KIT - Kalaignarkarunanidhi Institute of Technology

(An Autonomous Institution)
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' GRADE & NBA (AERO, CSE, ECE, EEE & MECH)
An ISO 9001 : 2015 Certified Institution
Coimbatore – 641 402.

REGULATIONS, CURRICULUM & SYLLABUS – 2019

(For Students admitted from the Academic Year 2019 – 20 and onwards)

I to VIII Semester

Bachelor of Engineering Degree
in
Mechanical Engineering

Department of Mechanical Engineering

Vision and Mission of the Department

Vision	
⊡	To enrich the students into a knowledgeable professionals and take a leading edge as a proficient Mechanical Engineers and Entrepreneurs to create a paradigm shift in their technical fields.

Mission	
⊡	To provide quality education in the domain of Mechanical Engineering in a conductive environment for enabling the students to face challenging career in ethical manner.
⊡	To inculcate technical knowledge to create a strong foundation for generating full–fledged professionals in the field of Mechanical Engineering.
⊡	To foster the students with Entrepreneurship training through EDC, leadership qualities and communication skills to meet the global demands

Program Educational Objectives (PEO's)	
PEO 1	Graduates will have successful professional career in Mechanical Engineering or related disciplines.
PEO 2	Graduates will formulate, analyze and solve real – world problems in Mechanical engineering to meet global challenges.
PEO 3	Graduates will have awareness and commitment to lifelong learning and professional ethics in their professional practice.

Programme Outcomes (PO's)	
Students graduating from Mechanical Engineering should be able to:	
PO 1	**Engineering knowledge :** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**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.
PO 3	**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 environmentalconsiderations.

PO 4	**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.
PO 5	**Modern tool usage :** 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.
PO 6	**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.
PO 7	**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.
PO 8	**Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work :** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**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.
PO 11	**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.
PO 12	**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 Outcome (PSO's)	
Graduates of a Mechanical Engineering Programme should be able to	
PSO 1	Apply the mechanical engineering principles to solve engineering problems utilizing advanced technology in the domain of design, thermal, fluid sciences and robotics.
PSO 2	Take part as an entrepreneur or professional in industries by applying manufacturing and management practices for the advancement of society and self.

BoS Chairman

UG Regulations

1. SHORT TITLE AND COMMENCEMENT

- These Regulations shall be called the “KIT-Kalaignarkaraunanidhi Institute of Technology, Coimbatore, Regulations for the Award of B.E./B.Tech., Degree”.
- They have been evolved, drafted and implemented after deliberations in and approvals from UGC, Anna University and Academic Council of the Institute, and are subject to change/modifications from time to time; (major modifications at a frequency of FOUR years in synchronization with the curriculum structure revision and minor changes as and when applicable).
- The latest/first version shall be applicable for the students enrolling for B.E/B.Tech degree programs at this Institute from Academic year 2019-2020 and onwards.

2. PREAMBLE

The regulations prescribed herein have been made by KIT, an autonomous institution, approved by AICTE,New Delhi and affiliated to the Anna University, Chennai, to facilitate the smooth and orderly conduct of its academic programmes and activities at the B.E/B.Tech., level. It is expected that the regulations will enable the students to take advantage of the various academic opportunities at the Institute and prepare themselves to face the challenges in their professional careers ahead. It may be noted that:

a. The provision made herein shall be applicable to all the B.E/ B.Tech. programmes offered at the institute, at present;

b. They shall also be applicable to all the new B.E /B.Tech. programmes which may be started at the Institute in the future;

c. Academic and non-academic requirements prescribed by the Academic Council have to be fulfilled by a student for eligibility towards award of B.E/B.Tech. Degree.

3. PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires :

Sl. No.	Name	Definition
1.	**Programme**	Refers to Degree Programme that is B.E./B.Tech. Degree Programme.
2.	**Discipline**	Refers to branch or specialization of B.E./B.Tech. Degree Programme, like Computer Science and Engineering, Mechanical Engineering etc.,
3.	**Course**	Refers to a theory or practical subject that is normally studied in a semester, like Mathematics, Physics, etc.,
4.	**Head of the Institution**	Refers to the Principal of the College.
5.	**Controller of Examinations (CoE)**	Refers to the authority of the college who is responsible for all activities of the Examinations.

6.	**Head of the Department (HoD)**	Refers to the Head of the Department concerned.
7.	**University**	Refers to Anna University, Chennai.
8.	**College (KIT)**	Refers to KIT-Kalaignarkarunanidhi Institute of Technology, Coimbatore.
9.	**Curriculum**	Refers to the various components/courses studied in each programme that provide appropriate outcomes (knowledge, skill and behavior/attitude) in the chosen branch of study.
10.	**T– P – TU – C**	Refers to Theory, Practical, TUtorial, and Credits respectively.
11.	**Humanities and Social Sciences (HS)**	Courses include English, Professional Ethics and Human Values, Communication skills etc.
12.	**Basic Sciences (BS)**	Courses include Mathematics, Physics, Chemistry, etc.,
13.	**Engineering Sciences (ES)**	Courses include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Civil / Computer Engineering etc.,
14.	**Professional Core (PC)**	Courses include the core courses relevant to the chosen specialization / branch.
15.	**Professional Elective (PE)**	Courses include the elective courses relevant to the chosen specialization / programme.
16.	**Open Elective**	Open Elective (OE) courses include the courses which a student can choose from the curriculum of other B.E. / B.Tech. programmes and courses offered by the Departments under the Faculty of Science and Humanities & Department of Management. These courses may be offered by internal/external experts.
17.	**Project Work (PW)**	Refers to the project done by a student or a group of students during final year.
18.	**Career Enhancement Courses (CEC)**	Includes Mini Project Work and/or Internship, Seminar, Professional Practices, Case Study, soft skills and Industrial / Practical Trainings etc.,

19.	**Academic Evaluation Committee (AEC)**	The committee includes Principal, CoE, HoD concerned (For details refer **Appendix V**)
20.	**Department Evaluation Committee (DEC)**	The committee included HoD (need basis), senior faculty member(s) of department from various levels, class advisor, Mentor of the students. (For details refer **Appendix V**)

4. ADMISSION

4.1 B.E. / B.Tech. Degree Programme (I Semester)

Candidates seeking admission to the first semester of the eight semester

The Candidates should have passed the Higher Secondary Examinations of (10+2) Curriculum (Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III or any examination of any other University or authority accepted by the Syndicate of Anna University as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

4.2 Lateral Entry Admission

i. The candidates who possess the Diploma in Engineering / Technology awarded by the State Board of Technical Education, Tamilnadu or its equivalent are eligible to apply for Lateral entry admission to the third semester of B.E. / B.Tech. in the branch corresponding to the branch of study.

(OR)

ii. The candidates who possess the Degree in Science (B.Sc.,) (10+2+3 stream) with Mathematics as a subject at the B.Sc. Level are eligible to apply for Lateral entry admission to the third semester of B.E. / B.Tech. Such candidates may be two additional Engineering subject(s) in the **third and fourth semesters** as prescribed by the AEC, if necessary.

4.3 Re - admission

Students, who have discontinued for reasons other than disciplinary action, may be readmitted as per guidelines given by DoTE, Government of Tamilnadu and Anna University. Department Evaluation Committee (DEC) shall study and recommend on the exception and addition of courses to be registered for, by the student concerned during re-admission. The details shall be forward to Academic Evaluation Committee (AEC) for approval and the committee's decision shall be final.

5. PROGRAMMES OFFERED

B.E. / B.Tech. Programmes under the Faculty of Mechanical Engineering, Faculty of Electrical Engineering, Faculty of Information and Communication Engineering and Faculty of Technology. KIT offers 4 year (8 Semesters) B.E./B.Tech. Degree programme affiliated to Anna University, under Choice Based Credit System (CBCS) for students admitted from 2019 onwards in the following branches of Engineering and Technology as in Table 1.

Table 1. List of B.E. / B.Tech. programmes offered

B.E.	B.Tech
Aeronautical Engineering	Biotechnology
Agriculture Engineering	
Bio Medical Engineering	
Computer Science and Engineering	
Electronics and Communication Engineering	
Electrical and Electronics Engineering	
Mechanical Engineering	

6. ACADEMIC STRUCTURE OF PROGRAMMES

6.1 Medium of Instruction

The medium of instruction for the entire undergraduate programme will be English.

6.2 Categorization of Courses

Every B.E. / B. Tech. Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

The typical curriculum structure for UG degree programmes are based on AICTE and Anna University and is given in Table 2.

Table 2: Curriculum Structure

Humanities and Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Basic Engineering Sciences (ES)
Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)
Career Enhancement Courses (CEC)		

The course outcomes (CO's) are designed to align with the Programme Outcomes (PO's) and Programme Educational Objectives (PEO's) of the respective programmes.

In addition to the courses listed in the curriculum, the department can include elective courses offered by reputed Industry / Educational Institutions /Experts from time to time, approved by DEC/AEC and ratified by the Academic Council.

The credits earned through such courses shall be considered equivalent to Professional Elective (PE) credits or Open Elective (OE) credits as decided by the Department evaluation Committee (DEC) on a course to course basis.

Experts from the Industry / Institution may design such specialized elective courses based on the current technical skill requirements. The Department evaluation Committee (DEC) shall review and approve the course offered by the expert from the industry / Institution.

In addition to the courses that carry credits, all students are required to complete mandatory non-credit courses, if offered (eg.,Value education courses, and others).Credits will not be awarded but will be assessed and graded, and must be completed.

The following is the credit distribution of KIT based on the suggested AICTE distribution. (Table 3)

Table 3 : Credit Distribution

Category	Credit range
A - Foundation Courses	
Humanities and Social Sciences including Management Courses (HS)	6-9
Basic Sciences Courses (BS)	17-26
Basic Engineering Sciences (ES)	10-29
B - Professional Core Courses	
Professional Core Courses (PC)	62-87
C - Elective Courses	
Professional Electives (PE)	15-18
Open Electives (OE)	6-12
D - Project Work	
Project Work (PW)	11-13
E - Mandatory Courses Prescribed by AICTE/UGC	
Mandatory Courses (Induction Program, Environmental Sciences, Indian Constitution)	–
F - Career Enhancement Courses (CEC)	8
Total Credits	**165 - 174**

6.3 Number of courses per semester

Each semester curriculum shall normally have a blend of lecture courses not exceeding 8 and Laboratory courses and Career Enhancement Courses (CEC) not exceeding 7.However, the total number of courses per semester shall not exceed 15. The students can register for Professional Elective/Open Elective courses in any semester, starting from the third semester.

6.4 Credit Assignment

Each course offered is given a T-P-TU-C structure, depending on the number of lecture periods (T), number of periods for practical (P) and number of tutorial periods (TU) required per week for an efficient teaching – learning process. A student is expected to put-in his/her own efforts in proportion with periods spent in classroom, as defined in T-P-TU-C structure. On successful completion of the course a student is said to have earned a specified number of credits defined for each course. Each course is assigned certain number of credits based on the following table:

Table 4: Credit Assigned

Contact period per week	Credits
1 Lecture Period (**T** = Lectures given during class by the faculty)	1
1 Tutorial Periods (**TU** = Tutorial, also class based with more emphasis on problem solving)	1
2 Practical Period (**P**) (Laboratory Periods / CEC / Projects)	1

6.5 Career Enhancement Courses

6.5.1 Personality and Character Development

All students shall enroll, on admission, in any one of the personality and character development programmes (NCC / NSS / YRC) and undergo training and attends camp as prescribe by the respective officers/ coordinators. The training shall include classes on hygiene and health awareness and also training in first-aid.

National Cadet Corps (NCC) will have number of parades/camps specified by the NCC officer.

National Service Scheme (NSS) will have social service activities in and around the College / Institution.

Youth Red Cross (YRC) will have activities related to social services in and around College /Institutions. While the trainingactivities will normally be during weekends, the camp will normally be during vacation period.

6.5.2 Industrial Training / Internship

Students shall undergo industrial training/Internship if mandated in the curriculum for periods as specified in the curriculum during the summer/winter vacation, the training being taken on a continuous basis for the periods mentioned. The industry/organization is to be selected with the approval of the Department Evaluation Committee (DEC). Industrial training may also be referred to as “In-plant training”.

The Industrial Training / Internship shall carry 100 marks and shall be evaluated through CIA only. The credit will be awarded to the student after the submission of Internship / Training report to the HoD. The report will be evaluated by a team of (DEC) faculty members nominated by the HoD for awarding the Credit. Based on the recommendation by the team, the student will be awarded credits and the results will be sent to the Controller of Examinations. The awarded credit will taken for CGPA calculation. The final year project period at industry / research organization will not be considered as industrial Training / internship.

6.5.3 Industrial Visit

Every student is required to go for at least one Industrial Visit every year starting from the second year of the Programme subject to the approval of the Head of the Department and Principal. The Heads of Departments shall ensure that necessary arrangements are made in this regard.

6.5.4 Professional Certificate Courses

Students have to undergo one credit courses offered by experts from industry / research organizations and approved by academic council. Students can register such courses from his / her second year of study as and when these courses are conducted by the departments. A student is also permitted to register for these courses of other departments.

If a student does not successfully complete the registered industry supported one credit courses in a semester, the registration of that course will be considered as cancelled. Further, it will not be treated as arrear and if he/she wishes, he/she can re-register for the same course in the ensuing semesters and successfully complete it as and when it is offered subsequently.

6.5.5 Online Courses

Students may be permitted to register for online courses (which are provided with certificate after evaluation of the performance, SWAYAM / NPTEL), during third to sixth semester of his / her study. On successful completion of the course, he / she has to submit the copy of the certificates to the Head of the Department. The assemment will not be calculated for CGPA.

6.5.6 Soft Skills

Every Student is required to go for two soft skill courses during first year of study. The soft skill course includes the communication skill, interpersonal skill and career development courses. One credit will be awarded for each soft skills courses and it will be included for SGPA/CGPA calculations.

6.5.7 Career Ability Course

The career Ability courses will be designed by the respective department with approval from DEC/AEC based on the industry requirements. One credit will be awarded for each soft skills courses and it will be included for SGPA / CGPA calculations.

6.5.8 Evaluation of One Credit Courses

Students can register for one credit courses in any semester when it is offered. Experts from the industry / Institution (KIT) may design such specialized one-credit courses based on the current technical skill requirements. The Department Evaluation Committee (DEC) shall review and approve the syllabus, course plan, and pedagogy and assessment pattern for the course. One credit courses can also be offered by internal experts i.e faculty members from other departments (not belonging to the specific discipline of the programme) also can offer such courses to the students with the approval of DEC.

A one - credit course shall carry 100 marks and shall be evaluated through Continuous Internal Assessment (CIA) only. The QP pattern and scheme will be decided by the course faculty and will be approved by the DEC/AEC.

The Head of the Department may identify a faculty member as the coordinator for the course. A committee consisting of the Head of the Department, faculty handling the course (if available), coordinator and a senior Faculty member nominated by the Head of the Department shall monitor the evaluation process.

The grades shall be assigned to the students by the above committee based on their performance and included in the calculation of CGPA.

6.5.9 Industry Supported Project Work

The students satisfying the following conditions shall be permitted to carry out their final semester Project work for six months in industry/research organization.

The student should not have current arrears and shall have CGPA of 8.0 and above until 5th semester. The student shall undergo the eighth semester courses in the sixth and seventh semesters. The Head of Department, in consultation with the faculty handling the said courses shall forward the proposal recommended by the Principal to CoE after approval from AEC at least four weeks before the commencement of the sixth semester of the programme.

6.6 Course Numbering Scheme

Each course is denoted by a unique code consisting of 9 alphanumeric characters. The details of the numbering scheme are in APPENDIX A

6.7 Credit Requirement for Programmes

The total number of credits that a student earns during the period of study is called the total credits. For the successful completion of the B.E/B.Tech programme, a regular student must earn 165-174 credits (varies with the programme) in minimum of eight semesters, while a lateral-entry student must earn 122-131 credits in a minimum of six semesters.

7 DURATION OF THE PROGRAMMES

7.1 The duration for the B.E./B.Tech. degree programmes shall extend over a period of 4 years (8 semesters) for the students admitted in the first semester but in any case not more than 7 years (14 semesters) and 3 years (6 semesters) for the students admitted in third semester (Lateral Entry Scheme) and not more than 6 years (12 semesters).

7.2 Each semester normally consists of 90 working days, including test and examination days. In any contingent situation, the number of working days per semester shall not be less than 65 days. The Principal is given the discretionary powers to decide the number of working days.

In such contingencies, the Principal shall ensure that every faculty member teaches the full content of the specified syllabus for the course being taught.

7.2.1 Due to Pandemic / Abnormal situations the Scheme of Examinations and Evaluation will be followed as per the guidelines issued by the Government of Tamil Nadu and Anna University, Chennai.

7.3 The total period for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 7.1 irrespective of the period of break of study in order that he/she may be eligible for the award of the degree.

7.4 For the purpose of regulations, the academic year will be divided into two semesters, the odd semester normally spanning from June to November and the even semester from December to May.

8. COURSE REGISTRATION

Each student, on admission shall be assigned to a mentor who shall advice and counsel the student about the details of the academic programme and choice of courses, considering the student's academic background and career objectives. Some courses require students to register through a course registration process via online.

8.1 Course Registration

Each student on admission shall register for all the courses prescribed in the curriculum in the students first semester of the study.

The registration process for the courses offered in the online registration mode in the forthcoming semester, will commence preferably 10 working days prior to the last working day of the current semester.

A department shall offer a course only if a minimum number of students register for that course. This minimum number may vary from course to course and shall be specified by the department from time to time.

After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Internal Assessment Marks and appear for the End Semester Examination (ESE) or as specified in the curriculum.

8.2 Credits details for Course Registration

A student has to earn the total credits specified in the curriculum of the respective programme of study, in order to be eligible to obtain the degree. However, if the student wishes, then he/she is permitted to earn more than the total number of credits prescribed in the curriculum.

The number of credits, most students are expected to register for, in a semester, will be about 20-30 credits (excluding arrears). so that they complete the programme within the specified duration of the programme. The minimum credits a student can register for, in a regular semester shall be 12 and the maximum credit a student can register is 36(excluding arrears). Students shall register for project work in the 7th and 8th semester or 8th semester only.

8.3 Flexibility to Add / Drop courses

A student can add or drop the courses registered within the first 5 instructional days, from the commencement of a regular semester, subject to the availability of resources and the minimum / maximum number of credits required to be registered in a semester vide clause 8.2.

From semester 3 to 8, the student has the options for Adding/dropping an existing course. The total number of credits that a student can add/drop is limited to 6. Practical courses cannot be added / dropped.

8.4 Reappearance Registration

8.4.1 If a student fails in a theory or practical course, the student shall do reappearance registration for that course in the subsequent semester by retaining the Continuous Assessment Marks already earned.

8.4.2 If the theory course, in which the student has failed, is 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. Such changes can be done only with due approval by DEC.

8.4.3 The student who fails in Project work/ Seminar other than Practical courses shall register for the same in the subsequent semester and reappear for the End Semester Examination.

8.4.4 If a student is not eligible to appear for End Semester Examination of a course due to lack of attendance, the student has to register for that course again, when offered next, attend the classes and fulfill the attendance requirements. If the course, in which the student has lack of attendance, is an elective, the student may register for the same or any other elective in the subsequent semesters.

8.4.5 If a student has completed the 8 semesters and has obtained RA grade in one or more courses, he can register and appear for arrear examination directly whenever conducted next.

8.4.6 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear the same course for improvement of Grade/ Marks.

9. REQUIREMENTS FOR APPEARING FOR CIA, ESE

9.1 A student who has fulfilled the following conditions shall be deemed to be eligible to appear for the CIA-1, CIA-2, CIA-3 and ESE. Ideally, every student is expected to attend all the classes and earn 100% attendance. Students who have earned not less than 75% attendance course wise taking into account the number of periods required for that course as specified in the curriculum. Table 5 illustrates the mandatory attendance requirement for CIA-1, CIA-2, CIA-3 and ESE.

Table 5: Mandatory Attendance Requirement for CIA-1, CIA-2, CIA-3 and ESE.

Test / Examination Type	Period of Calculation	Minimum % of attendance required
Continuous Internal Assessment Test - 1 (CIA-1)	**First Semester** From the date of joining of course to three working days before the start of CIA - 1	60%
	Second to Eighth semester From the date of commencement of the class to one week before the start of CIA - 1	75%
Continuous Internal Assessment Test - 2 (CIA-2)	From the date of joining (1stsemester) / date of commencement of class (2nd to 8th Semester) to one week before the start of CIA - 2	75% (for students maintaining 80% or more attendance between CIA 1 and CIA-2, but falls short of the 75% cumulative requirement, the requirement may be relaxed if recommended by the AEC)
Continuous Internal Assessment Test - 3 (CIA-3)	From the date of joining (1^{st} semester)/date of commencement of class (2^{nd} to 8^{th} Semester) to one week before the start of CIA - 3	75% (for students maintaining 80% or more attendance between CIA-2 and CIA 3, but falls short of the 75% cumulative requirement, the requirement may be relaxed if recommended by the AEC)
End Semester Examination (ESE)	From the date of joining (1^{st} semester) / date of commencement of class (2^{nd} to 8^{th} Semester) to the last day of instruction.	75%

9.1.1 Students having a CGPA of 8.50 and above and with no standing arrears will be exempted from the minimum attendance requirements (from 7th Sem. onwards).

9.1.2 A student shall normally be permitted to appear for End Semester Examination of the course if he / she has satisfied the attendance requirements (vide Clause -9.1). He /she is eligible to register for ESE in that semester by paying the prescribed fee.

9.1.3 A Candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester. Ideally every student is expected to attend all classes of all the courses and secure 100% attendance. However, in order to give provision for certain unavoidable reasons such as Medical / participation in sports, the student is expected to attend atleast 75% of the classes. Therefore, he/she shall secure not less than 75%.

9.1.4 However, a candidate who secures overall attendance between 65% and 74% in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) / Participation in Sports events may be permitted to appear for the current semester examinations subject to the condition that the candidate shall submit the medical certificate / sports participation certificate attested by the Head of the Institution. The same shall be forwarded to the Controller of Examinations for record purposes.

9.1.5 Candidates who secure less than 65% overall attendance and candidates who do not satisfy the clause 9.1.3 and 9.1.4 shall not be permitted to write the semester examination at the end of the semester and not permitted to move to the next semester. They are required to repeat the incomplete semester in the next academic year, as per the norms prescribed.

9.1.6 The students who are consistently good in academics ONLY be considered for the grant of ODL under Co-curricular activities by the competent authorities. The following activities shall be considered for the sanction of ODL;

- Sports and Games: TIES, Inter Collegiate, Inter Zonal, Inter University, State Level, National Level and Open Tournaments.
- NCC: Camps and expeditions, NSS camps
- Cultural Programme at State, National and International Level
- Seminar / Symposia: Paper presentation/Quiz
- Leadership courses organized by other organizations & Alumni Association activities, Association activities, Placement activities.
- Training programs/Internship at industries and Higher learning Institutions
- Personal damage incurred during the extracurricular activities
- The ODL requisition letter shall be forwarded to the Principal through the HoD of the student by the staff-in-charge of the respective activities before completion of every activity.

- The ODL sanctioned letters shall be submitted to the Department Office. The faculty-in-charge of the department office will check the eligibility for the award of attendance at the end of semester and the same may be submitted to DEC for approval.

9.1.7 The student should register all the courses of current semester and all the arrear courses in the previous semesters. If any student fails to register and pay the examination fees within the due date, he/she shall not be permitted to attend the End Semester Examinations. However, he/she will be permitted to continue their studies in the next higher semester, provided that the student satisfies the requirements as stipulated in this clause of this regulation.

9.1.8 Those students who are not deemed to have completed the semester with references to the conditions specified above shall undergo the semester again in all the courses in the respective semester during next academic year. He/she shall seek re-admission as per the norms of the affiliating University/DOTE (Directorate of Technical Education). The days of suspension for a student on disciplinary grounds will be considered as days of absence for calculating the percentage of attendance for each individual course.

10. PROVISION FOR WITHDRAWAL FROM EXAMINATION

A student may, for valid reasons (medically unfit / unexpected family situations/Sports person representing Tamilnadu / India with prior permission for participation from Principal / CoE / DEC), be granted permission to withdraw (after registering for the examinations) from appearing for any course or courses in the End Semester Examination of a particular semester. The student may withdraw by following the due process of the CoE's office before the commencement of examination. This facility can be availed only once during the entire duration of the degree programme.

Withdrawal from ESE will be valid only if the student is, otherwise, eligible to write the examination and the application for withdrawal is made to the CoE, prior to the examination in the course or courses concerned. The application for withdrawal should be recommended by the Head of the Department concerned and approved by the Head of the Institution.

11. TEMPORARY BREAK OF STUDY FROM A PROGRAMME

11.1 Break of study is normally not permitted. However, if a student intends to temporarily discontinue the programme in the middle of a semester / year for valid reasons (such as Internships, accident or hospitalization due to prolonged ill health) and wishes to re-join the programme in the next academic year, he / she shall apply in advance to the Principal through the Head of the Department, stating the reasons. The application shall be submitted not later than the last date for registering for the semester examinations. Break of study is permitted only once during the entire period of the degree programme.

11.2 The student permitted to re-join the programme after the break shall be governed by the rules and regulations in force, at the time of re-joining.

11.3 The duration specified for passing all the courses for the purpose of classification of degree(vide clause 19) shall be increased by the period of such break of study permitted(vide clause 11)

11.4 If a student is detained for want of requisite attendance, academic progress and good conduct, the period spent in that semester shall not be considered as permitted Break of Study and Clause 11.3 is not applicable for such cases.

12. ASSESSMENT PROCEDURES FOR AWARDING MARKS

The total marks for each course generally (Theory, Practical, Project Work) will be 100, comprising of two components namely Continuous Internal Assessment (CIA) and End Semester Examination (ESE). However, there could be some open elective courses, human excellence courses, one credit industry courses, add-on courses and Mandatory courses that have only continuous assessment for 100 marks without an End Semester Examination. The Department Consultative Committee (DCC) has to approve such courses every semester. The scheme of assessment may also be decided by the faculty handling the course concerned with the approval from DCC and shall be made available to the students during the online course registration. Each course shall be evaluated for a maximum of 100 marks as illustrated in **Table - 6.**

Table - 6 : Course Evaluation

S. No.	Category of course	Continuous Internal Assessment	Semester End Examinations
1.	Theory Courses	40 Marks	60 Marks
2.	Laboratory Courses		
3.	Project Work		
4.	CCA (Technical Seminar / Soft Skill / Industry oriented one credit courses)	100 Marks	–

The End Semester Examination (theory and practical) of 3 hours duration shall ordinarily be conducted between October and December during the odd semesters and between April and June during the even semesters.

The End Semester Examination for project work shall consist of evaluation of the final report submitted by the student or students of the project group (of not exceeding 4 students) by an external examiner and an internal examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner, the supervisor of the project group and an internal examiner.

For the End Semester Examination in both theory and practical courses including project work the internal and external examiners shall be appointed by the Controller of Examinations.

13. MARKS DISTRIBUTION

13.1 Attendance Mark

Marks are awarded for the attendance earned by the students for individual courses as per the following table.

Attendance Range in %	Marks to be earned by the students
96 - 100	5
91 - 95	4
86 - 90	3
81 - 85	2
75 - 80	1

13.2 Question paper pattern

a. Table 7.1 Continuous Internal Assessment (CIA 1, CIA -2 and CIA-3)

2 Marks	12 Marks	Total marks
7	3 (3 out of 5)	50

b. Table 7.2 End Semester Examinations

<table>
<tr><th>2 Marks</th><th>13 Marks</th><th>15 marks</th><th>Total Marks</th></tr>
<tr><td>10</td><td>5
(Either or Type)</td><td>1
(Either or Type)</td><td>100</td></tr>
<tr><th colspan="4">For Mathematics paper only</th></tr>
<tr><td>2 Marks</td><td colspan="2">16 Marks</td><td>Total Marks</td></tr>
<tr><td>10</td><td colspan="2">5</td><td>100</td></tr>
<tr><th colspan="4">For Engineering Graphics only</th></tr>
<tr><td colspan="3">20 Marks</td><td>Total Marks</td></tr>
<tr><td colspan="3">5</td><td>100</td></tr>
</table>

13.3 Theory Courses

Continuous Internal Assessment tests are conducted by the Office of the Controller of Examination. Continuous Internal Assessment comprises three Continuous assessment tests, Assignment / Class test / Presentation / Online Test / Mini projects / Tutorials and Attendance. By adopting this method, the students will go through a continuous and systematic study pattern. The Corresponding weightages are given below.

Table 8 : Continuous Internal Assessment Test for UG Theory Courses

Particulars	Syllabus	Duration	Exam Mark	Internal Mark
Continuous Internal Assessment 1	1.5 Units	1.5 hours	50 marks	10
Continuous Internal Assessment 2	1.5 Units	1.5 hours	50 marks	10
Continuous Internal Assessment 3	1.5 Units	1.5 hours	50 marks	10
Assignment / Class Test / Online Test / Mini Project / Tutorial / Presentation/ Online course/Certificate Course				5
Attendance				5
Total				40

13.4 CRITERIA FOR ASSESSMENT FOR LAB COURSES

Every exercise / experiment in all practical courses shall be evaluated on a continuous basis. The criteria for Continuous Assessment (for each cycle of exercise/experiment) are given in Table 9

Table 9: Assessment for Lab Courses

Sl. No.	Description		Weightage
1.	Continuous Internal Assessment Marks (CIAM)		
	a.	Average of Experimental Report / Workbook	25
	b.	Model examination	10
	c.	Attendance	5
	Total CIAM		**40**
2.	Semester End Exam Marks (ESEM)		
	a.	Lab Examination with Viva Voce	60
	Total ESM		**60**
		Total Marks	**100**

13.5 PROJECT WORK

For final year Project Work out of 100 marks, the maximum marks for Continuous Assessment is 40 marks and that for the End Semester Examination (project report evaluation and viva-voce examination) is 60 marks. Project work may be assigned to a single student or to a group of students not exceeding 4 per group, under the supervision of faculty guide(s).

The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three faculty members in the review committee. There shall be three reviews (as per **Table - 10**) in total, during the semester by a review committee. The student shall make presentation on the progress made before the committee.

Interim project report shall be submitted before the project reviews with the approval of the guide. The Project Report, prepared according to the approved guidelines and duly signed by the guide and the Head of the Department, shall be submitted to the department as per the timeline announced by the department. The End Semester Examination for project work shall consist of evaluation of the final project report by an external examiner, followed by a viva-voce examination conducted separately for each student, by a committee consisting of the external examiner, and an internal examiner. The Controller of Examinations (CoE) shall appoint Internal and External Examiners for the End Semester Examination of the Project Work.

The Continuous Internal Assessment Marks (CIAM) and End Semester Examinations Marks (ESEM) for Project Work and the Viva-Voce Examination will be distributed as indicated in **Table - 10**.

Table - 10 : CIAM and ESEM break-up for project work

<table>
<tr><th>Sl.No.</th><th colspan="2">Review No.</th><th>Description</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td rowspan="7">1.</td><td colspan="5">Continuous Internal Assessment Marks</td></tr>
<tr><td rowspan="2">a.</td><td rowspan="2">Review 1</td><td>Review Committee</td><td>5</td><td rowspan="2">10</td></tr>
<tr><td>Guide</td><td>5</td></tr>
<tr><td rowspan="2">b.</td><td rowspan="2">Review 2</td><td>Review Committee</td><td>7</td><td rowspan="2">15</td></tr>
<tr><td>Guide</td><td>8</td></tr>
<tr><td rowspan="2">c.</td><td rowspan="2">Review 3</td><td>Review Committee</td><td>7</td><td rowspan="2">15</td></tr>
<tr><td></td><td>8</td></tr>
<tr><td colspan="5">Total CIAM</td><td>40</td></tr>
<tr><td rowspan="4">2.</td><td colspan="5">End Semester Examinations Marks</td></tr>
<tr><td rowspan="2">a.</td><td rowspan="2">Evaluation of final report and viva-voce</td><td>Internal Examiner</td><td>10</td><td rowspan="2">50</td></tr>
<tr><td>External Examiner</td><td>40</td></tr>
<tr><td>b.</td><td>Outcome*</td><td>Publication of papers / prototype / patents etc.,</td><td>10</td><td>10</td></tr>
<tr><td colspan="5">Total ESEM</td><td>60</td></tr>
<tr><td colspan="5">Total Marks</td><td>100</td></tr>
</table>

Review committee consists of internal faculty members nominated by the Head of the Department. The guide of student being examined shall not be part of the committee.

* Outcome – in terms of paper publication, patents, product development and industry projects shall be awarded by both internal and external examiners, based on the document proofs submitted by the student concerned.

If a student fails to submit project report / does not appear for the ESE /fails in the End Semester Examination (ESE), he/she is deemed to have failed in the project work and shall have to re-register for the same when offered next.

14. PASSING REQUIREMENTS

14.1 A student is declared to have successfully passed a theory based course if he / she has secured:

- A minimum of 45% marks in the End Semester Examinations.
- A minimum of 50% marks on combining both Continuous Internal Assessment Marks (CIAM) and End Semester Examination Marks (ESEM).

14.2 A student is declared to have successfully passed a practical / project based course if he/she has secured :

- A minimum of 45% marks in the End Semester Examinations.
- A minimum of 50% marks on combining both Continuous Internal Assessment Marks (CIAM) and End Semester Examination Marks (ESEM).

14.3 For a student who does not meet the minimum passing requirements, the term “RA” against the course will be indicated in his/her grade sheet. He/she shall reappear in the subsequent examinations for the course as arrear or re-register for the course when offered .

14.4 For a student who is absent for end-semester theory / practical / project viva-voce, the term “RA” will be indicated against the corresponding course. He/she shall reappear for the End Semester Examination of that course as arrear in the subsequent semester or when offered next.

14.5 The letter grade “W” will be indicated for the courses for which the student has been granted authorized withdrawal (refer Clause 10).

14.6 For mandatory courses (non-credit), the student must satisfy the minimum attendance requirement & passing criteria as specified for the course as detailed in Section 16.2.

15. METHODS FOR REDRESSAL OF GRIEVANCES IN EVALUATION

Students who are not satisfied with the grades awarded in the End Semester Examination of Theory for regular and arrear exams can seek redressal as illustrated in Table 11.

Table - 11 : Grievance Redressal Mechanism

Sl. No.	Redressal Sought	Methodology	
		Regular Exam	Arrear Exam
1.	Revaluation	Apply for photo copy of answer book Then apply for revaluation after course expert recommendation	
2.	Challenge of Evaluation	Apply for photo copy of answer book Then apply for revaluation after course expert recommendation Next apply for challenge of evaluation	
Note: All applications to be made to COE along with the payment of the prescribed fee.			

Challenge of Evaluation – Flow Process

Table - 12 : Evaluation – Flow Process

Step 1	A student can make an appeal to the CoE for the review of answer scripts after paying the prescribed fee
Step 2	CoE will issue the photocopy of answer scripts to the student
Step 3	The faculty who had handled the subject will evaluate the script and HoD will recommend
Step 4	A committee consisting of 2 evaluators appointed by CoE will review and declare the result
Step 5	If the result is in favour of the student, the fee collected will be refunded to the student
Step 6	The final mark will be announced by CoE.

16. LETTER GRADE

Absolute grading system is adopted in converting marks to grads

16.1 Absolute Grading Policy

All assessments of a course will be evaluated on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Table - 13 : Absolute Grading - Letter Grade and its Range

Sl.No.	Range of percentage of total marks	Letter Grade	Grade Points
1.	91 - 100	O (Outstanding)	10
2.	81 – 90	A+ (Excellent)	9

3.	71 – 80	A (Very Good)	8
4.	61 – 70	B+ (Good)	7
5.	50 – 60	B(Average)	6
6.	<50	RA (Re-appearance)	0
7.	Shortage of Attendance	RA (Re-appearance due to shortage of attendance)	0
8.	Absent	RA (Re-appearance due to absence	0
9.	Withdrawal from examination	W	0
10.	Pass in Mandatory non-credit courses	P	0
11.	Fail in Mandatory non-credit courses	F	0

A student is deemed to have passed and acquired the corresponding credits in a particular course if he/she obtains any one of the following grades: "O", "A+", "A", "B+","B". 'RA' indicates that Reappearance is mandatory for that course concerned. 'SA' denotes shortage of attendance (as per Clause 9) and hence prevented from writing the End Semester Examination. P and F are grades for mandatory, but non-credit courses.

16.2 Grading for Mandatory Courses

Mandatory Courses are courses that are required to be completed to fulfill the degree requirements (e.g. Human excellence, Environmental science, etc.). They are normally non – credit based. These courses will not be taken in to consideration for the SGPA / CGPA calculations. Each of these courses is assessed continuously and internally for a total mark of 100. The pass mark is 50%. Students, who fail to pass this course, are required to repeat the course, when offered next.

16.2.1 For Mandatory non-credit courses the student must satisfy the minimum attendance requirement & passing criteria as specified for the course. These courses do not carry credits but needs to be completed to fulfill the degree requirements.

16.2.2 For the Mandatory non-credit courses student completing the course will be awarded Pass grade (P) and those who fail to satisfy the attendance requirement or fail to satisfy the minimum passing requirement of 50% marks, will be awarded Fail (F) grade and the student must re-register for the course when it is offered next.

16.2.3 Grade Sheet

After the results are declared, grade sheets will be issued to each student, which will contain the following details:

- The College Name and Affiliating University.
- The list of courses registered during the semester and the grades scored.
- The Semester Grade Point Average (SGPA) for the semester.
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

On completion of a semester, each student is assigned a Semester Grade Point Average which is computed as below for all courses registered for, by the student during that semester.

$$\text{Semester Grade Point Average} = \frac{\sum (C_i \times GP_i)}{\sum C_i}$$

where $\mathbf{C_i}$ is the credit for a course in that semester and $\mathbf{GP_i}$ is the Grade Point earned by the student for that course. The **SGPA** is rounded off to two decimals.

The overall performance of a student at any stage of the Degree programme is evaluated by the **C**umulative **G**rade Point **A**verage **(CGPA)** up to that point of time.

$$\text{Cumulative Grade Point Average} = \frac{\sum (C_i \times GP_i)}{\sum C_i}$$

where $\mathbf{C_i}$ is the credit for each course in each of the completed semesters at that stage and $\mathbf{GP_i}$ is the grade point earned by the student for that course. The **CGPA** is rounded off to two decimals.

16.2.4 FORMULA FOR CALCULATING PERCENTAGE

CGPA x 10 = % of Marks

17. 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 subjects prescribed in all the 8 semesters within a maximum period of 7 years and 6 years in the case of Lateral Entry reckoned from the commencement of the first (third in the case of Lateral Entry) semester to which the candidate was admitted.

iii. Successfully passed any additional courses prescribed by the Academic council

iv. Successfully completed the NCC / NSS / NSO / YRC requirements.

v. Successfully passed any additional courses prescribed by the Department & concerned whenever readmitted under regulations 2019 (R19) (vide Clause 4.3)

vi. No disciplinary action pending against the student.

vii. The award of Degree must have been approved by the Academic Council of KIT.

19. CLASSIFICATION OF B.E. / B.TECH DEGREE

The degree awarded to eligible students will be classified as given in **Table 14.**

Table - 14: Classification of the B.E. / B.Tech. Degree

Sl.No.	Class Awarded	Criteria
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 8 semesters and 6 semesters in the case of Lateral Entry) in the student's First Appearance within five years and Four years in the case of Lateral Entry).
		• Withdrawal from examination will not be considered as an appearance. • Should have secured a CGPA of not less than 8.50. • One year authorized break of study (if availed of) is included in the five years and (four years in the case of lateral entry) for award of First class with Distinction. • Should NOT have been prevented from writing End Semester Examination due to lack of attendance in any semester.
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 and 6 semesters in the case of Lateral Entry) **within Six years**. and Five years in the case of Lateral Entry). • One year authorized break of study (if availed of) or prevention from writing the End Semester Examination due to lack of attendance (if applicable) is included in the duration of six years and five years in the case of lateral entry) for award of First class. • Should have secured a CGPA of not less than **7.00**.

3.	Second Class	All other students (not covered in clauses Sl.No.1 and 2 under clause 18) who qualify for the award of the degree (vide Clause 19) shall be declared to have passed the examination in Second Class.
Note : A student who is absent for the End Semester Examination in a course / project work Viva Voce after having registered for the same will be considered to have appeared for that examination (except approved withdrawal from End Semester Examinations as per Clause 9) for the purpose of classification.		

19. AWARD OF DEGREE

The Academic Council of the institution will approve the award of Degree to all eligible students. The degree will be issued by Anna University, Chennai and the consolidated Grade Sheet will be issued by the institution. The consolidated grade sheet will specify any specializations and distinctions that the student has earned during the course of the study.

20. FACULTY MENTOR

To help the students in palnning their courses of study and for general advice on the academic progarmme, the Head of the Department will attach a certain number of students (maximum 25) to a faculty member of the department. He/She shall function as Faculty Mentor for these students throughout their period of study. The faculty mentor shall,

- Advice the students in registering and reappearance registering of courses
- Monitor their attendance, academic progress and discipline of the students
- Counsel periodically or during the faculty mentor meeting scheduled in the class time table.
- Inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- If necessary, the faculty mentor may also discuss with or inform the parents about the progress of the students through Head of the Department or in Parent-Teacher meeting.

21. CLASS COMMITTEE

The objective of the Class Committee is to improve the teaching-learning process.

The functions of the class committee include:

- Resolving difficulties experienced by students in the classroom and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein.
- Discussing the progress of academic schedule and deviations if any.
- Evaluating the performance of the students of the class after each test and finding the ways and means of improvement.
- Every class in first year of study shall have a class committee consisting of faculty members who are teaching in that class, student representatives (cross section of students from boys and girls) and a chairperson who is a faculty not handling the course for the class.

- From III semester onwards, Class committee comprises of all the faculty members who are handling courses in that particular semester and two student representatives from each course. A chairperson who is a faculty not handling course for that particular semester, nominated by the Head of the Department shall coordinate the activities of this committee.
- The class committee shall be constituted by the Head of the Department/Chief Tutor on the first week of commencement of the semester.
- The class committee shall meet three times in a semester as specified in the academic calendar.
- The Principal may participate in any class committee of the institution.
- During these meetings, the representative of the class shall meaningfully interact and express the opinions and suggestions of the other students of the class to improve the effectiveness of the teaching-learning process.
- The Chairperson is required to prepare the minutes of the meeting, signed by the members and submit the same to Head of the Department within five working days of the meeting. Head of the Department will in turn consolidate and forward the same to the Principal, within 10 working days of the meeting.
- In each meeting, the action taken report of the previous meeting is to be presented by the Chairperson of the class committee.

22. COMMON COURSE COMMITTEE

- A theory course handled by more than one teacher shall have a “Common Course Committee” comprising of all teachers teaching that course and few students who have registered for that course. There shall be two student representatives from each batch of that course. One of the teachers shall be nominated as Course Coordinator by the HoD concerned and duly approved by the Principal
- The first meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. The nature and weightage of the continuous assessments shall be decided in the first meeting, within the framework of the Regulations. Two or three 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 the whole batch.
- In addition, the “Common Course Committee” (without the student representatives) shall meet to ensure uniform evaluation of continuous assessments after arriving at a common scheme of evaluation for the assessments.
- Wherever feasible, the common course committee (without the student representatives) shall also prepare a common question paper for the continuous assessment tests. The question paper for the End Semester Examination is common and shall be set by the Course Coordinator in consultation with all the teachers or the external member as appointed by the Controller of Examinations.

23. DETAILS OF FACULTY PEDAGOGICAL AND STUDENT ASSESSMENT RECORD

Every teacher is required to maintain a Faculty Record Book/ course file consisting of the following details as shown below;

- Time-table, course syllabus, program outcomes, course outcomes.
- Details of attendance of each student marked in each theory/practical/project work class.
- CIA marks,Details of Assignment/ seminar given, course delivery details, corrective and preventive actions on test performance of students and any other additional details.

The record book should be submitted to the HOD periodically (at least three times in a semester) for checking the syllabus covered, the test marks and attendance. The HOD shall put his/her signature and date in the record book after due verification. At the end of the semester, the record book shall be verified by the Principal who will also ensure safe custody of the document for at least four years. The university or any inspection team appointed by the University / UGC / AICTE may verify the records of attendance and assessment of both current and previous semesters.

24. DISCIPLINE

Every student is required to maintain discipline and decorum both inside and outside the institution campus. They shall follow all the rules and regulations and should not indulge in any activity which can tarnish the reputation of the University or Institution. The Principal shall refer any act of indiscipline by students to the Discipline and Welfare Committee and other appropriate committees for action.

25. REVISION OF REGULATIONS AND CURRICULUM

The institution may from time to time revise, amend or change the Regulations,scheme of Examinations and syllabi, if found necessary. Academic Council assisted by Board of Studies and Standing Committee will make such revisions / changes.

Note : Any ambiguity in interpretation of this regulation is to be put up to the Standing Committee, whose decision will be final.

26. SPECIAL CASES

In the event of any clarification in the interpretation of the above rules and relations, they shall be referred to the Standing Committee. The standing committee will offer suitable interpretations/clarifications/ amendments required for special case on such references and get them ratified in the next meeting of the Academic Council. The decision of the Academic Council is final.

ANNEXURE - I

COURSE NUMBERING SCHEME

B	1	9	M	E	T	7	0	9
Programme	Regulation		Department Code		Course Type	Semester	Sequence Number	

Programme :	Course Type
Bachelor Degree (B.E. / B.Tech) - B	T - Theory
Masters Degree (M.E. / M.Tech) - M	P - Practical / Project/ Internship
Regulation :	E - Elective
R – 19	O - Open Elective
Department Code	C - One Credit Courses
AE - Aeronautical Engineering	N - Online courses
AG - Agricultural Engineering	S-Special Electives
BT - Biotechnology	
BM - Bio Medical Engineering	**Semester**
CS - Computer Science and Engineering	1 - First Semester
EC - Electronics and communication Engineering	2 - Second Semester
	3 - Third Semester
EE - Electrical and Electronics Engineering	4 - Fourth Semester
ME - Mechanical Engineering	5 - Fifth Semester
CA - Computer Application	6 - Sixth Semester
MB - Management Studies	7 - Seventh Semester
CH - Chemistry	8 - Eighth Semester
EN - English	
PH - Physics	**Sequence Number**
MA - Mathematics	00-99
MC - Mandatory Course	
CE - Career Enhancement	

ANNEXURE - II

POLICY ON MALPRACTICES

GENERAL

- It shall be the endeavour of all concerned to prevent, control and take remedial action to bring about the occurrences of malpractices to "Zero" in Examinations (both Internal and External), Assignments and in all Academic class works.
- Therefore, a comprehensive approach to the malady of malpractices has to be adopted to create a mindset of integrity and honesty, and at the same time take sufficiently stern action to make it clear that such attempts are fraught with comparably very high risk.
- In keeping with this stance, the following measures are to be taken by all concerned from class room level to the Examination Halls:

A. PREVENTION (This is the best method of tackling this malady)

a. Class room level:

All faculty members are to involve themselves in a psychological growth of students by personal example and self-respect and strive towards

- Developing a sense of honour in the minds of students so that they look down upon earning undeserved marks.
- Imbibing a sense of self-respect and internal dignity that prevents him/her from succumbing to the temptation of easy marks by cheating.
- Generating an awareness of the risks to their character and career if convicted, while also explaining the process and strict rules and regulations adopted by the educational system to prevent malpractices.
- Taking stern view of copied assignments and attempts at malpractices in internal examinations also merits equal seriousness as external examinations.
- Setting sufficiently strong deterrent rules in place and regulations like intimation to parents and warning to students in the presence of parents etc. even in case of efforts at malpractices in internal tests and/or repeated acts despite warnings in case of assignments also.

Examination Halls

Detailed instructions on Invigilation, question paper setting and evaluation and such other instructions will be issued for Invigilation, vigilance, which are to be brought to the notice of all students prior to the examinations.

B. PENAL ACTION FOR MALPRACTICES

All instances of malpractices will be forwarded to the Principal/ Chief Superintendents. The offences will be investigated by a Standing Enquiry Committee constituted by Principal, The committee is to summon and give the student an opportunity to present / plead his/her case. The Committee may also summon anybody else, if it so deems necessary for the conduct of enquiry, in the interest of proper investigation and dispensation of the case. The tenure of the committee would be a complete Academic year.

The Committee is to be guided by the following :

- The seriousness of the malpractice, in terms of deviousness, and culpability/ criminality of motive
- The seriousness in terms of effort and degree of deviousness and culpability / criminality of effort
- Any FIR / Police case that has been registered in the first instance by the Principal/ Chief Superintendent
- Any other special consideration either mitigating or to the contrary.

C. PENALTY FOR OFFENSES

The penalties awarded will depend on the seriousness of the Offence. A list of Offences and penalties are placed at Annexure III.

The Enquiry Report with findings and recommendations of the Committee are to be forwarded to the Controller who will undertake necessary follow up action. Based on the recommendations of the Controller of Examinations, the Principal is empowered to award penalties for offences classified as belonging to categories 1 to 7 of the offence table. The cases falling in categories from S.No. 8 onwards are to be put up to the Principal for consideration and award of suitable penalty.

ANNEXURE - III

<table>
<tr><th>Sl.No.</th><th>Nature of Malpractice</th><th>Maximum Punishment</th></tr>
<tr><td>1.</td><td>Appeal by the candidate in the answer script to show mercy by way of awarding more than deserving marks.</td><td rowspan="7">Fine of Rs. 1000/- per subject.</td></tr>
<tr><td>2.</td><td>The candidate writing his/her name in the answer script.</td></tr>
<tr><td>3.</td><td>The candidate writing his/her registration number/college name in places other than specified in the answer script</td></tr>
<tr><td>4.</td><td>Any special marking in the answer script by the candidate.</td></tr>
<tr><td>5.</td><td>The candidate communicating with neighbouring candidate orally or non- verbally; the candidate causing suspicious movement of his/her body.</td></tr>
<tr><td>6.</td><td>Irrelevant writing by the candidate in the answer script.</td></tr>
<tr><td>7.</td><td>The candidate writing answer on his/her question paper or making use of his/her question paper for rough work</td></tr>
<tr><td>8.</td><td>The candidate possessing cell phones / programmable calculator(s)/any other electronic storage device(s) gadgets</td><td>Invalidating the examination of the particular subject written by the candidate</td></tr>
<tr><td>9.</td><td>The candidate possessing cell phones/ programmable calculator(s)/any other electronic storage device(s) gadgets</td><td>Invalidating the examination of the particular subject written by the candidate</td></tr>
</table>

<table>
<tr><td>10.</td><td>The candidate possessing any incriminating material(s) (whether used or not). For example:-Written or printed materials, bits of papers containing written information, writings on scale, calculator, handkerchief, dress, part of the body, Hall Ticket, etc.</td><td rowspan="8">Invalidating the examination of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate.
Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects.
If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate.</td></tr>
<tr><td>11.</td><td>The candidate possessing cell phone(s)/ programmable calculator(s)/any other electronic storage device(s) gadgets and containing incriminating materials (whether used or not).</td></tr>
<tr><td>12.</td><td>The Candidate possessing the question paper of another candidate with additional writing on it.</td></tr>
<tr><td>13.</td><td>The candidate passing his/her question paper to another candidate with additional writing on it</td></tr>
<tr><td>14.</td><td>The candidate passing incriminating materials brought into the examination hall in any medium (hard/soft) to other candidate(s).</td></tr>
<tr><td>15.</td><td>The candidate copying from neighbouring candidate.</td></tr>
<tr><td>16.</td><td>The candidate taking out of the examination hall answer booklet(s), used or unused</td></tr>
<tr><td>17.</td><td>Appeal by the candidate in the answer script coupled with a promise of any form of consideration.</td></tr>
<tr><td>18.</td><td>Candidate destroying evidence relating to an alleged irregularity.</td><td>Invalidating the examinations of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate.
Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects.
If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate.</td></tr>
</table>

	.	**Additional Punishment :** i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears - subjects for two subsequent semesters.
19.	Vulgar/offensive writings by the candidate in the answer script.	Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate.
20.	The candidate possessing the answer script of another candidate	
21.	The candidate passing his /her answer script to another candidate	
22.	Involved in any one or more of the malpractices of serial no. 8 to 21 for the second or subsequent times.	Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears - subjects for two subsequent semesters.
23.	The candidate substituting an answer book let prepared outside the examination hall for the one already distributed to the candidate	

<table>
<tr><td>24.</td><td>The candidate indulge in any disruptive conduct including, but not limited to, shouting, assault of invigilator, officials or students using abusive and /or threatening language, destruction of property.</td><td rowspan="3">Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate.
Additional Punishment :
i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for two years i.e., for four subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period.
ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears-subjects for four subsequent semesters.</td></tr>
<tr><td>25.</td><td>The candidate harass or engage others to harass on his/her behalf an invigilator, official, witnesses or any other person in relation to an irregularity by making telephone calls, visits, mails or by any other means.</td></tr>
<tr><td>26.</td><td>Candidate possessing any firearm/weapon inside the examination hall.</td></tr>
<tr><td>27.</td><td>Cases of Impersonation</td><td>i. Handing over the impersonator to the police with a complaint to take appropriate action against the person involved in the impersonation by the Chief Supt.
If a student of this University is found to impersonate a ‘bonafide student’, the impersonating student is debarred from continuing his/her studies and writing the examinations permanently. He/she is not eligible for any further admission to any programme of the University.
Debarring the ‘bonafide student’ for whom the impersonation was done from continuing his/her studies and writing the examinations permanently. He/she is not eligible for any further admission to any programme of the University.</td></tr>
</table>

APPENDIX - IV

Process to Consider the Application for Revocation of Detainment

The process to consider the application for revocation of detainment on account of lack of attendance in 3 or more courses, due to genuine reasons (viz. sports participation, NCC, Medical Grounds etc.) is as follows:

The student submits an application for consideration via a request letter to the CoE,not later than 3 days from the last working day, along with the HoD's recommendation, Class Advisor's report and Mentor's recommendation. A committee consisting of the Principal, CoE, HoD (Respective Department) and HoD's-2 from departments other than the student's own. The committee shall meet within 4 working days,to consider the case. Stakeholders may be called to be present in the meeting as may be required, and Decision arrived at.The decision approved by Principal shall be final.

APPENDIX - V

Academic Evaluation Committee (AEC)

The committee includes the Principal, CoE, HoD concerned. The committee meets to carry out business related to academic matters which require central decision making and approval viz. retest approval of missed CIA, addressing the feedback collected from the various departments' class committee meetings.

Department Evaluation Committee (DEC)

The committee includes HoD (need basis), and a few faculty members of the department from various levels. The committee meets to carry out business related to academic matters that can be addressed within the department viz. course equivalence of common courses for readmitted students; approval of new courses to be offered by the department; consider and approve the credit equivalence of courses offered by industry, review the course offerings; consider the merit of applications involving lack of attendance in PE/OE courses to take up another PE or OE; approve CIAM only courses every semester; approve scheme of assessment for each course; Approval for and Mapping credits of certification courses; approval of list of nationally or internationally recognized professional certification courses with prometric testing.

Curriculum

Conceptual Frame work

(For Students admitted from the Academic Year 2019–20 and onwards)

Semester	Level of Course	Hrs. / Week	No of Courses	Range of Credits / Courses	Total Credits
PART – I					
A – Foundation Courses					
I to II	Humanities and Social Sciences **(HS)**	1- 3	5	1 - 3	11
I to IV	Basic Sciences **(BS)**	3 - 4	6	2 - 4	25
I to III	Engineering Sciences **(ES)**	3 - 6	8	2 - 4	19
B – Professional Core Courses					
II to VII	Professional Core **(PC)**	3 - 4	30	2 - 4	71
C – Elective Courses					
V to VIII	Professional Elective **(PE)**	3	6	3	18
V to VIII	Open Elective **(OE)**	3	4	3	12
D – Project Work					
V, VII & VIII	Project Work **(PW)**	4 - 16	3	2 - 8	12
E – Mandatory Courses Prescribed by AICTE / UGC (Not to be Included for CGPA)					
I, III & IV	Mandatory Course **(MC)**	3	4	NC	NC
Total Credit					**168**
PART II – Career Enhancement Courses (CEC)					
II	Soft Skills - I	2	1	1	1
III	Soft Skills - II	2	2	1	1
	Professional Certificate Course - I	2		1	1
IV	Career Ability Course - I	2	1	-	-
	NPTEL Online Certificate Courses	-	-	-	-
V	Career Ability Course - II	2	3	-	-
	Professional Certificate Course - II	2		1	1
	Summer Internship	-		1	1
VI	Career Ability Course - III	2	1	-	-
	NPTEL Online Certificate Courses	-	-	-	-
Total Credit					**05**
Total Credit to be Earned					**173**
PART III (Additional Credit Course - Not to be Included for CGPA)					
III	Problem Solving and Python Programming	20 - 30	1	-	**1**
IV	Non Destructive Testing (NDT)	20 - 30	1	-	**1**
V	Basics of Automation	40 - 60	1	-	**1**
VI	CNC Certification Programme	40 - 60	1	-	**1**
VII	Robotics and Embedded Systems	30 - 40	1	-	**1**

BoS Chairman

Scheme of Instructions and Examinations

(For Students admitted from the Academic Year 2019–20 and onwards)

Semester – I

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
Induction Programme											
B19ENT101	Functional English	**HS**	3	3	0	0	**3**	40	60	100	**3**
B19MAT101	Matrices and Differential Calculus	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19CHT101	Engineering Chemistry	**BS**	3	3	0	0	**3**	40	60	100	**3**
B19CST102	Problem Solving and Programming Using C	**ES**	3	3	0	0	**3**	40	60	100	**3**
B19MET101	Engineering Graphics	**ES**	6	2	4	0	**3**	40	60	100	**4**
B19CHP101	Chemistry Laboratory	**BS**	4	0	4	0	**3**	40	60	100	**2**
B19CSP102	Problem Solving and Programming Using C Laboratory	**ES**	4	0	4	0	**3**	40	60	100	**2**
B19MCP101	Life Skills	**MC**	2	0	2	0	**–**	100	–	100	**NC**
Total Contact Hours/Week			**29**	**14**	**14**	**1**	**Total Credits**				**21**

Semester – II

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19ENT201	Professional English	**HS**	3	3	0	0	**3**	40	60	100	**3**
B19MAT201	Integral Calculus and Complex Analysis	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19PHT101	Engineering Physics	**BS**	3	3	0	0	**3**	40	60	100	**3**
B19EET202	Basic Electrical, Electronics and Instrumentation Engineering	**ES**	3	3	0	0	**3**	40	60	100	**3**
B19MET201	Engineering Mechanics	**ES**	3	2	0	1	**3**	40	60	100	**3**
B19HST201	தமிழர்மரபு / Heritage of Tamils	**HS**	1	1	0	0	**3**	40	60	100	**1**
B19PHP101	Physics Laboratory	**BS**	4	0	4	0	**3**	40	60	100	**2**
B19MEP201	Basic Workshop Practices Laboratory	**ES**	4	0	4	0	**3**	40	60	100	**2**
B19EEP202	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	**ES**	4	0	4	0	**3**	40	60	100	**2**
B19CEP201	Soft Skills – I	**CEC**	2	0	2	0	–	100	–	100	**1**
Total Contact Hours/Week			**30**	**14**	**14**	**2**	**Total Credits**				**24**

BoS Chairman

Semester – III												
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MAT304	Partial Differential Equations and Probability	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19MET301	Engineering Thermodynamics	**PC**	4	3	0	1	**3**	40	60	100	**4**
B19MET302	Fluid Mechanics & Machinery	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MET303	Manufacturing Technology–I	PC	3	3	0	0	**3**	40	60	100	**3**
B19MET304	Applied Materials and Metallurgy	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MCT302	Indian Constitution	**MC**	3	3	0	0	**–**	100	–	100	**NC**
B19HST301	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	**HS**	1	1	0	0	**3**	40	60	100	**1**
B19MEP301	Fluid Mechanics & Machinery Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19MEP302	Computer Aided Machine Drawing Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19CEP301	Soft Skills – II	**CEC**	2	0	2	0		100	–	100	**1**
B19CEP302	Professional Certificate Course–I	**CEC**	2	0	2	0		100	–	100	**1**
Total Contact Hours/Week			**30**	**17**	**10**	**3**	**Total Credits**				**23**
In plant Training – Minimum ONE WEEK has to be completed(Review will be conducted in first week of Semester IV and its credit will be included in Semester IV and it will be included in Semester IV mark statement)												

Semester – IV												
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MAT405	Numerical Methods and Statistics	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19MET401	Kinematics of Machinery	**PC**	4	3	0	1	**3**	40	60	100	**4**
B19MET402	Manufacturing Technology–II	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MET403	Mechanical Measurements and Metrology	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MET404	Thermal Engineering	**PC**	4	3	0	1	**3**	40	60	100	**4**
B19MET405	Strength of Materials	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MEP401	Manufacturing Process and Metal Cutting Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19MEP402	Strength of Materials Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19CEP401	Career Ability Course – I	**CEC**	2	0	2	0	–	100	–	100	**NC**
B19CEP402	In plant Training	**CEC**	0	–	–	–	–	–	–	–	**NC**
B19CEP403	Online Certificate Course	**CEC**	–	–	–	–	–	–	–	–	**NC**
Total Contact Hours/Week			**29**	**17**	**8**	**4**	**Total Credits**				**24**
Summer Internship – THREE WEEKS (Review will be conducted in first week of Semester V and its credit will be included in Semester V) **Online Certificate Course (like NPTEL,COURSERA, UDEMY, etc…,)** has to be completed within second year (NC)												

BoS Chairman

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Semester – V								
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MET501	Heat and Mass Transfer	**PC**	4	3	0	1	**3**	40	60	100	**4**
B19MET502	Design of Machine Elements	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MET503	Dynamics of Machines	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MCT301	Environmental Sciences	**MC**	3	3	0	0	**–**	100	–	100	**NC**
	Professional Elective –I	**PE**	3	3	0	0	**3**	40	60	100	**3**
	Open Elective –I	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19MEP501	Kinematics and Dynamics Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19MEP502	Thermal Engineering Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19MEP503	Design and Fabrication Project	PW	4	0	4	0	**–**	100	–	100	**2**
B19CEP501	Career Ability Course –II	**CEC**	2	0	2	0	**–**	100	–	100	**NC**
B19CEP502	Professional Certificate Course–II	CEC	2	0	2	0	**–**	100	–	100	**1**
B19CEP503	Summer Internship	**CEC**	–	–	–	–	**–**	–	–	–	**1**
Total Contact Hours/Week			**33**	**16**	**14**	**3**	**Total Credits**				**23**

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Semester – VI								
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MET601	Design of Transmission Systems	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MET602	Computer Aided Design and Manufacturing Systems	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MET603	Finite Element Analysis	**PC**	3	2	0	1	**3**	40	60	100	**3**
	Professional Elective – II	**PE**	3	3	0	0	**3**	40	60	100	**3**
	Professional Elective – III	**PE**	3	3	0	0	**3**	40	60	100	**3**
	Open Elective –II	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19MEP601	Heat and Mass Transfer Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19MEP602	CAD / CAM Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19MEP603	Mechanical Measurements and Metrology Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19CEP601	Career Ability Course – III	**CEC**	2	0	2	0	**–**	100	–	100	**NC**
B19CEP602	Online Certificate Course	**CEC**	–	–	–	–	**–**	–	–	–	**NC**
Total Contact Hours / Week			**32**	**16**	**14**	**2**	**Total Credits**				**24**
Online Certificate Course (like NPTEL,COURSERA, UDEMY, etc…,) has to be completed within Third year (NC)											

BoS Chairman

Semester – VII

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MGT701	Total Quality Management	HS	3	0	0	3	3	40	60	100	3
B19MET701	Industrial Robotics and Expert Systems	PC	3	0	0	3	3	40	60	100	3
	Professional Elective – IV	PE	3	3	0	0	3	40	60	100	3
	Professional Elective – V	PE	3	3	0	0	3	40	60	100	3
	Open Elective – III	OE	3	3	0	0	3	40	60	100	3
B19MEP701	Mechatronics Laboratory	PC	2	0	2	0	3	40	60	100	1
B19MEP702	Simulation and Analysis Laboratory	PC	4	0	4	0	3	40	60	100	2
B19MEP703	Project work Phase – I	PW	6	0	6	0	3	40	60	100	2
Total Contact Hours/Week			**27**	**14**	**12**	**1**	**Total Credits**				**20**

Semester – VIII

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
	Professional Elective – VI	PE	3	3	0	0	3	40	60	100	3
	Open Elective–IV	OE	3	3	0	0	3	40	60	100	3
B19MEP801	Project Work Phase – II	PW	16	0	16	0	3	40	60	100	8
Total Contact Hours/Week			**22**	**6**	**16**	**0**	**Total Credits**				**14**

HUMANITIES AND SOCIALSCIENCES (HS)

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19ENT101	Functional English	HS	3	3	0	0	3	40	60	100	3
B19ENT201	Professional English	HS	3	3	0	0	3	40	60	100	3
B19MGT701	Total Quality Management	HS	3	3	0	0	3	40	60	100	3
B19HST201	தமிழர்மரபு / Heritage of Tamils	HS	1	1	0	0	3	40	60	100	1
B19HST301	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	HS	1	1	0	0	3	40	60	100	1

BoS Chairman

BASIC SCIENCES (BS)

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MAT101	Matrices and Differential Calculus	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19CHT101	Engineering Chemistry	**BS**	3	3	0	0	**3**	40	60	100	**3**
B19CHP101	Chemistry Laboratory	**BS**	4	0	4	0	**3**	40	60	100	**2**
B19MAT201	Integral Calculus and Complex Analysis	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19PHT101	Engineering Physics	**BS**	3	3	0	0	**3**	40	60	100	**3**
B19PHP101	Physics Laboratory	**BS**	4	0	4	0	**3**	40	60	100	**2**
B19MAT301	Partial Differential Equations, Probability & Statistics	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19MAT431	Numerical Methods	**BS**	3	2	0	1	**3**	40	60	100	**3**

ENGINEERING SCIENCES (ES)

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19CST102	Problem Solving and Programming Using C	**ES**	3	3	0	0	**3**	40	60	100	**3**
B19MET101	Engineering Graphics	**ES**	6	2	4	0	**3**	40	60	100	**4**
B19CSP102	Problem Solving and Programming Using C Laboratory	**ES**	4	0	4	0	**3**	40	60	100	**2**
B19EET202	Basic Electrical, Electronics and Instrumentation Engineering	**ES**	3	3	0	0	**3**	40	60	100	**3**
B19MET201	Engineering Mechanics	**ES**	3	2	0	1	**3**	40	60	100	**3**
B19MEP201	Basic Workshop Practices Laboratory	**ES**	4	0	4	0	**3**	40	60	100	**2**
B19EEP202	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	**ES**	4	0	4	0	**3**	40	60	100	**2**

BoS Chairman

PROFESSIONAL CORE (PC)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MET301	Engineering Thermodynamics	**PC**	4	3	0	1	**3**	40	60	100	**4**
B19MET302	Fluid Mechanics & Machinery	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MET303	Manufacturing Technology –I	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MET304	Applied Materials and Metallurgy	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MEP301	Fluid Mechanics & Machinery Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19MEP302	Computer Aided Machine Drawing Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19MET401	Kinematics of Machinery	**PC**	4	3	0	1	**3**	40	60	100	**4**
B19MET402	Manufacturing Technology – II	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MET403	Mechanical Measurements and Metrology	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MET404	Thermal Engineering	**PC**	4	3	0	1	**3**	40	60	100	**4**
B19MET405	Strength of Materials	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MEP401	Manufacturing Process and Metal Cutting Laboratory	**PC**	4	0	2	0	**3**	40	60	100	**2**
B19MEP402	Strength of Materials Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19MET501	Heat and Mass Transfer	**PC**	4	3	0	1	**3**	40	60	100	**4**
B19MET502	Design of Machine Elements	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MET503	Dynamics of Machines	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MEP501	Kinematics and Dynamics Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19MEP502	Thermal Engineering Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19MET601	Design of Transmission Systems	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MET602	Computer Aided Design and Manufacturing Systems	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MET603	Finite Element Analysis	**PC**	3	2	0	1	**3**	40	60	100	**3**
B19MEP601	Heat and Mass Transfer Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19MEP602	CAD / CAM Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19MEP603	Mechanical Measurements and Metrology Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19MET701	Industrial Robotics and Expert Systems	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MEP701	Mechatronics Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19MEP702	Simulation and Analysis Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**

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PROFESSIONAL ELECTIVES (PE)

SEMESTER – V

ELECTIVE – I

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MEE501	Refrigeration and Air conditioning	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE502	Gas Dynamics and Jet Propulsion	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE503	3D Printing and Design	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE504	Applied Hydraulics and Pneumatics	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE505	Product Design and Development	**PE**	3	3	0	0	**3**	40	60	100	**3**

SEMESTER – VI

ELECTIVE – II

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MEE601	Computer Integrated Manufacturing	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE602	Composite Materials	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE603	Computational fluid Dynamics	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE604	Supply Chain Management	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE605	Automation in Manufacturing	**PE**	3	3	0	0	**3**	40	60	100	**3**

SEMESTER – VI

ELECTIVE – III

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MEE606	Rapid Prototyping	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE607	Concurrent Engineering	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE608	Design of Thermal Systems	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE609	Six sigma and Lean manufacturing	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE610	Renewable Sources of Energy	**PE**	3	3	0	0	**3**	40	60	100	**3**

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SEMESTER – VII												
ELECTIVE – IV												
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MEE701	Advanced Casting and welding	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE702	Design of Jigs and Fixtures	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE703	Design of Heat Exchangers	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE704	Quality Control and Reliability Engineering	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE705	Industry 4.0	**PE**	3	3	0	0	**3**	40	60	100	**3**

SEMESTER – VII											
ELECTIVE – V											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MEE706	Non Traditional Machining	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE707	Design for Manufacturing and Assembly	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE708	Vibration and Noise Control	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE709	Production planning and Control	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE710	Solar Energy Conversion Systems and Design	**PE**	3	3	0	0	**3**	40	60	100	**3**

SEMESTER – VIII											
ELECTIVE – VI											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MEE801	Flexible Manufacturing system	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE802	Automobile Engineering	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE803	Manufacturing System Engineering	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE804	Industrial Safety	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MEE805	Power Plant Engineering	**PE**	3	3	0	0	**3**	40	60	100	**3**

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OPEN ELECTIVES (OE)

SEMESTER – V

ELECTIVE – I

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19AEO501	Basics of Flight Mechanics	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19AGO501	Environment and Agriculture	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19BMO501	Introduction to Medical Physics	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19BTO501	Food Processing and Preservation	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19CSO504	Fundamentals of DBMS	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19ECO501	Logic and Distributed Control Systems	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19EEO501	Rotating Machines & Transformers	**OE**	3	3	0	0	**3**	40	60	100	**3**

SEMESTER – VI

ELECTIVE – II

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19AEO601	Aircraft Electrical and Electronic Systems	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19AGO601	Integrated water resources management	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19BMO601	Introduction to Biomedical Engineering	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19BTO601	Basic Bioinformatics	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19CSO601	E– Commerce Technology and Management	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19ECO601	Geographic Information System	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19EEO601	Fundamentals of Power Electronics	**OE**	3	3	0	0	**3**	40	60	100	**3**

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SEMESTER – VII												
ELECTIVE – III												
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19AEO701	Unmanned Aircraft Systems Operation & MRO	OE	3	3	0	0	3	40	60	100	3
B19AGO701	Production Technology for Agricultural Machinery	OE	3	3	0	0	3	40	60	100	3
B19BMO701	Telemedicine	OE	3	3	0	0	3	40	60	100	3
B19BTO701	Fundamentals of Nanotechnology	OE	3	3	0	0	3	40	60	100	3
B19CSO701	Fundamentals of Cloud Computing	OE	3	3	0	0	3	40	60	100	3
B19ECO701	Introduction to Communication Systems	OE	3	3	0	0	3	40	60	100	3
B19EEO701	Hybrid Electric Vehicles	OE	3	3	0	0	3	40	60	100	3

SEMESTER – VIII												
ELECTIVE – IV												
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19AEO801	Vehicle Aerodynamics	OE	3	3	0	0	3	40	60	100	3
B19AGO801	Agriculture finance, Banking and Cooperatives	OE	3	3	0	0	3	40	60	100	3
B19BMO801	Hospital Management	OE	3	3	0	0	3	40	60	100	3
B19BTO801	Biological Waste Management	OE	3	3	0	0	3	40	60	100	3
B19CSO801	Fundamentals of IOT	OE	3	3	0	0	3	40	60	100	3
B19ECO801	Wireless Technologies	OE	3	3	0	0	3	40	60	100	3
B19EEO801	Energy Conservation and Management	OE	3	3	0	0	3	40	60	100	3

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PROJECT WORK (PW)

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MEP503	Design and fabrication Project	**PW**	4	0	4	0	**–**	100	–	100	**2**
B19MEP703	Project work Phase – I	**PW**	6	0	6	0	**3**	40	60	100	**2**
B19MEP801	Project Work Phase – II	**PW**	16	0	16	0	**3**	40	60	100	**8**

CAREER ENHANCEMENT COURSE (CEC)

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19CEP201	Soft Skills –I	**CEC**	2	0	2	0	**–**	100	–	100	**1**
B19CEP301	Soft Skills – II	**CEC**	2	0	2	0	**–**	100	–	100	**1**
B19CEP302	Professional Certificate Course–I	**CEC**	2	0	2	0	**3**	100	–	100	**1**
B19CEP303	In plant Training	**CEC**	–	–	–	–	**–**	–	–	–	**NC**
B19CEP401	Career Ability Course – I	**CEC**	2	0	2	0	**–**	100	–	100	**NC**
B19CEP501	Career Ability Course – II	**CEC**	2	0	2	0	**–**	100	–	100	**NC**
B19CEP502	Professional Certificate Course–II	**CEC**	2	0	2	0	**3**	100	–	100	**1**
B19CEP503	Summer Internship	**CEC**	–	–	–	–	**–**	–	–	–	**1**
B19CEP601	Career Ability Course – III	**CEC**	2	0	2	0	**–**	100	–	100	**NC**

MANDATORY COURSE (MC)

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MCP101	Life Skills	**MC**	2	0	2	0	**–**	100	–	100	**NC**
B19MCT301	Environmental Sciences	**MC**	3	3	0	0	**–**	100	–	100	**NC**
B19MCT302	Indian Constitution	**MC**	3	3	0	0	**–**	100	–	100	**NC**

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Syllabus

Semester – I

B.E / B.Tech	B19ENT101 – FUNCTIONAL ENGLISH (Common to all Branches)	T	P	TU	C
		2	0	1	3

Course Objectives	
1.	To develop the basic reading and writing skills of first year engineering and technology students.
2.	To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
3.	To help learners develop their speaking skills and speak fluently in real contexts.
4.	To help learners develop vocabulary of a general kind by developing their reading skills.
5.	To enhance their basic grammatical knowledge and Vocabulary skills.

UNIT – I	12
Reading	Short comprehension passages, practice in skimming–scanning
Writing	Instructions, developing hints.
Listening	Listening to peer group
Speaking	Self Introduction, introducing others
Language development	Parts of Speech, Wh–Questions, asking and answering–yes or no questions
Vocabularydevelopment	Prefixes–suffixes, articles.

UNIT – II	12
Reading	Skimming and Scanning – Pre & post reading, comprehension questions, including dialogues and conversations
Writing	Paragraph writing, free writing, day to day events
Listening	Telephonic conversations, conceptual conversations
Speaking	Sharing information of a personal kind, greeting, taking leave
Language development	Regular & Irregular Verbs, tenses
Vocabularydevelopment	Guessing meanings of words in context.

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UNIT – III		12
Reading	Short texts and longer passages, note making	
Writing	Understanding text structure, use of reference words and discourse markers, jumbled sentences	
Listening	Listening to longer texts and filling up the table, product description, narratives from different sources.	
Speaking	Short presentation, asking about routine actions and expressing facts and opinions	
Language development	Idioms and Phrases, Degrees of comparison, sentence pattern and types of sentences	
Vocabularydevelopment	single word substitutes	

UNIT – IV		12
Reading	Intensive and Extensive reading, reading longer texts, reading different types of texts–magazines,	
Writing	letter writing, informal or personal letters, e–mails	
Listening	listening to dialogues or conversations and completing exercises based on them	
Speaking	speaking about oneself, speaking about one's friend, conceptual conversations	
Language development	direct/indirect questions	
Vocabularydevelopment	synonyms–antonyms, phrasal verbs	

UNIT – V		12
Reading	longer texts–close reading	
Writing	writing short essays, developing an outline, identifying main and subordinate ideas, dialogue Writing	
Listening	listening to talks, conversations	
Speaking	participating in conversations, short group conversations	
Language development	Spelling and Punctuations, modal verbs	
Vocabularydevelopment	collocations	
		Total Instructional hours : 60

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Develop basic reading and effective reading skills.
CO2	Build their grammatical understanding.
CO3	Explain their opinions efficiently in writing in formal and informal contexts through letters.
CO4	Develop their vocabulary skills.
CO5	Develop their knowledge through LSRW skills.

Text Books	
1.	Board of Editors Using English, “A Course book for Undergraduate Engineers and Technologists”, Orient Black Swan Limited, Hyderabad: 2015.
2.	Richards, C. Jack, “Interchange Students Book–2”,New Delhi, CUP, 2015.

Reference Books	
1.	Bailey, Stephen, “A practical guide for students”, New York Rutledge, 2011.
2.	Comfort, Jeremy, et al, “Speaking Effectively: Developing Speaking Skills for Business English”, Cambridge University Press, Cambridge, Reprint 2011.
3.	Dutt P. Kiranmai and Rajeevan Geeta, “Basic Communication Skills”, Foundation Books, 2013.

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B.E / B.Tech	B19MAT101 – MATRICES AND DIFFERENTIAL CALCULUS (Common to all Branches)	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	Matrix algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
2.	The goal of this course is to achieve conceptual understanding and to retain the best traditions of differential calculus.
3.	This is a foundation course which mainly deals with topics such as single variable and multivariable differential calculus and plays an important role in the understanding of science, engineering, medical and business among other disciplines.
4.	To provide the basic tools of differential calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
5.	To make the student appreciate the purpose of using Laplace transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT – I	MATRICES	12
Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley–Hamilton theorem –Quadratic form: Nature, Reduction to canonical form by orthogonal transformation.		

UNIT – II	FUNCTIONS OF SEVERAL VARIABLES	12
Partial differentiation –Total derivative – Change of variables – Jacobians – Taylor‘s series expansion for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers.		

UNIT – III	ORDINARY DIFFERENTIAL EQUATIONS	12
Higher order linear ordinary differential equations with constant coefficients – Higher order linear ordinary differential equations with variable coefficients Cauchy Euler‘s and Cauchy Legendre‘s type – Method of variation of parameters (ordinary differential equations with constant coefficients) – Simultaneous differential equations		

UNIT – IV	APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS	12
Solution of specified differential equations connected with electric circuits, Bending of beams and simple harmonic motion (Differential equations and associated conditions need to be given).		

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UNIT – V	LAPLACE TRANSFORMS	12
Existence conditions – Properties (excluding proofs) – Transform of standard functions –Transforms of derivatives and integrals – Periodic function – Inverse Laplace transform –Applications to solution of linear second order ordinary differential equations with constant coefficients.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Make use of Eigen values and Eigen vectors to reduce the quadratic form into canonical form and to find the powers of a square matrix.
CO2	Determine solution for maxima and minima problems.
CO3	Solve differential equations which existing in different engineering disciplines.
CO4	Develop the applications of differential equations in various engineering field.
CO5	Apply Laplace transform and inverse transform to solve differential equations with constant coefficients.

Text Books	
1.	Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2.	Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media – An imprint of Lakshmi Publications Pvt., Ltd., New Delhi, 7th Edition, 2017.
3.	Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

Reference Books	
1.	Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2018.
2.	Srimantha Pal and Bhunia, S.C, "Engineering Mathematics", Oxford University Press, 2015.
3.	Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.
4.	Veerarajan T., “Engineering Mathematics for Semester I and II”, Tata McGraw Hill Publishing Company, New Delhi,2015.
5.	Gean Duffy., “Advanced Engineering Mathematics with MATLAB”, A CRC Press Company, Boca Raton London , New York Washington, D.C, 2nd edition 2009.

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B.E / B.Tech	B19CHT101 – ENGINEERING CHEMISTRY (Common to all Branches)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
2.	To make the students conversant with basics of polymer chemistry.
3.	To make the students conversant with basic of electrochemical reactions and corrosion.
4.	To make the student acquire sound knowledge of energy devices.
5.	To develop an understanding of the basic concepts of nano materials.

UNIT – I	WATER TECHNOLOGY	9

Hardness of water : Types, Expression of Hardness and their units, boiler troubles Scale and sludge, caustic embrittlement, boiler corrosion, priming and foaming.
Water quality standards : WHO, BIS and CPCB
Treatment of Boiler feed water : Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning).
External treatment : Ion exchange process, Zeolite process.
Desalination of brackish water : Reverse Osmosis – Municipal water treatment, break point chlorination.

UNIT – II	POLYMERS AND COMPOSITES	9

Polymers : Definition, polymerization, types – addition and condensation polymerization – Tacticity – biodegradable and conducting polymers
Plastics : Classification, preparation, properties and uses of PVC, Teflon, Nylon–6,6 and Epoxy resin.
Rubber : Vulcanization of rubber, Synthetic rubbers – Butyl rubber, SBR.
Moulding : Ingredients – compression and Injection.
Composites : Definition, types, polymer matrix composites – FRP.

UNIT – III	ELECTROCHEMISTRY AND CORROSION	9

Electrochemistry : Redox reaction, Electrode potential – oxidation potential, reduction potential, Nernst equation (derivation) – Measurement and applications – Electrochemical Series and its significance.
Corrosion : causes– factors– types–chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control – material selection and design aspects – electrochemical protection – sacrificial anode method and impressed current cathodic method.

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UNIT – IV	ENERGY DEVICES	9

Batteries : Types of batteries – Primary battery (dry cell), Secondary battery (lead acid battery, lithium–ion–battery), Fuel Cells– H_2 & O_2 fuel cell.
Super Capacitors : Principle, Construction, working and applications.
Photo voltaic cell : Solar cells – Principle, construction, working and applications.

UNIT – V	NANOCHEMISTRY	9

Basics – distinction between molecules, nanoparticles and bulk materials– Surface area to volume ratio – Quantum confinement (0D,1D,2D,3D) – Synthesis: Top down process (Ball milling) – Bottom up process (Chemical Vapour Deposition and Sol–Gel method) – properties of nano materials – optical, electrical, thermal and mechanical – applications (nano products of today)

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline the principle and characterization of water for the treatment of potable and industrial purposes.
CO2	Illustrate and interpret about the basics of Polymer Chemistry.
CO3	Relate the principles of electrochemical reactions and corrosion.
CO4	Understand the concepts of energy devices and its engineering applications.
CO5	Understand the basics of Nano–chemistry and its applications.

Text Books	
1.	Dara, S S and Umare, S S, “A Textbook of Engineering Chemistry”, Chand S & Company Ltd., New Delhi, 2015.
2.	Jain, P C and Monika Jain, “Engineering Chemistry”, DhanpatRai Publishing Company Pvt. Ltd., New Delhi, 2015.
3.	Vairam, S Kalyani, P and Suba Ramesh, “Engineering Chemistry”, Wiley India Pvt. Ltd.,New Delhi, 2013.

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Reference Books	
1.	Friedrich Emich, “Engineering Chemistry”, Scientific International Pvt. Ltd., New Delhi, 2014.
2.	PrasantaRath, “Engineering Chemistry”, Cengage Learning India Pvt. Ltd., Delhi, 2015.
3.	ShikhaAgarwal, “Engineering Chemistry – Fundamentals and Applications”, Cambridge University Press, Delhi, 2015.
4.	Charles P. Poole and Frank J. Owens, "Introduction to nanotechnology", John Wiley Sons, New Jersey, 2003.

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B.E / B.Tech	B19CST102 – PROBLEM SOLVING AND PROGRAMMING USING C (Common to Aero, Agri, BT and Mech)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of Structured Programming.
2.	To learn about the arrays, strings and their operations.
3.	To develop an application using functions and its methods.
4.	To develop a C program by using pointers and call by reference methods.
5.	To create a simple application using structures, Union and Files.

UNIT – I	STRUCTURED PROGRAMMING	7

Algorithms, building blocks of algorithms (instructions/statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving.

UNIT – II	ARRAYS AND STRINGS	11

Introduction to C Programming – Operators and Expressions – Data Input and Output – Control Statements.

Array : Defining an array – Processing an array – Multidimensional Arrays Character Arithmetic – Defining a string – NULL character – Initialization of Strings – Reading and Writing

Strings : Processing Strings – Searching and Sorting of Strings.

UNIT – III	FUNCTIONS, STORAGE CLASSES	9

Defining a function – Accessing a function – Function prototypes – Passing arguments to a function – Passing arrays to functions – Function with string – Recursion – Storage classes.

UNIT – IV	POINTERS	9

Pointer Fundamentals – Pointer Declaration – Passing Pointers to a Function – Pointers and one dimensional arrays – operations on pointers – Dynamic memory allocation.

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UNIT – V	STRUCTURES, UNIONS AND FILES	9
Structures and Unions : Defining a Structure – Processing a Structure – User defined data types (Type def) – Unions. **Files :** Opening and Closing a Data File – Reading and writing a data file – Processing adata file – Unformatted data files – Concept of binary files – Accessing a file randomly using seek.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Compare different problem – solving techniques.
CO2	Make use of appropriate data types and control structures for solving a Given problem.
CO3	Experiment with different array and string operations.
CO4	Experiment with the usage of pointers and functions.
CO5	Organize data using structures and unions and files.

Text Books	
1.	Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2016.
2.	Yashavant P. Kanetkar. “Let Us C”, 16th Edition, BPB Publications, 2016.

Reference Books	
1.	Byron S Gottfried, “Programming with C”, Schaum‟s Outlines, Fourth Edition, Tata Mc Graw – Hill, 2018.
2.	Reema Thareja, “Programming in C”, Second Edition, Oxford University Press, 2016.
3.	Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009.
4.	Dromey R.G., “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007.
5.	Kernighan, B. and Ritchie, D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.

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B.E / B.Tech	B19MET101 – ENGINEERING GRAPHICS (Common to All)	T	P	TU	C
		2	4	0	4

Course Objectives	
1.	To understand the conventions and method of engineering drawing.
2.	To construct and interpret the basic engineering drawings.
3.	To improve their visualization skills so that they can apply these skills in new product development.
4.	To enhance their technical communication skill in the form of communicative drawings.
5.	To comprehend the theory of projection.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)	2
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.	

UNIT – I	PLANE CURVES AND FREE HANDSKETCHING	14
Basic Geometrical constructions, Curves used in engineering practices–Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three–Dimensional objects – Layout of views– Free hand sketching of multiple views from pictorial views of objects.		

UNIT – II	PROJECTION OF POINTS, LINES AND PLANE SURFACE	14
Orthographic projection– principles–Principal planes–First angle projection–Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes– Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		

UNIT – III	PROJECTION OF SOLIDS	14
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.		

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UNIT – IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	14
Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		

UNIT – V	ISOMETRIC AND PERSPECTIVE PROJECTIONS	14
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders, cones– combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids–prisms, pyramids and cylinders by visual ray method.		

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY)	3
Introduction to drafting packages and demonstration of their use.	
Total Instructional hours : 75	

Course Outcomes : Students will be able to	
CO1	Construct the basic engineering curves and freehand sketching of basic geometrical constructions and multiple views of objects.
CO2	Draw problems related toprojections of points, straight lines, planes and solids.
CO3	Build the projection of simple solids.
CO4	Apply the knowledge acquired on practical applications of sectioning and development of solids.
CO5	Construct simple solids and its sections in isometric view and projections and to draw its perspective views.

Text Books	
1.	K.V.Natarajan, “A text book of Engineering Graphics”, 28th Edition, Dhana Lakshmi Publishers, Chennai, 2015.
2.	N.D. Bhattand V.M. Panchal, “Engineering Drawing”, Charotar Publishing House,53rdEdition, 2014.

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Reference Books	
1.	K. Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International Publishers, 2017.
2.	K.R.Gopalakrishna., “Engineering Drawing” (Vol.I & II combined) SubhasPublications, Bangalore, 2018.
3.	N.S Parthasarathy and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015.

BoS Chairman

B.E / B.Tech	B19CHP101 – CHEMISTRY LABORATORY (Common to all Branches)	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To make the students to acquire practical skills in the determination of water quality parameters and estimation of ions through volumetric and instrumental analysis.

List of Experiments

Expt. No.	Description of the Experiments (Any 8 experiments)
1.	Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinityin water sample.
2.	Determination of total, temporary & permanent hardness of water by EDTA method.
3.	Determination of DO content of water sample by Winkler's method.
4.	Determination of chloride content of water sample by Argentometric method.
5.	Estimation of copper in brass.
6.	Determination of strength of given hydrochloric acid using pH meter.
7.	Estimation of iron content of the given solution using potentiometer.
8.	Estimation of iron content of the water sample using spectrophotometer (1,10–Phenanthroline/ thiocyanate method).
9.	Estimation of sodium and potassium present in water using flame photometer.
10.	Conductmetric titration of strong acid vs strong base
11.	Estimation of iodine in common salt.
12.	Estimation of calcium in milk powder.
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Relate the acquired knowledge in the quantitative estimation of alkalinity, hardness, DO and chloride ion present in the water samples.
CO2	Understand the nature of water quality parameters to find the pollution level in water.
CO3	Estimate the amount of copper, iodine, calcium in alloys and food products.
CO4	Apply the spectroscopic techniques for the quantitative estimation of sodium, potassium and Ferrous ion.
CO5	Analyze the solutions by electrochemical parameters like conductivity, pH and EMF.

	Text Books
1.	Vogel's Textbook of Quantitative Chemical Analysis, 8th edition, 2014.

BoS Chairman

B.E / B.Tech	B19CSP102 – PROBLEM SOLVING AND PROGRAMMING USING C LABORATORY (Common to Aero, Agri, BT and Mech)	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To under stand the loops and decision–making statements to solve the problem.
2.	To develop the programs using one dimensional and two–dimensional arrays.
3.	Use functions to solve the given problem.
4.	To understand the pointers, structures and unions.
5.	To develop applications in Cusing file Operations.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Writing algorithms, flow charts and pseudo codes for simple problems.
2.	Demonstrate expressions and conversions.
3.	Develop a C program by using if, if–else, switch and nested if statements.
4.	Construct a C Program by using while, do–while and for loops.
5.	Implement one dimensional array, passing arrays to functions and perform array operations insertion, deletion, searching.
6.	Implement two dimensional arrays and passing 2D arrays to functions.
7.	Develop a C Program to perform the String operation using build in methods and arrays.
8.	Construct a C program using function calls, recursion and call by value
9.	Generate a simple application using pointers, call by reference and pointers with arrays.
10.	Implement a C program using structures and unions.
11.	Write a C Program to perform the file operations and modes.
12.	Working with text files, random files and binary files.
	Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Build algorithms, flow charts and pseudo code for simple problems.
CO2	Develop a program using control structures.
CO3	Make use of arrays and strings.
CO4	Make use of functions and pointers.
CO5	Organize a heterogeneous data using structures, unions and files.

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B.E / B.Tech	B19CEP101 – LIFE SKILLS (Common to all Branches)	T	P	TU	C
		0	2	0	0

Course Objectives	
1.	To make the students to enhance their attitude, confidence and communication.

UNIT – I	TRANSITION MANAGEMENT	6
Getting started–Getting involved– being responsible–adapting to the new environment.		

UNIT – II	VISION AND GOAL	6
Defining Vision and designing Goals in accordance–Seeing College life as a path towards Lifetime Goals.		

UNIT – III	VALUES VIRTUES	6
Not as preaching but a way of life to succeed in all aspects of life.		

UNIT – IV	FOCUS	6
Focus on basic quality in all activities .Tips to enhance memory and focus skills.		

UNIT – V	LEARNING SKILLS AND PASSIONATE LEARNER	6
Transforming information into knowledge and learning to read people like a book – hedding out inhibitions – Blossoming with talent and leadership abilities.		
		Total Instructional hours : 30

Course Outcomes : Students will be able to	
CO1	Develop the adapting skills to various environments.
CO2	Identify the Vision and Goal towards success.
CO3	Build Values and Virtues to succeed in life
CO4	Develop focus in all activities
CO5	Develop knowledge to understand various kinds of people

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Semester – II

B.E / B.Tech	B19ENT201 – PROFESSIONAL ENGLISH (Common to all Branches)	T	P	TU	C
		2	0	1	3

Course Objectives	
1.	Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
2.	Foster their ability to write convincing job applications and effective reports.
3.	Develop their speaking skills to make technical presentations, participate in group discussions.
4.	Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.
5.	Develop and integrate the use of the four language skills i.e. Reading, Listening, Speaking, Writing.

UNIT – I	12
Listening	Listening to motivational speech
Speaking	Asking for and giving directions
Reading	Reading short technical texts from newspapers and magazines
Writing	Extended definitions, Gerunds & Infinitives, writing checklists, recommendation
Vocabularydevelopment	Technical vocabulary, abbreviations
Language development	Subject verb agreement

UNIT – II	12
Listening	Listening to TED talks
Speaking	Describing a process, narrating a story
Reading	Reading longer technical texts, summarizing
Writing	Interpreting charts, graphs
Vocabularydevelopment	Vocabulary used in formal letters/emails and reports
Language development	British and American spelling, numerical adjectives.

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UNIT – III		12
Listening	Listening to classroom lectures, commentaries and announcements	
Speaking	Oral presentations	
Reading	Longer texts both general and technical, practice in speed reading	
Writing	process writing, use of sequence words, analytical essays and issue based essays	
Vocabularydevelopment	Sequence words, misspelled words.	
Language development	Identifying different types of sentences.	

UNIT – IV		12
Listening	Listening to documentaries, listening to resume preparation and making notes.	
Speaking	Techniques of effective presentations	
Reading	Reading for detailed comprehension	
Writing	Email etiquette, job application– cover letter, résumé preparation, Vocabulary	
Vocabularydevelopment	Finding suitable synonyms, paraphrasing	
Language development	Clauses, if conditionals	

UNIT – V		12
Listening	Listening to talks based on profession	
Speaking	Participating in a group discussion	
Reading	Reading and understanding technical articles	
Writing	Writing reports, minutes of a meeting, writing feasibility, survey and industrial reports	
Vocabularydevelopment	Verbal analogies	
Language development	Reported speech, active and passive voice, impersonal passive	
		Total Instructional hours : 60

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Course Outcomes : Students will be able to	
CO1	Develop their Vocabulary skills
CO2	Develop their grammatical proficiency
CO3	Develop strategies and skills to enhance their ability to read and comprehend
CO4	Interpret graphical representation by comparing and contrasting the information
CO5	Extend their knowledge through LSRW skills

Text Books	
1.	Board of editors, "Fluency in English A Course Book for Engineering and Technology", Orient Blackswan, Hyderabad: 2016.
2.	Sudharshana.N.P and Saveetha. C, "English for Technical Communication", Cambridge University Press: New Delhi, 2016.

Reference Books	
1.	Raman, Meenakshi and Sharma, Sangeetha, "Technical Communication Principles and Practice", Oxford University Press: NewDelhi, 2014.
2.	Kumar, Suresh. E, "Engineering English", Orient Blackswan: Hyderabad, 2015
3.	Booth L. Diana, "Project Work", Oxford University Press, Oxford: 2014.

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B.E / B.Tech	B19MAT201 – INTEGRAL CALCULUS AND COMPLEX ANALYSIS (Common to all Branches)	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
2.	To make the student understand the mathematical tools needed in evaluating multiple integrals and their usage.
3.	To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
4.	To use the various methods of complex analysis efficiently for solving the problems that occurs in various branches of engineering disciplines.
5.	To develop an understanding of the standard techniques of complex integration so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.

UNIT – I	DEFINITE AND INDEFINITE INTEGRALS	12
Definite and Indefinite integrals – Substitution rule – Techniques of integration – Integration by parts, Trigonometric integrals, Trigonometric substitutions.		

UNIT – II	MULTIPLE INTEGRALS	12
Double integrals: Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals: Evaluation of triple integrals–Volume as triple integral (Simple problems).		

UNIT – III	VECTOR CALCULUS	12
Gradient and directional derivative – Divergence and curl – Solenoidal and Irrotational vector fields – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Verification of theorem and applications (for cubes and rectangular parallellopipeds).		

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UNIT – IV	COMPLEX DIFFERENTIATION	12
Analytic functions – Cauchy–Riemann equations (excluding proof) – Properties of analytic function – Harmonic conjugate– Construction of analytic function by Milne Thomson method – Bilinear transformation.		

UNIT – V	COMPLEX INTEGRATION	12
Cauchy‘s integral theorem – Cauchy‘s integral formula – Taylor’s and Laurent’s series – Singularities – Residues – Cauchy‘s Residue theorem –Evaluation of real integrals – use of circular contour and semicircular contour (excluding poles on real axis).		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Develop Fundamental Theorem of Calculus, techniques of Integration such as substitution, partial fractions and integration by parts.
CO2	Make use of integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
CO3	Apply the line, surface and volume integrals for verification of Green‘s, Gauss and Stokes theorems.
CO4	Construct Analytic function and develop Conformal Mapping.
CO5	Identify infinite series of a complex function within the contour and types of the singularities, finding of complex integrals.

Text Books	
1.	Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2.	Kreyszig Erwin, “Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

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Reference Books	
1.	Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media–An imprint of Lakshmi Publications Pvt., Ltd., New Delhi, 7th Edition,2015.
2.	Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
3.	O‘Neil, P.V.,”Advanced Engineering Mathematics”, Cengage Learning India Pvt.Ltd, New Delhi, 7th Edition, 2017.
4.	Sastry, S.S, “Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5.	Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics”, Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
6.	Gean Duffy., “Advanced Engineering Mathematics with MATLAB”, A CRC Press Company, Boca Raton London, New York Washington, D.C, 2ndEdition, 2009.

BoS Chairman

B.E / B.Tech	B19PHT101 – ENGINEERING PHYSICS (Common to all Branches)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To gain knowledge on the basics of properties of matter and its applications.
2.	To acquire knowledge on the concepts of Photonics and their applications in fiber optics.
3.	To have adequate knowledge on the concepts of Ultrasonics and their applications.
4.	To get knowledge on advanced physics concepts of quantum theory and its applications in SEM, TEM.
5.	To make the students enhance the fundamental knowledge in Crystal Physics and its.
6.	Applications relevant to various streams of Engineering and Technology.

UNIT – I	PROPERTIES OF MATTER	9

Elasticity–Modulus, types of modulus, Stress–strain diagram and its uses–factors affecting elastic modulus and tensile strength–Twisting couple, torsion pendulum; theory and experiment.
Bending of beams – Bending moment– cantilever; theory and experiment– uniform and non–uniform bending; theory and experiment– I–shaped girders.

UNIT – II	PHOTONICS AND FIBER OPTICS	9

Lasers; Population of energy levels, Einstein‘s A and B coefficients derivation– resonant cavity, optical amplification (qualitative) – Types; Nd–YAG Laser, Semiconductor lasers; homojunction and heterojunction, Industrial and Medical Applications.
Fibre Optics; Principle, Numerical Aperture and Acceptance Angle – Types of optical fibres (material, refractive index, mode) – Applications; Fibre optic communication system–Block diagram, fibre optic sensors– pressure and displacement sensors –Endoscopy.

UNIT – III	ULTRASONICS	9

Classification of Sound, Production of ultrasonics – Magnetostriction generators, piezoelectric generators – acoustic grating – cavitation– ultrasonic cleaning.
Applications; Non Destructive Testing, pulse echo system through transmission and reflection modes, A, B and C, scan displays– Engineering applications; SONAR,– Medical applications; Sonograms.

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UNIT – IV	QUANTUM PHYSICS	9
Black body radiation; Planck's theory (derivation) – wave particle duality– debroglie wavelength– electron diffraction – Davisson–Germer experiment –concept of wave function and its physical significance. Wave equation; Schroedinger's time independent and time dependent equations, particle in a one–dimensional rigid box– Applications; Scanning Electron Microscope(SEM) and Transmission Electron Microscope (TEM).		

UNIT – V	CRYSTAL PHYSICS	9
Crystal Structures; Single crystalline, polycrystalline and amorphous materials – unit cell– crystal systems– Bravais lattices– Miller indices– inter–planar distances – coordination number and packing factor for SC, BCC, FCC and HCP structures –Crystal imperfections; Point and Line defects. Growth of single crystals; Solution and melt growth techniques (Bridgeman & Czhochralski).		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the basics of Properties of matter and its applications.
CO2	Illustrate the basics of Laser, Fiber optics and their applications.
CO3	Infer the concepts of ultrasonics and its applications
CO4	Interpret the basic knowledge of Quantum theory that could be helpful in understanding the wave functions of a particle
CO5	Classify and compare the different types of crystals, their structures and its preparation techniques

Text Books	
1.	Bhattacharya, D.K. &Poonam, T, "Engineering Physics", Oxford University Press, 2015.
2.	Gaur, R.K. & Gupta, S.L. "Engineering Physics", DhanpatRai Publishers, 2012.
3.	Pandey, B.K. &Chaturvedi, S. "Engineering Physics", Cengage Learning India, 2012.
4.	Rajendran V, 'Engineering Physics", Tata McGraw Hill, Publishing Company, New Delhi, 2011.

Reference Books	
1.	Halliday, D., Resnick, R. & Walker, J. "Principles of Physics'', Wiley, 2015.
2.	Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers", Cengage Learning, 2010.
3.	Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics", W.H. Freeman, 2007.
4.	Avadhanulu M.N, "Engineering Physics", Volume 1", S.Chand & Company Ltd., New Delhi, 2010.

BoS Chairman

B.E / B.Tech	B19EET202 – BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING (Common to AERO & MECH)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To Understand the Electric circuit laws.
2.	To Understand the single and three phase circuits and wiring.
3.	To Understand the Working principles of Electrical Machines.
4.	To Understand the Working principle of various electronic devices.
5.	To Understand the Working principle of measuring instruments.

UNIT – I	ELECTRICAL CIRCUITS	9
Basic circuit components – Ohms Law – Kirch off's Law – Instantaneous Power – Inductors – Capacitors – Independent and Dependent Sources. Steady state solution of DC circuits – Nodal analysis, Meshanalysis. Theorem's – Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem – Superposition Theorem.		

UNIT – II	AC CIRCUITS	9
Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three–phase balanced circuits – Three phase loads. Housing wiring, industrial wiring, materials of wiring.		

UNIT – III	ELECTRICAL MACHINES	9
Principles of operation and characteristics of ; DC machines, Transformers (single and three phase). Principles of operation, characteristics and speed control of Synchronous machines, three phase and single phase induction motors. (Qualitative)		

UNIT – IV	ELECTRONIC DEVICES & CIRCUITS	9
Types of Materials – Silicon & Germanium – N type and P type materials – PN Junction – Forward and Reverse Bias – Semiconductor Diodes. Bipolar Junction Transistor – Characteristics – Field Effect Transistors – Transistor Biasing. Introduction to operational Amplifier – Inverting Amplifier – NonInverting Amplifier – DAC – ADC. (Qualitative)		

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UNIT – V	EASUREMENTS & INSTRUMENTATION	9
Introduction to transducers – Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical. Classification of instruments – Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters – three – phase power measurements – instrument transformers (CT and PT). (Qualitative)		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply Ohm slaw, Kirchhoff's laws and Theorems to analyze the given electrical circuits.
CO2	Interpret waveforms, RMS value, Power and power factor in AC Circuits.
CO3	Outline the basic construction of wiring and materials.
CO4	Explain the construction and operation of dc machines, transformers, Induction motors and synchronous Machines.
CO5	Explain the operation and characteristics of basic semiconductor devices.
CO6	Explain the construction and working principle of various measuring instruments & Indicating instruments.

Text Books	
1.	Leonard S Bobrow, "Foundations of Electrical Engineering Ⅱ", Oxford University Press, 2013.
2.	Kothari DP and Nagarath I.J, "Electrical Machines – Basic Electrical and Electronics"
3.	"Engineering", Mc Graw Hill Education (India) Private Limited, Third Reprint, 2016.
4.	Sawhney A.K, Dhanpat Rai, "A Course in Electrical & Electronic Measurements & Instrumentation", 2010.

Reference Books	
1.	NK De, Dipu Sarkar, "Basic Electrical Engineering Ⅱ", Universities Press (India) Private Limited 2016.
2.	Vincent Del Toro, "Electrical Engineering Fundamentals Ⅱ", Pearson Education, Second Edition New Delhi, 2015.
3.	John Bird, "Electrical Circuit Theory and Technology Ⅱ", Elsevier, Fifth Edition, 2014.
4.	Murthy D.V.S. "Transducers and Instrumentation", Prentice Hall of India Pvt Ltd, 2015.

BoS Chairman

B.E / B.Tech	B19MET201 – ENGINEERING MECHANICS (Common to Mech, Aero, Agri)	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To make the students understand the vector and scalar representation of forces and the static equilibrium of particles.
2.	To understand the moment and the equilibrium of rigid bodies in two dimensions and three dimensions.
3.	To make the students understand the properties of surfaces and solidsin relation to moment of inertia.
4.	To understand laws of motion, kinetics of particles and their interrelationship.
5.	To make the students understandeffect of friction on equilibrium and the dynamic forces exerted in rigid bodies.

UNIT – I	STATICS OF PARTICLES	12

Introduction – Units and Dimensions – Laws of Mechanics – Principle of transmissibility – Lami's theorem, Parallelogram and triangular Law of forces – Coplanar Forces – rectangular components – Equivalent systems of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space using vector representation.

UNIT – II	EQUILIBRIUM OF RIGID BODIES	12

Free body diagram – Types of supports – Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Scalar components of a moment – Varignon's theorem – Single equivalent force – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

UNIT – III	PROPERTIES OF SURFACES AND SOLIDS	12

Centroids and centre of mass – Centroids of lines and areas – T section, I section, Angle section and Hollow section by using standard formula –Theorems of Pappus – Area moments of inertia of plane areas – T section, I section, Angle section and Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Mass moment of inertia for cylindrical and spherical solids from first principle.

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UNIT – IV	DYNAMICS OF PARTICLES	12
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.		

UNIT – V	FRICTION AND RIGID BODY DYNAMICS	12
Friction force – Laws of sliding friction – Equilibrium analysis of simple systems with sliding friction, wedge friction – General Plane motion of simple rigid bodies such as cylinder and wheel.		
Total Instructional hours : 60		

Course Outcomes : Students will be able to	
CO1	Explain the basics and state of particles and understand the vectorial and scalar representation of forces and moments.
CO2	Interpret static equilibrium of particles and rigid bodies in two and three dimensions.
CO3	Identify the properties of surfaces & solids in relation to moment of inertia.
CO4	Illustrate the laws of motion, kinematics and kinetics of particles and their interrelationship.
CO5	Apply the effect of Friction and dynamics of rigid bodies on general plane motion.

Text Books	
1.	Vela Murali, "Engineering Mechanics", Oxford University Press,2010.
2.	Dr. Bansal, R.K. Sanjay Bansal, "Engineering Mechanics", Lakshmi publication Pvt. Ltd., 2016.

Reference Books	
1.	Beer, F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", McGraw Hill Education (India) Pvt. Ltd. 10thEdition, 2013.
2.	Hibbeller, R.C., "Engineering Mechanics: Statics and Dynamics", 13th Edition, Prentice Hall, 2013.
3.	Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", Pearson Education Asia Pvt. Ltd., 2011.

BoS Chairman

B.E. / B.Tech.	B19HST201 - தமிழர் மரபு	T	P	TU	C
		1	0	0	1

அலகு – I	மொழி மற்றும் இலக்கியம்	3
இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.		

அலகு – II	மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை	3
நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கள், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.		

அலகு – III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	3
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.		

அலகு – IV	தமிழர்களின் திணைக் கோட்பாடுகள்	3
தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி		

அலகு – V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3
இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டில் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.		
		மொத்தம் – 15 காலங்கள்

BoS Chairman

Text - Cum - Reference Books	
1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு - தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by : International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by : International Institute of Tamil Studies).
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroyb of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

BoS Chairman

B.E. / B.Tech.	B19HST201 - HERITAGE OF TAMILS (Common to all Branches)	T	P	TU	C
		1	0	0	1

UNIT - I	LANGUAGE AND LITERATURE	3
Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan		

UNIT - II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART - SCULPTURE	3
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils		

UNIT - III	FOLK AND MARTIAL ARTS	3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils		

UNIT - IV	THINAI CONCEPT OF TAMILS	3
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas		

UNIT - V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books		
		Total Instructional hours : 15

BoS Chairman

Text - Cum - Reference Books	
1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு - தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by : International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by : International Institute of Tamil Studies).
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroy of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

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B.E / B.Tech	B19PHP101 – PHYSICS LABORATORY (Common to all Branches)	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To introduce different experiments to test basic understanding of physics concepts applied in properties of matter, optics, thermal physics, and liquids

List of Experiments		
Expt. No.	**Description of the Experiments (Any 8 experiments)**	
1.	Determination of rigidity modulus – Torsion pendulum	
2.	Determination of Young's modulus by non–uniform bending method	
3.	Determination of Young's modulus by uniform bending method	
4.	Determination of wavelength of mercury spectrum – spectrometer grating	
5.	Determination of Refractive index of a prism – spectrometer	
6.	Determination of thickness of a thin wire – Air wedge method	
7.	a.	Determination of wavelength, and particle size using Laser
	b.	Determination of acceptance angle in an optical fiber.
8.	Determination of thermal conductivity of a bad conductor – Lee's Disc method	
9.	Determination of band gap of a semiconductor	
10.	Determination of specific resistance of the wire using Carey Foster's Bridge	
11.	Experiment with Poiseuille's apparatus to determine the viscosity of liquids	
12.	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer	
		Total Instructional hours : 60

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Course Outcomes : Students will be able to	
CO1	Classify the elastic properties of the materials by using uniform, non– uniform Bending method and torsional pendulum apparatus.
CO2	Illustrate the Optical properties of light with the help of LASER, Spectrometer and to determine the thickness of the wire using air wedge.
CO3	Interpret the thermal conductivity of bad conductor using Lee's Disc apparatus.
CO4	Utilize the band gap apparatus to find the band gap a semiconductor and determine the specific resistance of the wire using Carey Foster's Bridge.
CO5	Make use of Poiseuilles's apparatus to determine the viscosity of liquid and to determine the velocity of sound and compressibility of liquid by using Itrasonic Interferometer.

Reference Books	
1.	Senthil Kumar, G. Physics Laboratory I & II, VRB publishers Pvt. Ltd., Chennai (2016).

BoS Chairman

B.E / B.Tech	B19MEP201 – BASIC WORKSHOP PRACTICE LABORATORY (GROUP – A & B) (Common to all Branches)	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To provide exposure to the students with hands–on experience on various basic engineering practices in Civil, Mechanical Engineering.
2.	To provide exposure to the students with hands on experience on various basic engineering practices in Electrical Engineering.
3.	To provide exposure to the students with hands on experience on various basic engineering practices in Electronics Engineering.

GROUP – A (CIVIL & MECHANICAL)

I	Civil Engineering Practices	12

Plumbing Works

Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings.

Carpentry

Preparation of wooden joints by sawing, planning and cutting

1.	Planning & Polishing operation
2.	Half lapjoint
3.	Cross lapjoint

II	Mechanical Engineering Practices	18

Welding Workshop

Study of welding tools and equipment's – Study of various welding methods – Instruction of BI standards and reading of welding drawings.

BoS Chairman

Exercise in arc welding for making	
1.	Lapjoint
2.	Buttjoint
3.	Demonstration of gas welding and cutting.
Machine Shop	
1.	Drilling and Tapping
2.	Lathe Exercise – Facing operation
3.	Lathe Exercise – Straight turning and Chamfering
Sheet metal	
Making of small parts using sheet metal	
1.	Square Tray
2.	Funnel

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GROUP – B (ELECTRICAL & ELECTRONICS)	30

Expt. No.	Description of the Experiments
1.	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2.	Fluorescent lamp and Stair case wiring.
3.	Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
4.	Measurement of energy using single phase energy meter.
5.	Measurement of resistance to earth of an electrical equipment.
6.	Study of Electronic components and equipment's – Resistor color coding
7.	Measurement of AC signal parameter (peak–peak, rms period, frequency) using CRO.
8.	Study of logic gates AND, OR, EX–OR and NOT.
9.	Soldering & desoldering practices.
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Explain the pipe connections and identify the various components used in plumbing.
CO2	Develop simple wooden joints using wood working tools and simple components using lathe and drilling machine.
CO3	Construct simple lap, butt and tee joints using arc welding equipment and simple parts using sheet metal.
CO4	Construct Residential house wiring, Fluorescent lamp wiring and Stair case wiring.
CO5	Measure electrical quantities such as voltage, current, power & power factor in RLC Circuit, resistance to earth, AC signal parameter (peak–peak, RMS period, frequency) and ripple factor.
CO6	Examine logic gates (AND, OR, EOR and NOT), Electronic components and equipment's.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
GROUP – A (CIVIL & MECHANICAL)		
Sl. No.	Description of Equipment	Quantity required
1.	Assorted components for plumbing,Consisting of metallic pipes, plastic pipes,flexible pipes, couplings, unions, elbows,plugs and other fittings.	15
2.	Carpentry vice (fitted to work bench)	15
3.	Standard woodworking tools	15
4.	Models of industrial trusses, door joints,furniture joints	5
5.	Power Tools: (a) Rotary Hammer	2
	(b) Demolition Hammer	2
	(c) Circular Saw	2
	(d) Planer	2
	(e) Hand Drilling Machine	2
	(f) Jigsaw	2
6.	Arc welding transformer with cables and holders	5
7.	Welding booth with exhaust facility	5
8.	Welding accessories like welding shield,chipping hammer, wire brush, etc.	5
9.	Oxygen and acetylene gas cylinders, blowpipe and other welding outfit.	2
10.	Centre lathe	2
11.	Hearth furnace, anvil and smithy tools	2
12.	Moulding table, foundry tools	2
13.	Power Tool: Angle Grinder	2
14.	Study–purpose items: Centrifugal pump,Airconditioner	1

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GROUP – B (ELECTRICAL & ELECTRONICS)		
Sl. No.	**Description of Equipment**	**Quantity required**
1.	Assorted Electrical Components for House Wiring	15 sets
2.	Electrical Measuring Instruments	10 sets
3.	Iron Box	1
4.	Fan and Regulator	1
5.	Emergency Lamp	1
6.	Megger	1
7.	Digital Live Wire Detector	2
8.	Soldering Guns	10
9.	Assorted Electronic Components for Making Circuits	50
10.	Multipurpose PCBs	10
11.	Multi Meters	10
12.	Telephone	2
13.	FM radio	2
14.	Regulated Power Supply	2
15.	CRO (30MHz)	2
16.	Bread board	10
17.	Digital IC types (IC 7432, IC 7408, IC 7400, IC 7404, IC 7402, IC 7486)	Each 10

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B.E. – MECH & AERO	B19EEP202 – BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To gain practical experience on electric circuits and verification of Theorems.
2.	To train the students in performing various tests on electrical drives.
3.	To train the students in performing various tests on Transducers & Sensors.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Verification of Circuit Laws.
2.	Verification of Circuit Theorems.
3.	Measurement of three phase power.
4.	Diode based application circuits.
5.	Transistor based application circuits.
6.	Calibration of Rotometer.
7.	RTD and Thermistor.
8.	Load test on DC shunt motor.
9.	Speed control of DC shunt motor.
10.	Load test on Single phase Transformer.
11.	Load test on single phase Induction motor.
	Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Analyze the Performance characteristics of different electrical machines.
CO2	Analyze the concept of circuit laws and theorems in an electric circuit.
CO3	Use Wattmeters for measuring three phase power.
CO4	Design simple circuits involving diodes and transistors.
CO5	Analyze the characteristics of transducers and sensors.
CO6	Analyze the various electrical parameters of ac signals using Oscilloscope.

BoS Chairman

B.E / B.Tech	B19CEP201 – SOFT SKILLS – II	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	To Develop the inter personal skills
2.	To Develop creativity skills
3.	To Enhance communication and problem solving skills
4.	To Improve emotional maturity and emotional health
5.	To Enhance the Employability and Career Skills of students

UNIT – I	SELF EVALUATION	6
Introducing to soft skills, familiarize yourself, Self–understanding, SWOT analysis, Goal Setting.		

UNIT – II	INNOVATIVE THINKING	6
Divergent thinking, Encourage curiosity, Write your story, Poster making		

UNIT – III	COMMUNICATION SKILLS	6
Just a Minute, workplace communication, Role Play, Extempore, Effectiveness of body language.		

UNIT – IV	EMOTIONAL INTELLIGENCE	6
Personal etiquette and relationship, Stress and Time Management.		

UNIT – V	PERSONALITY DEVELOPMENT	6
Leadership skills, Managerial skills, corporate etiquette, Team Building Language Development.		
		Total Instructional hours : 30

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Course Outcomes : Students will be able to	
CO1	Develop the Interpersonal Skills
CO2	Show the creative skill in different aspects.
CO3	Explain their ideas through conversations.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop leadership qualities

Reference Books	
1.	Butterfield, Jeff, “Soft Skills for Everyone”, Cengage Learning, New Delhi, 2015.
2.	S. Hariharanetal, “Soft Skills”, MJP Publishers: Chennai, 2010.
3.	Peter, Francis, “Soft Skills and Professional Communication”, New Delhi: Tata McGraw Hill, 2012.

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Semester – III

B.E. / B.TECH	B19MAT304 – PARTIAL DIFFERENTIAL EQUATIONS AND PROBABILITY (Biotechnology & Mechanical)	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To introduce the basic concepts of PDE for solving standard partial differential equations.
2.	To understand Fourier series analysis in representation of Periodic signals.
3.	To develop Fourier series techniques in solving wave and heat flow problems.
4.	To introduce the basic concepts of probability and random variables.
5.	To introduce the basic concepts of two dimensional random variables

UNIT – I	PARTIAL DIFFERENTIAL EQUATIONS	12
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of first order partial differential equations of the forms f(p,q) = 0, z = px +qy + f(p,q) – Lagrange's linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients.		

UNIT – II	FOURIER SERIES	12
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series –Complex form of Fourier series – Parseval's identity – Harmonic analysis.		

UNIT – III	BOUNDARY VALUE PROBLEMS	12
Classification of second order linear PDE – Method of separation of variables – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction– Fourier series solutions in Cartesian coordinates..		

UNIT – IV	PROBABILITY AND RANDOM VARIABLES	12
Probability – Conditional probability – Baye's theorem – Discrete and continuous randomvariables – Moments – Moment generating functions – Binomial, Poisson and Normal distributions.		

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UNIT – V	TWO–DIMENSIONAL RANDOM VARIABLES	12
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and line arregression – Transformation of random variables.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Solve the partial differential equations with constant coefficients.
CO2	Solve differential equations using Fourier series analysis.
CO3	Apply Fourier series to solve boundary value problems.
CO4	Develop the concepts of probability and standard distributions.
CO5	Apply the basic concepts of two dimensional random variables.

Text Books	
1.	Grewal B.S.,"Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2020.
2.	Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics'' Volume III, S. Chand & Company Ltd., 2016.
3.	Johnson, R.A., Miller, Miller, Iand Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

Reference Books	
1.	Ramana B.V., "Higher Engineering Mathematics", Mc Graw Hill Education Pvt. Ltd, New Delhi, 2016.
2.	Erwin Kreys zig, "Advanced Engineering Mathematics",10th Edition, John Wiley, India, 2016.
3.	Wylie C. Ray and Barrett Louis C.,"Advanced Engineering Mathematics", Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
4.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.

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B.E.	B19MET301 – ENGINEERING THERMODYNAMICS	T	P	TU	C
		3	0	1	4

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychometric Chart permitted)

Course Objectives	
1.	To familiarize the students to understand the fundamentals of thermodynamics.
2.	To understand the concepts of energy transformation, conversion of heat into work.
3.	To apply the laws of thermodynamics into an energy system.
4.	To understand the thermodynamic behavior of steam and its applications.
5.	To apply psychometric process in various energy system.

UNIT – I	BASIC CONCEPTS AND FIRST LAWOF THERMODYNAMICS	12

Basic concepts – concept of continuum, comparison of microscopic and macroscopic approach. Thermodynamic properties. System and their types. Thermodynamic Equilibrium State, path and process. Quasi–static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work. P–V diagram. Zeroth and first law of thermodynamics – concept of temperature and thermodynamic scales. First law of thermodynamics – application to closed and open systems – steady and unsteady flow processes.

UNIT – II	SECOND LAW OF THERMODYNAMICS AND AVAILABILITY ANALYSIS	12

Heat Reservoir, source and sink. Heat Reservoir, source and sink. Heat Engine, Refrigerator, and Heat pump. Statements of second law and its c corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T–s diagram, ideal gases – different processes, principle of increase in entropy. Available energy, Availability and Irreversibility.

UNIT – III	STEAM GENERATOR AND PROPERTIES OF STEAM	12

Importance terms of steam boiler, Selection of good boiler, classification of steam boiler and its working, boiler mounting and its accessories, performance of boilers. Pure substance Formation of steam and its thermodynamic properties, p–v, p–T, T–v, T–s, h–s diagrams. P–v–T surface. Use of Steam Table and Mollier Chart. Measurement of dryness fraction of steam. Application of I and II law for pure substances.

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UNIT – IV	THERMODYNAMIC RELATIONS AND GAS MIXTURES	12
Some mathematical Theorems. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule–Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations. Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function.		

UNIT – V	PSYCHROMETRY	12
Psychrometric properties, Psychrometric charts. Property calculations of air vapor mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Explain the basics concepts and Laws of Thermodynamics.
CO2	Relate the Thermodynamics Principles in to Mechanical Engineering applications.
CO3	Develop sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
CO4	Utilize the Mathematical Model for thermodynamic properties and Real Gas.
CO5	Apply the basic concept of Gas Mixture and the Properties Psychometric.

Text Books	
1.	Rajput. R. K, "Engineering Thermodynamics", 5th Edition, Lakshmi Publications, New Delhi, 2016.
2.	Nag. P. K., "Engineering Thermodynamics", 6th Edition, Tata McGraw–Hill, New Delhi, 2017.

Reference Books	
1.	Cengel. Y and M. Boles, "Thermodynamics – An Engineering Approach", 9th Edition, Tata McGraw Hill, 2019.

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2.	Holman.J.P., "Thermodynamics", 3rd Edition, McGraw–Hill, 1995.
3.	Rathakrishnan. E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice– Hall of India Pvt. Ltd, 2006.
4.	Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2010.
5.	Arora C.P, “Thermodynamics”, Tata McGraw–Hill, New Delhi, 2003.

B.E. / B.TECH	B19MET302 – FLUID MECHANICS AND MACHINERY	T	P	TU	C
		2	0	1	3

Course Objectives	
1.	The properties of fluids and concept of control volume are studied.
2.	The applications of the conservation laws to flow through pipes arestudied.
3.	To understand the importance of dimensional analysis
4.	To understand the importance of various types of flow in pumps.
5.	To understand the importance of various types of flow in turbines.

UNIT – I	FLUID PROPERTIES AND FLOW CHARACTERISTICS	9

Units and dimensions– Properties of fluids– mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, capillarity and surface tension. Flow characteristics – concept of control volume – application of control volume to continuity equation, energy equation and momentum equation.

UNIT – II	FLOW THROUGH CIRCULAR CONDUITS	9

Hydraulic and energy gradient – Laminar flow through circular conduits and circular annuli Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation – friction factor– Moody diagram– commercial pipes– minor losses – Flow through pipes in series and parallel.

UNIT – III	DIMENSIONAL ANALYSIS	9

Need for dimensional analysis – methods of dimensional analysis – Rayleigh method and Buckingham π theorems.Similitude –types of similitude – Dimensionless parameters– application of dimensionless parameters – Model analysis.

UNIT – IV	PUMPS	9

Impact of jets – Euler's equation – Theory of rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor– velocity triangles – Centrifugal pumps– working principle – work done by the impeller – performance curves – Reciprocating pumpworking principle – indicator diagram – work saved by fitting air vessels – Rotary pumps – classification – comparison of working principle with other pumps – advantages.

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UNIT – V	TURBINES	9
Classification of turbines – heads and efficiencies – velocity triangles – axial, radial and mixed flow turbines – Pelton wheel and Francis turbine – working principles – work done by water on the runner – draft tube – specific speed – unit quantities – performance curves for turbines – governing of turbines.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply mathematical knowledge to predict the properties and characteristics of a fluid.
CO2	Analyse and calculate major and minor losses associated with pipe flow in pipingnetworks.
CO3	Solve problems in mass, momentum and energy balance equations in fluiddynamics
CO4	Analyse the performance of pumps.
CO5	Analyse the performance of turbines.

Text Books	
1.	R. K. Bansal, “A Textbook of Fluid Mechanics and Hydraulic Machines”, Laxmi Publications, 2010.
2.	Modi P.N. and Seth, S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.

Reference Books	
1.	Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.
2.	Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (p) Ltd., New Delhi, 2016.
3.	Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, “Fluid Mechanics and Machinery”, 2011.
4.	Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010.

BoS Chairman

B.E. / B.TECH	B19MET303 – MANUFACTURING TECHNOLOGY – I	T	P	TU	C
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Course Objectives	
1.	To outline the different metal casting processes associated defects, merits and demerits.
2.	To compare different metal joining processes.
3.	To summarize various hot working and cold working methods of metals.
4.	To explain the various sheet metal making processes.
5.	To explain various methods of manufacturing plastic components.

UNIT – I	METAL CASTING PROCESSES	9

Sand Casting: Sand Mould – Type of patterns – Pattern Materials – Pattern allowances, Moulding sand Properties and testing – Cores – Types and applications – Moulding machines – Types and applications; Melting furnaces: Blast and Cupola Furnaces; Principle of special casting processes: Shell – investment – Ceramic mould – Pressure die casting Centrifugal Casting – CO_2 process – Stir casting; Defects in Sandcasting.

UNIT – II	JOINING PROCESSES	9

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding – Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding– Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of: Resistance welding – Plasma arc welding ,Thermit welding – Electron beam welding – Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes andcure.

UNIT – III	METAL FORMING PROCESSES	9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – forging operations. Rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion.

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UNIT – IV	SHEET METAL PROCESSES	9
Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods – special forming processes – Working principle and applications – Hydro forming – Rubber pad forming, Metal spinning – Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Microforming.		

UNIT – V	MANUFACTURE OF PLASTIC COMPONENTS	9
Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer moulding – Typical industrial applications – introduction to blow moulding Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain different metal casting processes, associated defects, merits and demerits
CO2	Compare different metal joining processes.
CO3	Summarize various hot working and cold working methods of metals.
CO4	Explain various sheet metal making processes.
CO5	Distinguish various methods of manufacturing plastic components.

Text Books	
1.	HajraChouldhary S.K and HajraChoudhury. AK., "Elements of workshop Technology", Volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2010.
2.	Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2013.

Reference Books	
1.	Gowri P. Hariharan, A. Suresh Babu, "Manufacturing Technology I", Pearson Education, 2010.
2.	Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4^{th} Edition, TMH–2013.
3.	Sharma, P.C., "A Text book of Production Technology", S.Chand and Co. Ltd, 2014.
4.	R.K. Rajput, "A textbook of Manufacturing Technology (Manufacturing Processes)", Laxmi publications (p) ltd, 2015.

BoS Chairman

B.E.	B19MET304 – APPLIED MATERIALS AND METALLURGY	T	P	TU	C
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Course Objectives	
1.	To outlinethe constitutions of alloys, phase diagrams and different types of ferrousalloys.
2.	To identify and select suitable heat treatment processes of steel with the aid of transformation diagrams and to understand the powder metallurgy.
3.	To summarize the non–ferrous metal alloys andmodern engineering materialsemployed for various engineering applications.
4.	To explainthe properties and applications of non–metallic materials.
5.	To demonstratevarious destructive and non–destructive testing methods and common failure mechanisms of materials.

UNIT – I	CONSTITUTION OF ALLOYS, PHASE DIAGRAMS AND FERROUS METALS	9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbide equilibrium diagram – Classification of steel and cast Iron – Types of steels – Effects of alloying elements (Mn, Si, Cr, Mo, V , Ni,Ti and W) on properties of steel – stainless and tool steels – HSLA, Maraging steels – Cast Iron – grey, white, malleable, spheroidal – alloy cast irons.

UNIT – II	HEATTREATMENTAND POWDER METALLURGY	9

Types of annealing processes – normalizing, hardening andtempering of steels – austempering, martempering. Isothermal transformation diagrams – cooling curves superimposed onI.T diagram CCR – Hardenability, Jominy end quench test. Types of casehardening processes – diffusion methods (carburizing, nitriding, cyaniding, carbonitriding) – thermal methods (flame and induction hardening) –Vacuum and plasma hardening. Production of powders, mixing, blending, compacting, sintering and hot pressing – secondary operations – application of powder metallurgy – advantages and limitations.

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UNIT – III	NON–FERROUS AND MODERN ENGINEERING MATERIALS	9
Copper and copper alloys – brass, bronze and cupronickel – Aluminium and Al–Cu – precipitation strengthening treatment – Mg – alloys, Ni–based super alloys and Titanium alloys. Metallic glasses – preparation, properties, applications – Shape Memory Alloys (SMA) – characteristics, properties of NiTi alloy – applications, advantages and disadvantages of SMA. Nanomaterials–Classifications – properties and applications of Nanoparticles – Carbon Nanotubes (CNT) – structure, properties, applications of the CNTs.		

UNIT – IV	NON – METALLIC MATERIALS	9
Polymers – commodity and engineering polymers – properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes). Engineering ceramics – properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON. Composites – basic terminology – manufacturing offiber reinforced composites (FRP with MMC) – introduction to CMC, MMC, PMC – applications.		

UNIT – V	DEFORMATION MECHANISMSANDTESTING OF MATERIALS	9
Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materialsunder tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell) – Impact tests – Izod and Charpy –fatigue and creep failuremechanisms.Non–Destructive Testing (NDT) – basic principles of radiographic testing, ultrasonic testing,magnetic particle inspection, liquid penetrant inspection test,eddy current testing.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain alloys, phase diagram, Iron–Iron carbide diagram, classification of ferrous metalsand its effects of alloying.
CO2	Outline isothermal transformation, continuous cooling diagrams, different heat treatment processes and powder metallurgy.
CO3	Clarify the effect of alloying elements on non–ferrous metals and introduction on modern engineering materials.
CO4	Summarize the properties and applications of non–metallic materials.
CO5	Explain the testing of mechanical properties.

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Text Books	
1.	Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian Edition, 2014.
2.	O.P. Khanna “Material Science and Metallurgy”, Dhanpat Rai Publication, 2011.

Reference Books	
1.	Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 2010.
2.	Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd., 2015.
3.	U.C.Jindal: Material Science and Metallurgy, “Engineering Materials and Metallurgy”, First Edition, Dorling Kindersley, 2012.

BoS Chairman

B.Tech.	B19MCT302 – INDIAN CONSTITUTION	T	P	TU	C
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Course Objectives	
1.	To understand the constitutional organization of India.
2.	To understand the hierarchy of Union Government of India.
3.	To know the hierarchy and systems of state Governments.
4.	To know the power, role of local administration in Government sectors.
5.	To understand role, function of Election Commission of India.

UNIT – I	THE CONSTITUTION – INTRODUCTION	6

- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation
- State Policy Principles

UNIT – II	UNION GOVERNMENT	6

- Structure of the Indian Union
- President – Role and Power
- Prime Minister and Council of Ministers
- Lok Sabha and Rajya Sabha

UNIT – III	STATE GOVERNMENT	6

- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

UNIT – IV	LOCAL ADMINISTRATION	6

- District Administration
- Municipal Corporation
- Zila Panchayat

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UNIT – V	ELECTION COMMISSION	9
❍ Role and Functioning ❍ Chief Election Commissioner ❍ State Election Commission		
		Total Instructional hours : 30

Course Outcomes : Students will be able to	
CO1	Develop the knowledge on organization of Indian constitution.
CO2	Explains the hierarchy organization of Indian Government.
CO3	Explain various systems and applications of State Governments.
CO4	Understand the power and functional systems of local administration.
CO5	Understand the role and administration of Indian Election Commission.

Text Books	
1.	Rajeev Bhargava, "Ethics and Politics of the Indian Constitution", Oxford University Press, New Delhi, 2008.
2.	Fadia, B.L., "The Constitution of India", Sahitya Bhawan; New edition 2017.
3.	Basu, D.D., "Introduction to the Constitution of India", Lexis Nexis; Twenty –Third 2018.

Suggested Software/Learning Websites	
1.	https://www.constitution.org/cons/india/const.html
2.	http://www.legislative.gov.in/constitution–of–india
3.	https://www.sci.gov.in/constitution
4.	https://www.toppr.com/guides/civics/the–indian–constitution/the–constitution–ofindia/

BoS Chairman

B.E. / B.Tech.	B19HST301 - தமிழரும் தொழில்நுட்பமும்	T	P	TU	C
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அலகு – I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு – II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழா் காலத்துப் பெருங்கோவில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கா் காலக் கோவில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கா் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக்கலை

அலகு – III	உற்பத்தித் தொழில் நுட்பம்	3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருவாக்குதல், எ்.கு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்

அலகு – IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3

அணை, ஏரி, குளங்கள், மதகு - சோழா்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சாா்ந்த செயல்பாடுகள் - கடல்சாா் அறிவு - மீன் வளம் - முத்து மற்றும் முத்துக் குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசாா் சமூகம்

அலகு – V	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்	3

அறிவியல் தமிழின் வளா்ச்சி - கணித்தமிழ் வளா்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்

மொத்தம் – 15 காலங்கள்

BoS Chairman

Text - Cum - Reference Books	
1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு - தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL
6.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by : International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by : International Institute of Tamil Studies).
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroy of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

BoS Chairman

B.E. / B.Tech.	B19HST301 - TAMILS AND TECHNOLOGY	T	P	TU	C
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UNIT - I	WEAVING AND CERAMIC TECHNOLOGY	3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries

UNIT - II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period

UNIT - III	MANUFACTURING TECHNOLOGY	3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel - Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram

UNIT - IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society

UNIT - V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project

Total Instructional hours : 15

BoS Chairman

Text - Cum - Reference Books	
1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு - தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by : International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by : International Institute of Tamil Studies).
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroyb of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

BoS Chairman

B.E.	B19MEP301 – FLUID MECHANICS AND MACHINERY LABORATORY	T	P	TU	C
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Course Objectives	
1.	To execute flow measurement where calculation accuracy is critical.
2.	To study the venturi effect of the pipe to satisfy the equation of continuity.
3.	To measure the volumetric flow of liquids and gases.
4.	To study the graphical representation of all types of pumps.
5.	To measure the power output of Francis & Kaplan Turbine.

List of Experiments

Expt. No.	Description of the Experiments
1.	Determination of the Coefficient of discharge of given Orifice meter.
2.	Determination of the Coefficient of discharge of given Venturi meter.
3.	Calculation of the rate of flow using Rota meter.
4.	Determination of friction factor for a given set of pipes.
5.	Conducting experiments and drawing the characteristic curves of centrifugal pump.
6.	Conducting experiments and drawing the characteristic curves of submersible pump.
7.	Conducting experiments and drawing the characteristic curves of reciprocating pump.
8.	Conducting experiments and drawing the characteristic curves of Gear pump.
9.	Conducting experiments and drawing the characteristic curves of Pelton wheel.
10.	Conducting experiments and drawing the characteristics curves of Francis turbine.
11.	Conducting experiments and drawing the characteristic curves of Kaplan turbine.
	Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Compare the principles studied in theory by performing the experiments in lab.
CO2	Ability to choose the measurement equipment for flow measurement.
CO3	Identify the fluid flow in pipes and determine frictional losses.
CO4	Experiment with characteristics of all types of pumps.
CO5	Experiment with characteristics of Francis & Kaplan Turbine.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Orifice meter setup	1
2.	Venturi meter setup	1
3.	Rotameter setup	1
4.	Pipe Flow analysis setup	1
5.	Centrifugal pump/submersible pump setup	1
6.	Reciprocating pump setup	1
7.	Gear pump setup	1
8.	Pelton wheel setup	1
9.	Francis turbine setup	1
10.	Kaplan turbine setup	1

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B.E / B. Tech	B19MEP302 – COMPUTER AIDED MACHINE DRAWING LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To make students to appreciate the functions of various machine assemblies.
2.	To draw part drawings, sectional views and assembly drawings as perstandards and parts.

DRAWING STANDARDS & FITS AND TOLERANCES	12

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. – Limits, Fits – Tolerancing of individual dimensions – Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning &tolerance.

INTRODUCTION TO 2D DRAFTING	16

- Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing.
- Orthographic Projections of simple machine parts.

3D GEOMETRIC MODELING AND ASSEMBLY	32

- Sketcher – Datum planes – Protrusion – Holes – Part modeling – Extrusion – Revolve – Sweep – Loft – Blend – Fillet – Pattern – Chamfer – Round – Mirror – Section – Assembly
- Couplings – Flange and Universal couplings
- Joints – Knuckle, Gib& cotter, strap, sleeve & cotter joints
- Engine parts – Piston, connecting rod, cross–head (vertical and horizontal).

Total Instructional hours : 60

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Total 20% of classes for theory and 80% of classes for practice
Note : 25% of assembly drawings must be done manually and remaining 75% of assembly. Drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software.

Course Outcomes : Students will be able to	
CO1	Understand and interpret drawings of machine components.
CO2	Develop part drawings, sectional views and assembly drawings as per standards and parts.
CO3	Make use of CAD packages to prepare assembly drawings.
CO4	Make use of Indian Standards on drawing practices and standard components.
CO5	Develop knowledge in handling 2D drafting and 3D modeling software system.

Reference Books	
1.	N. D. Bhatt and V.M. Panchal, “Machine Drawing”, 48th Edition, Charotar Publishers,2013.
2.	N.D. Junnarkar, “Machine Drawing”, 1st Edition, Pearson Education, 2007.
3.	N. Siddeshwar, P. Kanniah, V.V.S. Sastri,” Machine Drawing”, published by Tata McGraw Hill, 2006.
4.	S. Trymbaka Murthy, “A Text Book of Computer Aided Machine Drawing”, CBS Publishers, New Delhi, 2007.

LIST EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	Computers with necessary accessories	30
2.	Assembly drawings using any 2D / 3D CAD Software	30
3.	Printer	1

BoS Chairman

B.E / B. Tech	B19CEP301– SOFT SKILLS – II (Common to all Branches)	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	To enhance communication skills through LSRW skills.
2.	To enrich inter personal skills through integrated activities.
3.	To enrich inter personal skills through integrated activities.
4.	To enrich inter personal skills through integrated activities.

UNIT – I	COMMUNICATION SKILLS	6
Define Listening – Types of Listening – Listening and Filling Information – Basis of Phonetics – Strategies of Effective Reading – Reading & Responding to Business Communications – E–mail.		

UNIT – II	INTERPERSONAL SKILLS	6
Interpersonal Skills – Need & Components – Understanding Inter cultural Competence – Team Work – Problem Solving Skills – Workplace Conflict Management & Resolutions.		

UNIT – III	EMOTIONAL INTELLIGENCE	6
Key Elements of Emotional Intelligence – Self Awareness – Self Performance – Psychometric Analysis – Relationship Management – Critical Thinking & Reasoning.		

UNIT – IV	BUSINESS ETIQUETTE	6
Define Etiquette – Types & Importance of Workplace Etiquette – Basic Corporate Etiquette – Telephone Etiquette – Meeting & E–mail Etiquette – Customer Service Etiquette.		

UNIT – V	CORPORATE SKILLS	6
Work Ethics – Adaptability – Analytical Reasoning – Lateral Thinking – Stress & Time Management – Professionalism in Today's Workforce.		

Total Instructional hours : 30

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Course Outcomes : At the end of the course the student will be able to	
CO1	Develop professional communication through LSRW skills.
CO2	Apply systematic approach in problem solving skills.
CO3	Utilize leadership skills with ability to work in a team.
CO4	Demonstrate employability skills.
CO5	Analyze & adapt workplace etiquette.

Reference Books	
1.	**R1** – Meenakshi Raman, Shalini Upadhyay, 'Soft Skills', Cengage Learning India Pvt. Ltd, Delhi, 2018.
2.	**R2** – M.S. Rao, 'Soft Skills Enhancing Employability', I.K. International Publishing House Pvt. Ltd, New Delhi, 2010.
3.	**R3** – Sabina Pillai, Agna Fernandez, 'Soft Skills and Employability Skills', Cambridge University Press, 2018.
	R4 – John Peter. A, 'Self – Development and Professional Excellence', Cengage Learning India Pvt. Ltd, Delhi, 2019.

BoS Chairman

B.E / B. Tech	B19CEP302 – PROFESSIONAL CERTIFICATE COURSE – I (SOLID WORKS)	T	P	TU	C
		0	2	0	1

Sl. No.	Topics	Hours
1.	**Introduction to Solidworks** Menu Bar and Solidworks Menus, Command Manager, Dimensioning Standards and Units	3
2.	**Drawing Sketches for Solid Models** Drawing Lines, Circles, Arcs, Rectangles, Polygons, Splines, Slots, Ellipses, Elliptical Arcs, Parabolic Curves, Conic Curves	3
3.	**Editing, Modifying Sketches, Adding Relations and Dimensions to Sketches** Editing Sketched Entities, Creating Patterns, Applying Geometric Relations to Sketches, Dimensioning a Sketch, Concept of a Fully Defined Sketch	6
4.	**Base Feature Options** Creating Base Features by Extruding Sketches & Revolving Sketches, Determining the Mass Properties of Parts, Assigning Materials and Textures to Models	6
5.	**Creating Reference Geometries** Reference Planes, Creating New Planes, Creating Reference Axes, Creating Reference Points, Creating Reference, Coordinate Systems, Creating Center of Mass, Creating a Bounding Box	3
6.	**Advanced Modelling Tools – I & II** Creating Standard Holes Using the Hole Wizard, Threads, Fillets, Chamfers, Shell Features, Wrap Features, Creating Mirror Features, Pattern Features	3
7.	**Assembly Modelling** Creating Bottom–up Assemblies, Creating Top–down Assemblies, Moving and Rotating Individual Components, Advanced Assembly Mates	3
8.	**Working with Drawing Views** Types of Views, Generating Standard Drawing Views	3
Total Instructional Hours : 30		

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Semester – IV

B.E.	B19MAT405 – NUMERICAL METHODS AND STATISTICS (MECHANICAL)	L	P	TU	C
		3	0	1	4

Course Objectives	
1.	To expose to the basic concepts of solving algebraic and transcendental equations.
2.	To provide the numerical techniques of interpolation, differentiation and integration which plays an important role in engineering and technology disciplines.
3.	Acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
4.	To introduce the basic concepts of statistical and numerical methods and solve numerically different kinds of problems occurring in engineering and technology.
5.	To understand the knowledge of testing of hypothesis for small and large samples with applications in real life problems.

UNIT – I	ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEMS	12

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT – II	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	12

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT – III	INITIAL VALUEPROBLEMS	12

Single step methods : Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge – Kutta method for solving first order equations – Multi step methods : Milne's and Adams – Bash forth predictor corrector methods for solving first order equations.

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UNIT – IV	TESTING OF HYPOTHESIS	12
Sampling distributions – Estimation of parameters – Statistical hypothesis – Large sample tests based on Normal distribution for single mean and difference of means –Tests based on t, Chi–square and F distributions for mean, variance – Contingency table (test for independent) – Goodness off it.		

UNIT – V	DESIGNOF EXPERIMENTS	12
One way and two way classifications – Completely randomized design – Randomized block design – Latin square design – 22 factorial design.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Interpret the solution of equations and Eigen value problems.
CO2	Apply the knowledge of Interpolation, numerical differentiation and integration in real world situations.
CO3	Solve first and second order initial value problems.
CO4	Demonstrate a solid understanding of testing of hypothesis.
CO5	Construct the ANOVA tables for CRD, RBD and LSD.

Text Books	
1.	Grewal B.S.,“Higher Engineering Mathematics”, 44th Edition, Khanna Publishers, New Delhi, 2020.
2.	Kandasamy P., Thilagavathy K. and Gunavathy K., “Statistics and Numerical Methods” S. Chand & Company Ltd., 2018.
3.	Johnson, R.A., Miller, Iand Freund J., “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 8th Edition, 2015.

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Reference Books	
1.	Ramana. B.V., “Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2.	Erwin Kreys zig, “Advanced Engineering Mathematics”, 10th Edition, John Wiley, India, 2016.
3.	Wylie C. Ray and Barrett Louis C., “Advanced Engineering Mathematics” Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
4.	Devore. J.L., “Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.

BoS Chairman

B.E.	B19MET401 – KINEMATICS OF MACHINERY	L	P	TU	C
		3	0	1	4

Course Objectives	
1.	To understand the basic components and layout of linkages in the assembly of a system machine.
2.	To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
3.	To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
4.	To understand the basic concepts of toothed gearing and kinematics of gear trains.
5.	To understand the basic of the effects of friction in motion transmission and in machine components.

UNIT – I	BASICS OF MECHANISMS	9

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four–bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Universal Joint – rocker mechanisms.

UNIT – II	KINEMATICS OF LINKAGE MECHANISMS	9

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method – Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration – Introduction to linkage synthesis problem.

UNIT – III	KINEMATICS OF CAM MECHANISMS	9

Classification of cams and followers – Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

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UNIT – IV	GEARS AND GEAR TRAINS	9
Law of toothed gearing – Involutes and cycloidal tooth profiles – Spur Gear terminology and definitions – Gear tooth action – contact ratio – Interference and under cutting. Helical, Bevel, Worm, Rack and Pinion gears (Basics only). Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains.		

UNIT – V	FRICTION IN MACHINE ELEMENTS	9
Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction in brakes – Band and Block brakes.		
		Total Instructional hours : 45

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Discuss the basics of mechanism.
CO2	Calculate velocity and acceleration in simple mechanisms.
CO3	Develop CAM profiles.
CO4	Solve problems on gears and gear trains.
CO5	Examine friction in machine elements.

Text Books	
1.	RS Khurmi, JK Gupta,"Theory of Machines", 14th Edition, S.Chand, 2017.
2.	Rattan, S.S, "Theory of Machines", 5th Edition, Tata McGraw Hill, 2017.
3.	Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

Reference Books	
1.	Sadhu Singh, "Theory of Machines: Kinematics and Dynamics", 3rd Edition, Pearson Education, 2011.
2.	R.K. Bansal, "A Textbook of Theory of Machines", 5th Edition, Laxmi Publications, 2016.
3.	Thomas Bevan, "Theory of Machines", 3rd Edition, Pearson Education, 2010.
4.	Talpasanu I, "Mechanics of Mechanisms and Machines", Taylor & Francis, 2018.

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B.E.	B19MET402 – MANUFACTURING TECHNOLOGY – II	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the concept and basic mechanics of metal cutting.
2.	To observe and conclude the effect of varying tool materials, cutting parameters and work piece materials
3.	To understand the concepts of standard machine tools and special purpose machines.
4.	To learn the selection of tool and tool holder designation system.
5.	To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming.

UNIT – I	THEORY OF METAL CUTTING	9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools – nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT – II	TURNING MACHINES	9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – tool layout – automatic lathes: semi–automatic – single spindle : Swiss type, automatic screw type – multi spindle.

UNIT – III	SHAPER, MILLING AND GEAR CUTTING MACHINES	9

Shaper – Types of operations. Drilling, reaming, boring, Tapping. Milling operations – types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes – finishing of gears.

UNIT – IV	ABRASIVE PROCESS AND BROACHING	9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding and internal grinding– Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull surface and continuous broaching machines.

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UNIT – V	CNC MACHINING	9
Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre, part programming fundamentals CNC – manual part programming – micromachining – wafer machining.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the mechanism of material removal processes.
CO2	Describe the constructional and operational features of centre lathe and other special purpose lathes.
CO3	Describe the constructional and operational features of shaper, planner, milling, drilling, sawing and broaching machines.
CO4	Explain the types of grinding and other super finishing processes apart from gear manufacturing processes.
CO5	Summarize numerical control of machine tools and write a part program.

Text Books	
1.	Hajra Choudhury, "Elements of Workshop Technology", Vol. II., Media Promoters 2014.
2.	Rao. P.N "Manufacturing Technology – Metal Cutting and Machine Tools", 3rd Edition, Tata McGraw Hill, New Delhi, 2013

Reference Books	
1.	Richerd R. Kibbe, John E. Neely, Roland O. Merges and Warren J. White "Machine Tool Practices", Prentice Hall of India, 2003
2.	Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984
3.	HMT, "Production Technology", Tata McGraw Hill, 1998.

BoS Chairman

B.E.	B19MET403 – MECHANICAL MEASUREMENTS AND METROLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basic principles of measurements.
2.	To deliver knowledge on various linear and angular metrological instruments available to measure the sizes
3.	To convey the ideas on the advanced laser metrology for various industrial applications.
4.	To educate the proper procedure to be adopted in measuring the dimensions of the components.
5.	To impart the skill on different kind of traditional and latest computer aided measuring instruments with appropriate parameters of measuring components.

UNIT – I	GENERAL CONCEPTS OF MEASUREMENT	9
Definition – standards of measurement – accuracy and precision – errors in measurement limits, fits and tolerance analysis in manufacturing and assembly – calibration of instruments. Principles of light interference – measurements and calibrations –interchangeability and selective assembly.		

UNIT – II	LINEAR AND ANGULAR MEASUREMENTS	9
Linear measuring instruments: Vernier instruments, micrometres, height gauge, dial indicators, bore gauges and slip gauges, comparators. Angle measuring instruments: bevel protractors, sprit level, sine bar, autocollimator, and angle dekkor and clinometers interferometry.		

UNIT – III	ADVANCES IN METROLOGY	9
Laser in engineering metrology – methods of laser metrology – precision instruments based on laser – laser interferometer – applications of laser in industry – coordinate measuring machine (CMM) – need, construction, types, applications – computer aided inspection.		

UNIT – IV	FORM MEASUREMENT	9
Screw thread terminology – Measurement of effective diameter by two wire and three wire methods – errors in threads – Measurement of pitch, profile errors and total composite errors, Gear tooth terminology – Methods of measurements of runout, pitch, profile, lead, backlash, tooth thickness composite method of inspection – Measurement of surface finish– Stylus probe instruments – profilometer – Tomlinson and Talysurf instrument – Straightness, Flatness and Roundness measurement.		

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UNIT – V	COMPUTER AIDED INSPECTION	9
Automated inspection – online and offline inspection, sensor technology for manufacturing process monitoring and inspection – flexible inspection system–non contact inspection methods – automatic gauging and size control system – coordinate measuring machine – non–contact sensors for surface finish measurements – machine vision systems and its applications.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Describe the concepts of measurements to apply in various metrological instruments.
CO2	Outline the principles of linear and angular measurement tools used for industrial applications.
CO3	Express the various measurement concepts involved in laser metrology.
CO4	Demonstrate the techniques of form measurement used for industrial components.
CO5	Explain the basic concepts of computer aided inspection.

Text Books	
1.	Anand K. Bewoor, Vinay A. Kulkarani, “Metrology and Measurement”, 1st Edition, McGraw Hill Publishing Co. Ltd., 2014.
2.	Tayal A.K., “Instrumentation and Mechanical Measurements”, 2nd Edition, Galgotia Publications, New Delhi, 2013.

Reference Books	
1.	Jain. R.K., “Engineering Metrology”, Khanna Publishers, Delhi, 2015.
2.	Gupta I.C., “Engineering Metrology”, 7th Edition, Dhanpat Rai Publication, 2012.
3.	Rajput R.K., “Mechanical Measurements and Instrumentation”, 2nd Edition, S.K. Kataria & Sons Publishers, New Delhi, 2012.
4.	Beckwith, Marangoni, Lienhard, “Mechanical Measurement”, 6th Edition, Pearson Education, 2013.

BoS Chairman

B.E.	B19MET404 – THERMAL ENGINEERING	L	P	TU	C
		3	0	1	4

(Use of Standard and approved Steam Table, Mollier Chart, and Psychrometric Chart permitted)

Course Objectives	
1.	To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes.
2.	To apply the thermodynamic concepts into various thermal application like IC engines, Steam.
3.	To evaluate the performance parameters of an IC engines.
4.	To apply the thermodynamic concepts for nozzles, turbines.
5.	To apply the working principles of various refrigeration systems and perform cop calculations.

UNIT – I	GAS AND STEAM POWER CYCLES	12

Air Standard Cycles – Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison – Rankine, reheat and regenerative cycle.

UNIT – II	INTERNAL COMBUSTION ENGINES AND COMBUSTION	12

IC engine – Classification, working, components and their functions. Ideal and actual : Valve and port timing diagrams, p–v diagrams – two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air–fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control.

UNIT – III	INTERNAL COMBUSTION ENGINE PERFORMANCE AND SYSTEMS	12

Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common Rail Direct Injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms.

UNIT – IV	NOZZLES AND TURBINES	12

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow, Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi–staging, compounding and governing.

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UNIT – V	REFRIGERATION AND AIR – CONDITIONING	12
Vapour compression refrigeration cycle, Effect of Superheat and Sub–cooling, Performance calculations, working principle of air cycle, Vapour absorption system, and thermoelectric refrigeration. Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Apply thermodynamic concepts to different air standard cycles and solve problems.
CO2	Explain the functioning and features of IC engines, components and auxiliaries.
CO3	Calculate performance parameters of IC Engines.
CO4	Solve problems in Steam Nozzle, explain the flow in steam turbines, draw velocity diagrams for steam turbines and solve problems.
CO5	Solve problems using refrigerant table / charts and psychrometric charts.

Text Books	
1.	Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010.
2.	Rajput. R. K., “Thermal Engineering” S.Chand Publishers, 2017.

Reference Books	
1.	Ananthanarayanan P.N, “Basic Refrigeration and Air – Conditioning”, 4th Edition, Tata McGraw Hill, 2013.
2.	Arora, “Refrigeration and Air – Conditioning”, 2nd Edition, Prentice Hall of India, 2010.
3.	Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3rd Edition, Jain Brothers, Pvt. Ltd, 2017.
4.	Soman. K, “Thermal Engineering”, 2nd Edition, Prentice Hall of India, 2011.
5.	Ballaney. P.L . “Thermal Engineering”, Khanna publishers, 24th Edition 2012.

BoS Chairman

B.E.	B19MET405 – STRENGTH OF MATERIALS	L	P	TU	C
		2	0	1	3

Course Objectives	
1.	To understand the concepts of stress, strain, principal stresses and principal planes.
2.	To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
3.	To determine stresses and deformation in circular shafts and helical spring due to torsion.
4.	To compute slopes and deflections in determinate beams by various methods.
5.	To study the stresses and deformations induced in thin and thick shells.

UNIT – I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT – II	TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM	9

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending – bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT – III	TORSION	9

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts – Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT – IV	DEFLECTION OF BEAMS	9

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams – Conjugate beam and strain energy – Maxwell's reciprocal theorems.

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UNIT – V	THIN CYLINDERS, SPHERES AND THICK CYLINDERS	9
Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
CO2	Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
CO3	Apply basic equation of simple torsion in designing of shafts and helical spring.
CO4	Calculate the slope and deflection in beams using different methods.
CO5	Analyze and design thin and thick shells for the applied internal and external pressures.

Text Books	
1.	Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016.
2.	R S Khurmi & N. Khurmi ., "Textbook of Strength of Materials", S. Chand Publishing 2015.

Reference Books	
1.	Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.
2.	Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
3.	S. Ramamrutham and R. Narayan., "Strength of Materials", Dhanapat Rai publications", 2011.
4.	Sadhu singh., "Strength of Materials", Khanna publications, 2016.

BoS Chairman

B.E.	B19MEP401 – MANUFACTURING PROCESS AND METAL CUTTING LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To practice operations and obtain shapes using Lathe and milling machine.
2.	To make gears using Milling machines.
3.	To fabricate required shape and size using CNC machines.
4.	To produce cavities of required shape using moulding.
5.	To obtain smooth finish using grinding machines.

List of Experiments	
1.	Taper Turning operation using lathe.
2.	External Thread cutting using lathe.
3.	Internal Thread Cutting using lathe
4.	Eccentric Turning using lathe.
5.	Preparation of green sand moulds using patterns.
6.	Square Head Shaping in shaper machine.
7.	Contour milling using vertical milling machine.
8.	Spur gear cutting in milling machine.
9.	Helical Gear Cutting in milling machine.
10.	Plain Surface grinding.
11.	Cylindrical grinding.
12.	CNC Part Programming for basic shapes.
	Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Obtain Required shape and size through Lathe operations.
CO2	Preparing Sand moulds using moulding tools and patterns.
CO3	Ability to use different machine tools for finishing operations.
CO4	Use different machine tools to manufacturing gears.
CO5	Develop CNC part programming.

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Centre Lathe	7
2.	Horizontal Milling Machine	1
3.	Vertical Milling Machine	1
4.	Surface Grinding Machine	1
5.	Cylindrical Grinding Machine	1
6.	Tool and cutter grinder	1
7.	CNC Lathe	1
8.	Shaper Machine	1
9.	Moulding table, Moulding equipments	2 sets

BoS Chairman

B.E.	B19MEP402 – STRENGTH OF MATERIALS LABORATORY	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	Perform Tension, shear and torsion test on solid materials.
2.	Determine the Toughness of the material using CHARPY and IZOD Test.
3.	Determine the Brinnell and Rockwell hardness number of the given specimen.
4.	Estimate the elastic constants through compression test on springs and deflection test on beams.
5.	Compare the structures and hardness of Unhardened and Hardened specimen through microscopic examinations

List of Experiments		
1.	Tension test on a mild steel rod	
2.	Double shear test on Mild steel and Aluminium rods	
3.	Torsion test on mild steel rod	
4.	Impact test on metal specimen	
5.	Hardness test on metals – Brinnell and Rockwell Hardness Number	
6.	Deflection test on beams	
7.	Compression test on helical springs	
8.	Effect of hardening– Improvement in hardness and impact resistance of steels.	
9.	Tempering– Improvement Mechanical properties Comparison	
	i.	Unhardened specimen
	ii.	Quenched Specimen and
	iii.	Quenched and tempered specimen
10.	Microscopic Examination of	
	i.	Hardened samples and
	ii.	Hardened and tempered samples
		Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Determine the mechanical properties like tensile and compressive strength, hardness, impact strength and flexural rigidity of materials.
CO2	Identify the materials for best practices based on mechanical properties.
CO3	Analyze the deformation behavior of materials for different loading conditions.
CO4	Utilize appropriate materials in design considering their properties, sustainability, Cost and weight.
CO5	Examine and Distinguish different destructive testing methods.
CO6	Analyze the different hardened samples using various harnesses testing Machine.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2.	Torsion Testing Machine (60 NM Capacity)	1
3.	Impact Testing Machine (300 J Capacity)	1
4.	Brinnell Hardness Testing Machine	1
5.	Rockwell Hardness Testing Machine	1
6.	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7.	Metallurgical Microscopes	1
8.	Muffle Furnace (800 C)	1

BoS Chairman

B.E.	B19CEP401 – CAREER ABILITY COURSE – I	T	P	TU	C
		0	2	0	1

Sl. No.	Topics	Hours
1.	**NUMBER SYSTEM** Numbers, HCF and LCM of Numbers, Decimal Fractions, Square Roots & Cube Roots, Problems on Numbers, Surds and Indices	6
2.	**SIMPLIFICATION** Addition, Subtraction, Multiplication, Division, Decimal Fractions BODMAS Rule.	6
3.	**ARITHMETIC ABILITY – I** Average, Problems on Ages, percentage, Profit & Loss, Ratio and Proportion, Partnership.	6
4.	**ARITHMETIC ABILITY – II** Chain Rule, Time and Work, Pipes and cisterns, Time and Distance.	6
5.	**ARITHMETIC ABILITY – III** Problems on trains, Boats and Streams, Allegation or Mixture, Simple interest, Compound Interest.	6
Total Instructional Hours : 30		

BoS Chairman

Semester – V

B.E.	B19MET501 – HEAT AND MASS TRANSFER	L	P	TU	C
		3	0	1	4

(Use of standard HMT data book permitted)

Course Objectives	
1.	To apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems
2.	To apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems
3.	To explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems
4.	To explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems
5.	To apply diffusive and convective mass transfer equations and correlations to solve problems for different applications

UNIT – I	CONDUCTION	12

General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids – Use of Heisler's charts.

UNIT – II	CONVECTION	12

Free and Forced Convection – Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes.

UNIT – III	HEAT EXCHANGERS, CONDENSATION AND BOILING	12

Nusselt's theory of condensation–Regimes of Pool boiling and Flow boiling. Correlation in boiling and condensation. Heat Exchanger Types – Overall Heat Transfer Coefficient – Fouling Factors – Analysis – LMTD method – NTU method. Condensation and Boiling: Dimensionless parameters, boiling modes.

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UNIT – IV	RADIATION	12
Black Body Radiation – Grey body radiation – Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.		

UNIT – V	MASS TRANSFER	12
Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations. Limitations of heat and mass transfer analogy.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
CO2	Apply free and forced convective heat transfer correlations to internal and external flows through/ over various surface configurations and solve problems.
CO3	Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems.
CO4	Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.
CO5	Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications.

Text Books	
1.	J. P. Holman, "Heat Transfer", 10th Ed., McGraw Hill, 2010.
2.	Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015.

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Reference Books	
1.	Y. A. Cengel and A.J. Ghajar, "Heat and Mass Transfer : Fundamentals and Applications", 5th Ed., McGraw–Hill, 2014.
2.	Lienhard, J.H., "A Heat Transfer Text Book" Dover publication, 2011.
3.	Sachdeva, R.C., "Fundamentals of Engineering Heat & Mass Transfer", New Age International, New Delhi, 2011.
4.	Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012.
5.	Nag, P.K., "Heat and Mass Transfer", Tata McGraw Hill, New Delhi, 2011.

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B.E.	B19MET502 – DESIGN OF MACHINE ELEMENTS	L	P	TU	C
		2	0	1	3

(Use of Standard and approved PSG Design data book permitted)

Course Objectives	
1.	To familiarize the various steps involved in the design process.
2.	To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
3.	To learn to use standard practices in the design of temporary and permanent joints.
4.	To learn about energy storing machine elements.
5.	To make use of catalogues and standards in the design of bearings

UNIT – I	STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS	9

Introduction to the design process – factors influencing machine design, selection of materials based on mechanical properties – Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and „C" frame– Factor of safety – theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

UNIT – II	SHAFTS AND COUPLINGS	9

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys, key ways and splines – Rigid and flexible couplings.

UNIT – III	TEMPORARY AND PERMANENT JOINTS	9

Threaded fastners – Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, riveted joints for structures – theory of bonded joints.

UNIT – IV	ENERGY STORING ELEMENTS AND ENGINE COMPONENTS	9

Various types of springs, optimization of helical springs – rubber springs – Flywheels considering stresses in rims and arms for engines and punching machines– Connecting Rods and crank shafts.

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UNIT – V	BEARINGS	9
Sliding contact and rolling contact bearings – Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs, — Selection of Rolling Contact bearings		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the concepts of principal stresses, theories of failure, stress concentration and fatigue loading.
CO2	Estimate the dimensions, stress requirements of shaft and couplings based on various load conditions.
CO3	Select suitable joint for machine element for different types of permanent and temporary joints.
CO4	Select the dimensions of the energy storing devices for specific applications.
CO5	Explain different type of bearing and select them for the required design.

Text Books	
1.	Bhandari V, “Design of Machine Elements”, 3rd Edition, Tata McGraw Hill Book Co, 2010.
2.	Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 9th Edition, Tata McGraw Hill, 2014.

Reference Books	
1.	Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw Hill Book Co. (Schaum’s Outline), 2010
2.	Bernard Hamrock, Steven Schmid, Bo Jacobson, “Fundamentals of Machine Elements”, 3rd Edition, Tata McGraw Hill Book Co., 2016.
3.	Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 9th Edition, Printice Hall, 2013.

BoS Chairman

B.E.	B19MET503 – DYNAMICS OF MACHINES	T	P	TU	C
		2	0	1	3

Course Objectives	
1.	To provide the knowledgeon force–motion relationship in components when applying external forcesand analysis of standard mechanisms.
2.	To estimate the effects of unbalances resulting from prescribed motions in mechanism.
3.	To deliver knowledge on varioustypes of free vibrations and effects.
4.	To impart the skill on various forced vibration and damping systems and vibration measuring instruments.
5.	To understand the principles in mechanisms used for speed control and stability control.

UNIT – I	FORCE ANALYSIS	9
Static force analysis of mechanisms – D' Alembert's principle – Inertia force and Inertia torque – Dynamic force analysis – Dynamic Analysis in Reciprocating Engines – Gas Forces – Equivalent masses – Bearing loads – Crank shaft Torque. Flywheels, Turning moment diagrams – Flywheels of engines and punch press.		

UNIT – II	BALANCING	9
Static and dynamic balancing – balancing of rotating masses–Balancing Multi cylinder Engines – Balancing of Reciprocating masses – Primary and secondary unbalanced forces–partial balancing of unbalanced primary force–partial balancing of Locomotives–Variation of tractive force, swaying couple and Hammer blow.		

UNIT – III	FREE VIBRATION	9
Basic features of vibratory systems – degrees of freedom– free vibration – equations of motion – natural frequency – typesof damping – damped vibration – critical speeds of simple shaft – torsional systems: single, two rotor systems.		

UNIT – IV	FORCED VIBRATION	9
Response to periodic forcing – harmonic forcing – unbalanced forcing – force transmissibility and amplitude transmissibility– vibration isolation.Selection of vibration measuring instruments – accelerometer – dynamic properties and selection of structural materials for vibration control.		

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UNIT – V	MECHANISM FOR CONTROL	9
Governors – types – centrifugal governors – gravity controlled and spring controlled centrifugal governors – characteristics– effect of friction – controlling force. Gyroscopes – gyroscopic forces and torques – gyroscopic stabilization – gyroscopiceffects in automobiles, ships and airplanes.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply the principles and calculate static and dynamic forces of mechanisms.
CO2	Determine the balancing masses and their locations of rotating and reciprocating masses.
CO3	Compute the frequency of various types of free vibrations.
CO4	Calculate the frequency of different forced vibrations and damping coefficient.
CO5	Estimate the gyroscopic effect onautomobiles, ships and airplanes and determine the speed and lift of various governors.

Text Books	
1.	Rattan S.S., “Theory of Machines”, McGraw Hill India Pvt. Ltd., 2014, 4th Edition.
2.	Ghosh A. and Mallick A.K., “Theory of Mechanisms and Machines”, Affiliated East West Press Pvt. Ltd., New Delhi – 2015.
3.	Shigley J. E. and Uicker J. J., “Theory of Machines and Mechanisms”, Oxford Publishers, 2014, SI units Edition.

Reference Books	
1.	F.B. Sayyad, “Dynamics of Machinery”, McMillan Publishers India Ltd., Tech Max Educational resources, 2011.
2.	Sadhu Singh, “Theory of Machines”, Pearson Education, 2011, 3rd Edition.
3.	Khurmi, R.S.,”Theory of Machines”, 14th Edition, S. Chand Publications, 2015.
4.	Thomas Bevan, “Theory of Machines”, Pearson Education Limited, 2010.
5.	Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw Hill, 2017.

BoS Chairman

B.E. / B.TECH	B19MCT301 – ENVIRONMENTAL SCIENCES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the nature and facts about environment.
2.	To find and implement scientific, technological, economic and political solutions to environmental problems.
3.	To study the interrelationship between living organism and environment.
4.	To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
5.	To study the dynamic processes and understand the features of the earth‟s interior and surface.

UNIT – I	ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY	9
Definition, scope and importance of environment – need for public awareness – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams,lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega–diversity nation – hot–spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man–wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In–situ and ex–situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.		

UNIT – II	ENVIRONMENTAL POLLUTION	9
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.		

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UNIT – III	NATURAL RESOURCES	9
Forest resources: Use and over–exploitation, deforestation, case studies– timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over– utilization of surface and ground water, floods, drought, conflicts over water, dams–benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer–pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.		

UNIT – IV	SOCIAL ISSUES AND THE ENVIRONMENT	9
From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non–governmental organization environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation– central and state pollution control boards– Public awareness.		

UNIT – V	HUMAN POPULATION AND THE ENVIRONMENT	9
Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the basic concepts of environment, ecosystem and biodiversity.
CO2	Recognize the different types of pollution and their control measures.
CO3	Discuss various natural resources.

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CO4	Summarize Development and improvement in the standard of living that has lead to serious environmental disasters.
CO5	Explain the causes of population and role of Information technology in environment.

Text Books	
1.	**T1** – Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, New Delhi, 2006.
2.	**T2** – Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.

Reference Books	
1.	**R1** – Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.
2.	**R2** – Erach Bharucha, "Text book of Environmental Studies ll", Universities Press (I) PVT, LTD, Hydrabad, 2015.
3.	**R3** – Rajagopalan, R, "Environmental Studies – From Crisis to Cure", Oxford University Press, 2005.
4.	**R4** – G.Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage LearningIndia Pvt, Ltd, Delhi, 2014

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B.E.	B19MEP501 – KINEMATICS AND DYNAMICS LABORATORY	L	P	TU	C
		0	2	0	1

Course Objectives	
1.	To provide a foundation for the study of machine design.
2.	To supplement the principles learnt in kinematics and Dynamics of Machinery.
3.	To understand how certain measuring devices are used for dynamic testing.
4.	To develop skills for designing and analysing linkages, cams, gears and other mechanisms.
5.	Development of individual and team communications skills.

List of Experiments		
1.	a.	Study of gear parameters.
	b.	Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2.	a.	Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker,
	b.	Kinematics of single and double universal joints.
3.	a.	Determination of Mass moment of inertia of Fly wheel and Axle system.
	b.	Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table Apparatus.
4.		Motorized gyroscope – Study of gyroscopic effect and couple.
5.		Governor – Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6.		Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7.	a.	Single degree of freedom Spring Mass System – Determination of natural
	b.	Frequency and verification of Laws of springs – Damping coefficient determination.
8.		Determination of torsional natural frequency of single Rotor systems. – Undamped and Damped Natural frequencies.
9.		Vibration of Equivalent Spring mass system – undamped and damped vibration.
10.		Whirling of shafts – Determination of critical speeds of shafts with concentrated loads
11.	a.	Balancing of rotating masses.
	b.	Balancing of reciprocating masses.

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12.	a.	Transverse vibration of Free–Free beam – with and without concentrated masses.
	b.	Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Determine the velocity ratio of various types of gear trains.
CO2	Determine the mass moment of inertia of the different types of component
CO3	Estimate the magnitude of gyroscopic couple using motorized gyroscope.
CO4	Analyze the different types of vibrations and its effects on the machine components.
CO5	Calculate the speed range of different types of governors.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Cam follower setup	1 No.
2.	Motorised gyroscope	1 No.
3.	Governor apparatus – Watt, Porter, Proell and Hartnell governors	1 No.
4.	Whirling of shaft apparatus	1 No.
5.	Dynamic balancing machine	1 No.
6.	Spring mass vibration system	1 No.
7.	Torsional Vibration of single rotor system setup	1 No.
8.	Gear Models	1 No.
9.	Kinematic Models to study various mechanisms	1 No.
10.	Turn table apparatus	1 No.
11.	Transverse vibration setup of cantilever	1 No.

BoS Chairman

B.E.	B19MEP502 – THERMAL ENGINEERING LABORATORY	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	Analyzing the performance characteristics of various engines.
2.	Analyzing for proper valve and port timing in IC engines.
3.	Analyzing boiler and steam turbine operation.
4.	Experiment with two stage Reciprocating Air compressor.
5.	Analyzing characteristics of fuels/Lubricates used in IC Engines.

List of Experiments	
1.	Valve Timing diagrams
2.	Port Timing diagrams
3.	Performance Test on four – stroke Diesel Engine
4.	Heat Balance Test on 4 – stroke Diesel Engine
5.	Retardation Test on a Diesel Engine
6.	Determination of Flash Point and Fire Point of various fuels / lubricants
7.	Performance test on a two stage Reciprocating Air compressor.
8.	Study of Steam Generators.
9.	Study of Steam Turbines.
	Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Infer the concepts, laws and methodologies from the first course in thermo dynamics into analysis of cyclic processes.

BoS Chairman

CO2	Apply the thermodynamic concepts into various thermal applications like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems.
CO3	Apply the thermodynamic concepts to solve a variety of problems.
CO4	Estimate the performance of different thermal equipment's like air blower, reciprocating compressors, Boilers.
CO5	Experiment with variety of experiments in internal combustion engines.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	I.C Engine – 2 stroke and 4 stroke model	1
2.	Apparatus for Flash and Fire Point	1
3.	4 – stroke Diesel Engine with mechanical loading.	1
4.	4 – stroke Diesel Engine with hydraulic loading.	1
5.	4 – stroke Diesel Engine with electrical loading.	1
6.	Multi – cylinder Petrol Engine	1
7.	Single cylinder Diesel Engine	1
8.	Two stage Reciprocating Air compressor	1

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B.E.	B19MEP503 – DESIGN AND FABRICATION PROJECT	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To identify a specific problem for the current/future need of the society/industry.
2.	To provide the innovative solution for problem identifications.
3.	To apply the mechanical engineering knowledge and other domain skills.
4.	To get hands on training in the design and fabrication of components.
5.	To understand the preparation of technical report.

The students in convenient groups of 2 to 4 members have to identify a problem from the industry or society and must find the innovative solution that is to be presented as the working model. Every innovative project shall have a supervisor who is the member of the faculty of the institution and if possible with an industry supervisor also. The item chosen may also be innovative small machine elements (Example–screw jack, coupling,machine vice, cam and follower, governor etc), attachment to machine tools, tooling(jigs, fixtures etc), small gear box, automotive appliances, agricultural implements,simple heat exchangers, small pumps, hydraulic /pneumatic devices, mechatronics, robotics, automationetc. Such innovative projects shall be done irrespective of the domains such as automobile, automation, auxiliary industries, bio–medical, defense, healthcare, industrial etc.Students are required to work on the problem identification, solution, concept design, detailed design and fabrication for the chosen item and demonstrate its working apart from submitting the project report. The report should contain design, assembly drawing, parts drawings, process charts relating to fabrication.

A project report and the fabricated model are to be submitted by the group, which will be reviewed and evaluated for internal assessment through rubrics by a committee constituted by the Head of the Department. During the end–semester examination, the project work is evaluated based on oral presentation and the technical project report jointly by external and internal examiners constituted by the Head of the Department.

Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Identify problem in various sectors.
CO2	Process various methods for innovative solution.
CO3	Design and fabricate the machine element/mechanical/mechatronics product.
CO4	Demonstrate the working model.
CO5	Prepare the technical project report.

BoS Chairman

B.E. / B.Tech	B19CEP501 – CAREER ABILITY COURSE – II	T	P	TU	C
		0	2	0	1

Sl. No.	Topics	Hours
1.	**GENERAL MENTAL ABILITY– I** Analogy, Classification, Series Completion, Coding and Decoding, Blood Relations.	6
2.	**GENERAL MENTAL ABILITY – II** Direction Sense Test, Logical Venn Diagram, Data Sufficiency, Assertion and Reason.	6
3.	**NON VERBAL REASONING – I** Mirror Images, Water Images, Embedded Figures, Paper folding and paper cutting, Cubes and Dice	6
4.	**NON VERBAL REASONING – II** Completion of incomplete pattern, Dot Situation, Construction of Squares and Triangles.	6
5.	**DATA INTERPRETATION** Tabulation, Bar Graphs, Pie Chart, Line Graphs.	6
Total Instructional Hours : 30		

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B.E. / B.Tech	B19CEP502 – PROFESSIONAL CERTIFICATE COURSE – II (CREO)	T	P	TU	C
		0	2	0	1

Sl. No.	Topics	Hours
1.	**INTRODUCTION TO CREO MODELLING AND BASIC CONCEPTS** Creo Interface, Getting Started with Creo Parametric, Important Terms and Definitions, File Menu Options.	3
2.	**CREATING SKETCHES IN THE SKETCH MODE – I** The Sketch Mode, Drawing a Sketch Using tools available in the Sketch Tab, Dimensioning the Sketch, Working with Constraints.	3
3.	**CREATING SKETCHES IN THE SKETCH MODE – II** Dimensioning the Sketch, Creating Fillets, Working with Splines, Writing Text in the Sketcher Environment, Rotating and Resizing Entities, Importing 2D Drawings in the Sketch Mode.	3
4.	**CREATING BASE FEATURES – I** Creating extrudes, Revolves and Ribs, Creating sweeps and blends, Creating holes, shells and drafts, Creating rounds, chamfers.	3
5.	**CREATING BASE FEATURES – II** Creating datum Features: Planes and Axes, Datums in Modelling Selection, Creating Cuts.	3
6.	**OPTIONS AIDING CONSTRUCTION OF PARTS** Creating Standard Holes Using the Hole Wizard, Threads, Fillets, Chamfers, Shell Features, Wrap Features.	3
7.	**ADVANCED MODELLING TOOLS – I** Creating holes, shells and drafts, Creating rounds, chamfers, Sweep Features, Blend Features, Datum Curves.	3
8.	**ADVANCED MODELLING TOOLS – II** Advanced Feature Creation Tools, Copy and mirror tools, creating patterns.	3
9.	**ASSEMBLY MODELLING** Assembling with constraints, Modifying the Components of an Assembly Exploding assembly,using layers.	3
Total Instructional Hours : 30		

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Professional Elective – I

B.E.	B19MEE501 – REFRIGERATION AND AIR CONDITIONING	L	P	TU	C
		3	0	0	3

(Use of Psychrometric chart, Refrigeration tables and charts are permitted)

Course Objectives	
1.	To understand the fundamental principles of refrigeration cycle and its properties.
2.	To understand and discuss, vapour compression cycles and its performance, compressors, condensers, evaporators.
3.	To understand Non–conventional refrigeration systems and psychrometry.
4.	To understand air conditioning systems and their design, load calculation, control and accessories.
5.	To have a thorough knowledge of the applications of refrigeration and air conditioning.

UNIT – I	INTRODUCTION	9

Definition and methods, Unit of refrigeration, COP, EER, Carnot Principle, Heat pump and Refrigerator, Air Refrigeration System, Reversed Brayton cycle – Quantitative treatment, Aircraft refrigeration system, Refrigerants properties, Types, Selection criteria, Designation, Oil Compatibility, Eco Friendly Refrigerants, Environmental Impact, Ozone depletion potential and Global warming potential, Montreal/ Kyoto protocols.

UNIT – II	VAPOUR COMPRESSION REFRIGERATION SYSTEM	9

Simple and actual VCR cycle, T–s and p–h representation, Effect of Sub cooling and superheating – Quantitative treatment, Two stage compression, flash chamber, Intercooler. Compressors: single and multistage, Hermetic, Screw, Vane and Centrifugal compressors, Condensers and evaporators; Expansion devices, Cooling towers, types – Qualitative treatment only.

UNIT – III	NON–CONVENTIONAL REFRIGERATION	9

Vapour absorption refrigeration, importance, Principle of Operation of Ammonia–Water, Lithium Bromide–Water VAR systems, Comparison of VCR and VAR systems, merits over VCR system, Electrolux System, Steam ejector system. Introduction to adsorption system, Thermoelectric, Vortex tube and pulse tube refrigeration, Descriptive study of Low temperature refrigeration, Joule Thomson effect, Applications of cryogenics – Qualitative treatment only.

BoS Chairman

UNIT – IV	PSYCHROMETRICS AND AIR CONDITIONING	9
Psychrometry properties, charts, processes and relations, Gibbs–Dalton’s law, Adiabatic mixing of two streams, Human comfort , factors affecting comfort, Comfort chart, Ventilation requirement, Comfort air conditioning, Air conditioning loads, load estimation, Solar radiation, infiltration and ventilation, Air washer; BPF, ADP temperature, RSHF, GSHF, ERSHF – Quantitative treatment.		

UNIT – V	AIR CONDITIONING SYSTEMS	9
Summer, winter and central air conditioning systems. room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems Ducts, types, various types of losses of fluid flow in ducts, Methods of duct design, arrangement system. Air distribution system, Fans and blowers, filters; sources of noise in AC equipments and methods to control noise; Refrigeration and air conditioning controls: pressure, humidity, temperature sensors; safety controls; actuators.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the basic concepts of Refrigeration.
CO2	Explain the Vapor compression Refrigeration systems and to solve problems.
CO3	Discuss the various types of Refrigeration systems.
CO4	Calculate the Psychrometric properties and its use in psychrometric processes.
CO5	Explain the concepts of Air conditioning and to solve problems.

Text Books	
1.	Arora C.P., “Refrigeration and Air Conditioning”, 3rd Edition, Tata McGraw–Hill, 2017.
2.	H.G. Katariya, J.P. Hadiya, “Refrigeration and Air Conditioning”, Books India Publications, 4th edition, 2018.
3.	Manohar Prasad, “Refrigeration and Air conditioning”, New Age International, 3rd Edition, 2011.

BoS Chairman

Reference Books	
1.	Anantanarayanan P.N., “Basic Refrigeration and Air Conditioning”, 4th Edition, Tata McGraw Hill, 2013.
2.	Arora R.C., “Refrigeration and Air Conditioning”, Prentice Hall India, 2010.
3.	“ASHRAE Handbook Series: Fundamentals, Refrigeration, Systems and Equipments and HVAC Applications”, 2014 – 18, ASHRAE Inc, Atlanta, USA.

BoS Chairman

B.E.	B19MEE502 – GAS DYNAMICS AND JET PROPULSION	L	P	TU	C
		3	0	0	3

(Use of Standard and approved Steam Table, and Mollier Chart permitted)

Course Objectives	
1.	To apply the fundamentals of compressible flow concepts and the use of gas tables.
2.	To analyze the compressible flow behaviour in constant area ducts.
3.	To analyze the development of shock waves and its effects.
4.	To explain the types of jet engines and their performance parameters.
5.	To explain the types of rocket engines and their performance parameters.

UNIT – I	BASIC CONCEPTS AND ISENTROPIC FLOWS	9

Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.

UNIT – II	COMPRESSIBLE FLOW THROUGH DUCTS	9

Single and multi–compressor and multi– evaporator systems, System with flash chamber and intercooler, thermodynamic analysis, effect of inter cooling, sub–cooling and super heating. Types of compressors, condensers, evaporators, expansion devices – Comparison between air–cooled and water–cooled condenser based air–conditioning plants.

UNIT – III	NORMAL AND OBLIQUE SHOCKS	9

Governing equations – Rankine – Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.

UNIT – IV	JET PROPULSION	9

Theory of jet propulsion – thrust equation – Performance parameters – thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.

BoS Chairman

UNIT – V	SPACE PROPULSION	9
Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply the fundamentals of compressible flow concepts and the use of gas tables.
CO2	Analyze the compressible flow behaviour in constant area ducts.
CO3	Analyze the development of shock waves and its effects.
CO4	Explain the types of jet engines and their performance parameters.
CO5	Explain the types of rocket engines and their performance parameters.

Text Books	
1.	S.M. Yahya, “Fundamentals of Compressible Flow with Aircraft and Rocket propulsion”, New Age International (P) Limited, 4th Edition, 2012.
2.	Prof. Pr.S.L. Somasundaram, “Gas Dynamics and Jet Propulsion”, New Age International (P) Ltd., Publishers, 1st Edition 2012.

Reference Books	
1.	R. D. Zucker and O Biblarz, “Fundamentals of Gas Dynamics”, 2nd edition, Wiley, 2011.
2.	Singhal B L, “Gas Dynamics and Jet Propulsion”, Macmillan India Limited, 2011.
3.	Pandian K., Anderson A, Ramachandran S, “Gas Dynamics and Jet Propulsion”, Airwalk Publications; 3rd Edition, 2016.

BoS Chairman

B.E.	B19MEE503 – 3D PRINTING AND DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the basic concepts of Additive Manufacturing.
2.	To Develop CAD models for 3D printing.
3.	To Select a specific material for the given application.
4.	To Select a 3D printing process for an application.
5.	To Produce a product using 3D Printing or Additive Manufacturing (AM).

UNIT – I	INTRODUCTION TO ADDITIVE MANUFACTURING (AM)	9

Introduction to AM, AM evolution, Distinction between AM and CNC machining, Advantages of AM.
AM process chain : Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removal and clean up, post processing.
Classification of AM processes : Liquid polymer system, discrete particle system, molten material systems, and solid sheet system.

UNIT – II	DESIGN FOR AM	10

Motivation, DFMA concepts and objectives, AM unique capabilities, exploring designfreedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, InterlockingFeatures, Reduction of Part Count in an Assembly, Identification of markings / numbers etc.

UNIT – III	GUIDELINES FOR PROCESS SELECTION	8

Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control.

UNIT – IV	AM APPLICATIONS	9

Functional models, Pattern for investment and vacuum casting, Medical models, art models,Engineering analysis models, Rapid tooling, new materials development, Bi–metallic parts,Re–manufacturing. Application examples for Aerospace, defence, automobile, Bio–medicaland general engineering industries.

BoS Chairman

UNIT – V	POST PROCESSING OF AM PARTS	9
Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non–thermal andthermal techniques.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the importance of Additive Manufacturing.
CO2	Classify the different AM processes.
CO3	Design for AM processes.
CO4	Understand the applications of AM.
CO5	Differentiate the post processing processes.

Text Books	
1.	Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2.	Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
3.	Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.

Reference Books	
1.	J.D. Majumdar and I. Manna, "Laser–Assisted Fabrication of Materials", Springer Series in Material Science, 2013.
2.	L. Lu, J. Fuh and Y.S. Wong, "Laser–Induced Materials and Processes for Rapid Prototyping", Kulwer Academic Press, 2001.
3.	CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping – Principles and Applications", World Scientific, 2017.

BoS Chairman

B.E.	B19MEE504 – APPLIED HYDRAULICS AND PNEUMATICS	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	Applying the working principles of fluid power systems and hydraulic pumps.
2.	Applying the working principles of hydraulic actuators and control components.
3.	Designing and develop hydraulic circuits and systems.
4.	Applying the working principles of pneumatic power system and its components.
5.	Solving problems and troubles in fluid power systems.

UNIT – I	FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS	9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids – Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow – Friction loss – Work, Power and Torque – Problems, Sources of Hydraulic power: Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems.

UNIT – II	HYDRAULIC ACTUATORS AND CONTROL COMPONENTS	9

Hydraulic Actuators : Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary actuators – Hydraulic motors – Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories : Reservoirs, Pressure Switches – Filters –types and selection– Applications – Fluid Power ANSI Symbols – Problems.

UNIT – III	HYDRAULIC CIRCUITS AND SYSTEMS	9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double – Pump, Pressure Intensifier, Air–over oil, Sequence, Reciprocation, Synchronization, Fail–Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits – Servo and Proportional valves – Applications – Mechanical, hydraulic servo systems.

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UNIT – IV	PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS	9
Properties of air – Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – classification – single cylinder and multi cylinder circuits – Cascade method – Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits – Problems, Introduction to fluidics and pneumatic logic circuits.		

UNIT – V	TROUBLE SHOOTING AND APPLICATIONS	9
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low cost Automation – Hydraulic and Pneumatic power packs.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Apply the working principles of fluid power systems and hydraulic pumps.
CO2	Apply the working principles of hydraulic actuators and control components.
CO3	Design and develop hydraulic circuits and systems.
CO4	Apply the working principles of pneumatic power system and its components.
CO5	Solve problems and troubles in fluid power systems.

Text Books	
1.	Jagadeesha T., “Hydraulics and Pneumatics”, Dreamtech Press, 2019.
2.	Ilango, “Introduction to Hydraulics and Pneumatics”, Prentice Hall India Learning Private Limited, 2011.

Reference Books	
1.	Jagadeesha. T., “Pneumatics Concepts, Design and Applications”, Universities Press, 2015.
2.	Dr. V. Jayakumar, “Applied Hydraulics and Pneumatics”, Lakshmi Publications; June 2014 Latest Edition.
3.	Noah D. Manring, “Hydraulic Control Systems”, John Wiley Publications, 2nd Edition, 2019.

BoS Chairman

B.E.	B19MEE505 – PRODUCT DESIGN AND DEVELOPMENT	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide the fundamental knowledge of product planning and identifying customer needs.
2.	To inculcate the practices on concept generation, and to determine final specification of products.
3.	To impart the skill on concept screening, selection and testing.
4.	To understand about industrial design and processes involved in product architecture.
5.	To throw lights on managing projects and procedures involved in patents filing and sale.

UNIT – I	PRODUCT PLANNING	9
Need for IPPD – Product Planning Process – Identify Opportunities, Evaluating and Prioritizing Projects, Allocating Resources and Timing, Pre–Project Planning, Reflect on the Results and the Process – Identifying Customer Needs – Gathering Raw Data from Customers, Interpreting Raw Data in Terms of Customer Needs – Organizing the Needs into a Hierarchy – Establishing the Relative Importance of the Needs – Case study for motor driven nailer –Reflecting on the Results and the Process.		

UNIT – II	PRODUCT SPECIFICATIONS AND CONCEPT GENERATION	9
Specification Establishment – Establishing Target Specifications – QFD – Setting the Final Specifications – Concept Generation – The Activity of Concept Generation – Clarify the Problem – Search Externally – Search Internally – Explore Systematically – Reflect on the Results and the Process.		

UNIT – III	CONCEPT SELECTION AND CONCEPT TESTING	9
Overview of Methodology – Six steps on Concept Screening – Six steps on Concept scoring – Caveats – Concept Testing – Define the Purpose of the Concept Test, Choose a Survey Population, Choose a Survey Format, Communicate the Concept, Measure Customer Response, Interpret the Results, Reflect on the Results and the Process.		

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UNIT – IV	PRODUCT ARCHITECTURE AND INDUSTRIAL DESIGN	9
Product Architecture – Implications of the Architecture – establishing the architecture – Platform Planning – related system level design issues – The Impact of Industrial Design – The Industrial Design Process – Management of the Industrial Design Process – Assessing the Quality of Industrial Design.		

UNIT – V	MANAGING PROJECTS AND PATENT INTELLECTUAL PROPERTY	9
Elements of Economic Analysis – Understanding and Representing Tasks – Baseline Project Planning – Accelerating Projects – Project Execution – Postmortem Project Evaluation – Formulate a Strategy and Plan – Study Prior Inventions – Outline Claims – Writing Description of the Invention – Refine Claims – Pursue Application – Reflect on the Results and the Process – Patent application steps – Patent intellectual property – Patent office prosecution – Sale of patent rights.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify customer needs and understand the steps involved in product planning
CO2	Outline the procedures of concept generation and techniques in specifying the products
CO3	Choose the best concept based on screening, selection and testing of ideas
CO4	Implement the product architecture and ready for the activities on industrial design.
CO5	Execute the projects systematically and filing the patent of product

Text Books	
1.	Karl T. Ulrich and Steven D. Eppinger, “Product Design and Development”, McGraw Hill International Edns, 2011.
2.	Chitale and Guptha, “Product Design and manufacturing” PHI learning Pvt. Ltd, Delhi, 2013.

Reference Books	
1.	C. Hearn Buck, “Problems of Product Design and Development”, Elsevier Science, 2013.
2.	Dr. Ali Jamnia, “Introduction to Product Design and Development for Engineers”, CRC Press, 2018.
3.	Mattson, Christopher A., Sorensen, Carl, “Product Development”, Springer, 2020.

BoS Chairman

Open Elective – I

B.E. / B.TECH	B19AEO501 – BASICS OF FLIGHT MECHANICS (Common to all Except AERO)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understands of basic concepts like lift, drag, pressure distribution and airfoil characteristics
2.	To understand the effect of weight and height, range and endurance of the aircraft.
3.	To know about the different aerobatics and maneuvers performance in the aircraft.
4.	To get introduce to the basic concepts of shock waves, vortex formation and its effects on the aircraft.
5.	To understand the nature of supersonic flow, C–D nozzle expansion and Flight at hypersonic speeds.

UNIT – I	SUBSONIC SPEED AERO FOILS	9

Introduction to Lifting Surfaces – Lift and drag– Airflow and pressure over Airfoil – Chord line and angle of attack – Pressure distribution – Airfoil characteristics – Camber – Design and nomenclature of airfoil sections.

UNIT – II	LEVELING OF FLIGHT	9

Forces Acting on the Aircraft – Balancing the four forces– Loads on tail plane – Effects of downwash – Tail load determination – Relation between air speed and angle of attack – Effect of Weight and Height – Flying for maximum Range and Endurance.

UNIT – III	MANEUVERS	9

Introduction to Degrees of freedom – Diving – Turning – Angles of bank – Turning Problems – Controls on Steep Banks – Aerobatics – Loops, Spins, Rolls, Sideslips and Nose – Dives – Inverted maneuvers.

UNIT – IV	TRANSONIC FLIGHTS	9

Speed of Sound – Compressibility and Incompressibility – Shock waves – Effects of shock waves – Mach Number – Critical Mach Number – Drag rise in the Transonic Region – Drag and Power Required – Behavior of airplane at shock stall – Shock – wave patterns – Pressure distribution – Slimness and Sweep Back – Area rule – Vortex generators.

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UNIT – V	SUPERSONIC FLIGHTS	9
Introduction to Supersonic flow – Supersonic flow over an aero foil – Convergent divergent nozzle Expanding – contracting duct – Supersonic wing shapes – Supersonic Wing and body shapes – Kinetic heating – Flight at hypersonic speeds.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the Characteristics, Design and Nomenclature of Airfoil Sections. (K2)
CO2	Identify the Forces Acting on the Aircraft and Its Effects to make the Aircraft Flying for Maximum Range and Endurance. (K3)
CO3	Illustrate the different types of Aircraft maneuvering during flight. (K2)
CO4	Outline the effect of shock waves, critical Mach number during transonic flights. (K2)
CO5	Identify the supersonic flow over an Aero foil and able to examine its effects. (K3)

Text Books	
1.	A.C. Kermode cbe, Ma, Ceng, Fraes, "Mechanics of flight s" revised by R H. barnard phd, Ceng, Fraes and D.R. Philpott Phd, Ceng, Mraes, Maiaa, 11th edition.

Reference Books	
1.	Hull DG. "Fundamentals of Airplane Flight Mechanics". Berlin: Springer; 2007 Feb 5.
2.	Cook MV. "Flight dynamics principles: a linear systems approach to aircraft stability and control". Butterworth–Heinemann; 2012 Oct 3.
3.	Miele A. "Flight mechanics: theory of flight paths". Courier Dover Publications; 2016 Mar 15.
4.	Kermode AC. "Mechanics of flight". Longman Scientific & Technical"; 1987.
5.	Von Mises R. "Theory of flight. Courier Corporation"; 1959.

BoS Chairman

B.E. / B.TECH	B19AG0501 – ENVIRONMENT AND AGRICULTURE (Common to all Except AGRI)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the importance of land, water and social structure in agriculture.
2.	To remember the impacts of mechanization, irrigation and urbanization in agriculture.
3.	To know the ecological issues, climate change, environmental policies and sustainable agriculture.
4.	To learn about the Ecological diversity in agricultural applications.
5.	To understand the emerging issues in environment and agriculture.

UNIT – I	ENVIRONMENTAL CONCERNS	8

Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems.

UNIT – II	ENVIRONMENTAL IMPACTS	9

Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts.

UNIT – III	CLIMATE CHANGE	8

Global warming and changing environment – Ecosystem changes – Changing blue–green– grey water cycles – Water scarcity and water shortages – Desertification.

UNIT – IV	ECOLOGICAL DIVERSITY AND AGRICULTURE	10

Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insets and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.

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UNIT – V	EMERGING ISSUES	10
Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural Biodiversity – Agricultural environment policies and its impacts – Sustainable agriculture.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the environmental concerns and impacts in agriculture
CO2	Outline about the interventions like mechanization, watershed development and irrigation in agriculture
CO3	Summarize about the climate change and its issue in agriculture
CO4	Illustrate a capacity building on the focus areas for ecological farming and agriculture biotechnology issues
CO5	Explain the agriculture environmental policies for sustainable agriculture

Text Books	
1.	M.Lakshmi Narasaiah, “Environment and Agriculture”, Discovery Pub. House, 2006.
2.	Arvind Kumar, “Environment and Agriculture”, ABH Publications, New Delhi, 2005.

Reference Books	
1.	T.C. Byerly, “Environment and Agriculture”, United States. Dept. of Agriculture. Economic Research Service, 2006.
2.	Robert D. Havener, Steven A. Breth, “Environment and agriculture: rethinking development issues for the 21st century: proceedings of a symposium”, Winrock International Institute for Agricultural Development, 1994.
3.	“Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium”, Bangkok, Thailand. 1989.
4.	https://nptel.ac.in/courses/126/105/126105014/

BoS Chairman

B.E. / B.TECH	B19BMO501 – INTRODUCTION TO MEDICAL PHYSICS (Common to all Except BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To outline the effects of non ionizing radiation and its application.
2.	To summarize the principles of radioactive nuclides.
3.	To explain the interaction of radiation with matter.
4.	To illustrate the radiation detectors.
5.	To explain the radiation quantities.

UNIT – I	NON IONIZING RADIATION AND ITS MEDICAL APPLICATION	9

Overview of non–ionizing radiation effects – Low Frequency Effects – Higher frequency effects. Thermography – Application. Ultrasound Transducer – Interaction of Ultrasound with matter; Cavitations, Conditions for reflection, Transmission – Scanning systems – Artefacts – Ultrasound Doppler – Double Doppler shift Clinical Applications.

UNIT – II	PRINCIPLES OF RADIOACTIVE NUCLIDES	9

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology ,Decay series, Production of radionuclides – Cyclotron produced Radionuclide– Reactor produced Radio– nuclide–fission and electron Capture reaction, radionuclide Generator–Milking process (Technetiumgenerator).

UNIT – III	INTERACTION OF RADIATION WITH MATTER	9

Interaction of charged particles with matter – Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter – Photoelectric effect, Compton Scattering, Pair production, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance.

BoS Chairman

UNIT – IV	PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS	9
Principles of radiation detection, Properties of dosimeters, Theory of gas filled detectors, Ionization Chamber, Proportional chamber, G.M. Counter, Film dosimetry, luminescence dosimetry, scintillation detectors, Radiation detection instruments, Area survey meters, Personal Radiation monitoring device, Film badge, TLD, OSLD.		

UNIT – V	BASIC RADIATION QUANTITIES	9
Introduction – exposure – Inverse square law – KERMA – Kerma and absorbed dose – stopping power – relationship between the dosimetric quantities – Bremsstrahlung radiation, Bragg"s curve – concept of LD 50 – Stochastic and Non–stochastic effects, Different radiation Unit, Roentgen, gray, Sievert.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Recall the effect of non ionising radiation in human body and applications in the field of medicine
CO2	Interpret radioactive decay and production of radio nuclides
CO3	Discuss the interaction of radiation with matter
CO4	Illustrate the measurement of ionizing radiation
CO5	Summarize about the radiation quantities

Text Books	
1.	John. R Cameron, James G Skofronick, "Medical Physics", John–Wiley & Sons, 1978.
2.	Muhammad Maqbool, "An Introduction to Medical Physics", Springer International Publishing AG 2017.

Reference Books	
1.	P.Uma Devi, A.Nagarathnam, BS Satish Rao, "Introduction to Radiation Biology", B.I Chur Chill Livingstone Pvt. Ltd, 2000.
2.	By B.H Brown, R.H Smallwood, D.C. Barber, P.V Lawford, D.R Hose J.P.Woodcock, "Medical Physics and Biomedical Engineering", CRC Press,1998.
3.	Hylton B.Meire and Pat Farrant, "Basic Ultrasound", John Wiley & Sons, 1995.

BoS Chairman

B.E. / B.TECH	B19BTO501 – FOOD PROCESSING AND PRESERVATION (Common to all Except BT)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To make the students acquire the basics of food processing.
2.	To able to understand the food preservation techniques.
3.	To be able to understand the significance of food processing.
4.	To familiarize with the recent methods of processing of foods
5.	To understand the principles of food preservation.

UNIT – I	FOOD PROCESSING	9

Principles, importance, food processing methods: pasteurization (definition, time–temperature combination and equipments) sterilization (definition, time–temperature combination and equipments), blanching (definition, time–temperature combination and equipments, adequacy in blanching), canning (definition, time–temperature combination and equipments), packaging (Introduction, Metal Containers, Glass Containers, Rigid Plastic Containers, Retortable Pouches).

UNIT – II	FOOD FREEZING AND DRYING	9

Freezing : Introduction, freezing point and freezing rate, freezing methods: Air freezing, plate freezing, liquid immersion freezing and cryogenic freezing, Freezer selection, Advantages and disadvantages of freezing.

Drying : Definition, free and bound moisture, concept of water activity, factors affecting drying, Drying methods and equipments: sun/solar drying, Cabinet drying, tunnel dryer, spray dryer, freeze dryer, fluidized bed dryer, Nutritional, physico–chemical changes during drying.

UNIT – III	PROCESSING OF FOOD PRODUCTS	9

Evaporation – Definition, types of evaporator (single effect, double effect and multiple effect evaporator); Freeze concentration – General principles and applications, basic elements, ice crystal nucleation, growth and crystallization, separation techniques (filtration and wash column).

BoS Chairman

UNIT – IV	MEMBRANE TECHNOLOGIES IN FOOD PROCESSING	9
General principles and advantages, dead end and cross flow, Classification of membrane system: Reverse Osmosis, Nanofiltration, Ultra Filtration, Micro Filtration, Electodialysis and Pervaporation; Membrane technology comparison chart, Membrane application in the food industries and industrial effluent treatments; Membrane performance, and Limitation of membrane processes.		

UNIT – V	FOOD PRESERVATION	9
Introduction and principles. Traditional methods of preservation; Types of food based on its perishability; Importance of food preservation, Wastage of processed foods; Shelf life of food products. Advantages of food preservation		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Understand the different methods applied in the processing of foods
CO2	Understand the significance of food processing and the role of food and beverage industries in the supply of foods
CO3	Acquire knowledge on the changes occurring in the food during processing and storage
CO4	Explain the food preservation and various food processing techniques
CO5	Understand effective food preservation techniques

Text Books	
1.	Ramaswamy H. and Marcotte M, “Food Processing: Principles and Applications”, by Taylor & Francis, 2005.
2.	Norman N Potter and Joseph H. Hotchkiss, “Food Science”, 5th Edition, CBS Publishers and Distributors, 1996.
3.	Barbosa–Canovas.,“Novel Food Processing Technologies”, Tapia & Cano CRC Press, 2004.

BoS Chairman

4.	Gould GW, “New Methods of Food Preservation”, Springer Science & Business Media. 2012.
5.	Rahman MS, “Food Preservation”, In: Handbook of Food Preservation, 2nd Edition, (pp. 14–29), CRC press, 1999.
6.	Subbulakshmi G. and A.S. Udipi, “Food Processing and Preservation”, New Age Publications, 2006.

Reference Books

1.	Manay S. and M.S. Swamy, “Foods: Facts and Principles”, 4th Ed. New Age Publishers, 2004.
2.	Deman J.M., “Principles of Food Chemistry”, 2nd Ed., Van Nostrand Reinhold, NY., 1990.

BoS Chairman

B.E. / B.TECH	B19CSO504 – FUNDAMENTALS OF DBMS (Common to all Except CSE,AI&DS,CSBS)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basic concepts of database management systems.
2.	To acquire basic knowledge about database models and its design.
3.	To reveal the role and functionalities of database in business community.
4.	To learn about the Structured Query Language (SQL)
5.	To learn the client / server relation.

UNIT – I	INTRODUCTION	9
Database Types and Systems – An Overview – Meaning, Definition – Components – Objectives – Advantages and Disadvantages – Evolution.		

UNIT – II	MODELS	9
DBMS Architecture – Associations – Relationship – Generalization – Classifications – Conceptual Data Modeling – File Organization.		

UNIT – III	DATABASE DESIGN	9
Relational Data Model – ER Diagram – Data Dictionary – Normalization – Boyce Code Normal Form – Integrity – Relational Database Languages – Database Administration.		

UNIT – IV	UNDERSTANDING SQL	9
SQL Data Definition and Data Types – SQL – Specifying Constraints – Key and Referential Integrity Constraints – Basic Retrieval Queries in SQL – Joins – Sub queries – Nested subquery.		

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UNIT – V	OPERATIONS AND MANAGEMENT	9
Client/Server and Databases – Data Warehousing – Query Processing – Heterogeneous and Homogeneous – Controls.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the basics of database management systems.
CO2	Acquire basic knowledge about database and its design with models.
CO3	Translate ER model to Relational model to perform database design effectively.
CO4	Understand the SQL for DB creation and updation.
CO5	Design client / server relation.

Text Books	
1.	Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017.

Reference Books	
1.	Abraham Silberschatz, Henry F Korth and Sudarshan S, "Database System Concepts", Sixth Edition, McGraw Hill, 2011.
2.	Martin Gruber," Understanding SQL", Sybex Inc,1990 (4th unit 50%)
3.	C.J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
4.	Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, McGraw Hill College Publications, 2015.

BoS Chairman

B.E. / B.TECH	B19ECO501 – LOGIC AND DISTRIBUTED CONTROL SYSTEMS (Common to all Except ECE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To give an introductory knowledge on Programmable Logic Controller (PLC) and their programming languages
2.	To give adequate knowledge about applications of PLC
3.	To give basic knowledge about Computer Controlled Systems
4.	To give basic knowledge on the architecture and local control unit of Distributed Control System (DCS)
5.	To give adequate information with respect to interfaces used in DCS

UNIT – I	PROGRAMMABLE LOGIC CONTROLLER	9

Evolution of PLCs – Components of PLC – Architecture of PLC – Discrete and analog I/O modules – Programming languages – Ladder diagram – Function block diagram (FBD) – Programming timers and counters.

UNIT – II	APPLICATIONS OF PLC	9

Instructions in PLC – Program control instructions, math instructions, data manipulation Instructions, sequencer and shift register instructions – Case studies in PLC.

UNIT – III	COMPUTER CONTROLLED SYSTEMS	9

Basic building blocks of computer controlled systems – Data acquisition system – Supervisory control – Direct digital control– SCADA – Hardware and software, Remote terminal units, Master Station and Communication architectures.

UNIT – IV	DISTRIBUTED CONTROL SYSTEM	9

DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities.

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UNIT – V	INTERFACES IN DCS	9
Operator interfaces – Low level and high level operator interfaces – Displays – Engineering interfaces – Low level and high level engineering interfaces – Factors to be considered in selecting DCS – Case studies in DCS.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Infer the PLC
CO2	Apply PLC in various applications
CO3	Infer the concepts of Computer Controlled Systems
CO4	Construct knowledge about various architectures of DCS
CO5	Analyze the various interfaces in DCS

Text Books	
1.	F.D. Petruzella, "Programmable Logic Controllers", Tata McGraw Hill, Third edition, 2010.
2.	Michael P. Lukas, "Distributed Control Systems: Their Evaluation and Design", Van Nostrand Reinhold Co., 1986.
3.	D. Popovic and V.P.Bhatkar, "Distributed computer control for industrial Automation" Marcel Dekker, Inc., Newyork ,1990.

Reference Books	
1.	T.A. Hughes, "Programmable Controllers", Fourth edition, ISA press, 2005.
2.	Krishna Kant, "Computer Based Industrial Control", Second edition, Prentice Hall of India, New Delhi, 2010.
3.	John W. Webb and Ronald A. Reis, "Programmable Logic Controllers", Fifth edition, Prentice Hall of India, New Delhi, 2010.
4.	John R. Hackworth and Frederick D. Hackworth Jr, "Programmable Logic Controllers", Pearson, New Delhi, 2004.
5.	Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
6.	E.A.Parr, "Programmable Controllers, An Engineer"s Guide", Elsevier, 2013.

R. Gowri

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B.E. / B.TECH	B19EEO501 – ROTATING MACHINES AND TRANSFORMERS (Common to all Except EEE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impact knowledge on magnetic–circuit analysis and introduce magnetic materials.
2.	To understand the Working principles of DC Generator.
3.	To understand the Working principles of DC Motor.
4.	To understand the Working principles of Induction and synchronous machines.
5.	To understand the Working principles of Transformer.

UNIT – I	MAGNETIC CIRCUITS AND MAGNETIC MATERIALS	9

Magnetic circuits –Laws governing magnetic circuits – Flux linkage, Inductance and energy – Statically and Dynamically induced EMF – Torque – Properties of magnetic materials, Hysteresis and Eddy Current losses – AC excitation, introduction to permanent magnets– Transformer as a magnetically coupled circuit (Qualitative Only).

UNIT – II	DC GENERATORS	9

Construction and components of DC Machine – Principle of operation – Lap and wave windings– EMF equations– circuit model – armature reaction –methods of excitation commutation – inter poles compensating winding –characteristics of DC generators (Qualitative Only).

UNIT – III	DC MOTORS	9

Principle and operations – types of DC Motors – Speed Torque Characteristics of DC Motors starting and speed control of DC motors –Plugging, dynamic and regenerative braking testing and efficiency – Permanent Magnet DC (PMDC) motors–applications of DC Motor (Qualitative Only).

UNIT – IV	INDUCTION AND SYNCHRONOUS MACHINES	9

Single phase motor – Double revolving field theory – starting methods – no load and block rotor test – equivalent circuit – types of single phase motor – 3 Phase induction motor – Construction – types – principle of operation – speed control of 3 phase motor – starting methods for 3 phase induction motor. Synchronous Machine Alternator, Construction and Basic principle – Synchronous motor – Basic principle, methods of starting, applications (Qualitative Only).

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UNIT – V	TRANSFORMERS	9
Transformers – Construction and types – Operation of single phase transformers – EMF equation – Voltage regulation – Losses and Efficiency – All day efficiency – Parallel operation Testing: Open circuit and Short circuit tests – 3 Phase transformers: (Construction & connections) – Autotransformers (Qualitative Only).		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the magnetic–circuits and materials.
CO2	Explain the construction and operation of DC Generator.
CO3	Explain the construction and operation of DC Motor.
CO4	Explain the construction and operation of induction and Synchronous machines.
CO5	Explain the construction, working principle of transformer and Autotransformer.

Text Books	
1.	Nagrath, I.J. and Kothari D.P., "Electrical Machines", Tata McGraw Hill Publishing Company Ltd., 4th Edition, 3rd Reprint, New Delhi, 2011.
2.	P.C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons; 3rd Edition 2013.

Reference Books	
1.	S.K. Bhattacharya, "Electrical Machines", McGraw Hill Education, New Delhi, 3rd Edition, 2009.
2.	B.R. Gupta, "Fundamental of Electric Machines", New age International Publishers, 3rd Edition, Reprint 2015.
3.	Vincent Del Toro, "Basic Electric Machines", Pearson India Education, 2016.
4.	Surinder Pal Bali, "Electrical Technology Machines & Measurements", Vol. II, Pearson, 2013.

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Semester – VI

B.E.	B19MET601 – DESIGN OF TRANSMISSION SYSTEM	L	P	TU	C
		2	0	1	3

(Use of Standard and approved PSG Design data book permitted)

Course Objectives	
1.	To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
2.	To understand the standard procedure available for Design of Transmission of Mechanical elements.
3.	To satisfy functional and strength requirements to learn to use standard practices and standard data.
4.	To Identify various bevel, worm &cross helical gears and analyze their terminologies.
5.	To learn to use catalogues and standard machine components.

UNIT – I	TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS	6 + 3

Selection of V belts and pulleys – selection of Flat belts and pulleys –Wire ropes and pulleys – Selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

UNIT – II	SPUR GEARS AND PARALLEL AXIS HELICAL GEARS	6 + 3

Gear Terminology – Speed ratios and number of teeth – Force analysis – Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Module and Face width – power rating calculations based on strength and wear considerations – Parallel axis Helical Gears – Pressure angle in the normal and transverse plane – Equivalent number of teeth – forces and stresses. Estimating the size of the helical gears.

UNIT – III	BEVEL, WORM AND CROSS HELICAL GEARS	6 + 3

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits – terminology. Thermal capacity, materials – forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology – helix angles – Estimating the size of the pair of cross helical gears.

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UNIT – IV	DESIGN OF GEAR BOXES	6 + 3
Geometric progression – Standard step ratio – Ray diagram, kinematics layout – Design of sliding mesh gear box – Constant mesh gear box. Design of multi speed gear box.		

UNIT – V	DESIGN OF CAM CLUTCHES AND BRAKES	6 + 3
Cam Design: Types – pressure angle and under cutting base circle determination – forces and surface stresses. Design of plate clutches – axial clutches – cone clutches – internal expanding rim clutches – internal and external shoe brakes.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Design of flexible components using basic principles and procedure.
CO2	Design of gear transmission systems with the available standard procedure.
CO3	Analyze the mechanical properties and thermal capacity of the gear transmission systems.
CO4	Assume the working principles of mechanical components employed in mechanical transmission systems.
CO5	Evaluate the basic engineering principles and procedures to design the transmission elements.

Text Books	
1.	Shigley J.E and Mischke C.R., "Mechanical Engineering Design", Sixth Edition, Tata McGraw Hill, 2020.
2.	Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2018.

Reference Books	
1.	Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw Hill, 2014.
2.	Bhandari, V.B., "Design of Machine Elements", Tata McGraw Hill Publishing Company Ltd., 2010.
3.	Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2020.
4.	Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", McGraw Hill Book Co., 2011.
5.	Ugural A,C, "Mechanical Design, An Integrated Approach", McGraw Hill, 2014.

BoS Chairman

B.E.	B19MET602 – COMPUTER AIDED DESIGN AND MANUFACTURING SYSTEMS	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand how computers are used in the areas of Design and manufacturing.
2.	To understand the different types of entities and their application in creating geometric models.
3.	To learn the different types of standards used in CAD.
4.	To understand the concepts of CNC and write part programming for Lathe and milling machines.
5.	To understand how computers are used in component design and manufacturing.

UNIT – I	INTRODUCTION	9

Introduction to Cad, Scope and applications in mechanical engineering, Need for cad system, Computer aided design process, Cad tools. Product cycle – Design process– sequential and concurrent engineering – CAD system architecture – Computer graphics – co–ordinate systems– 2D and 3D transformations, homogeneous coordinates – Line drawing – Clipping – viewing transformation – Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control – Introduction to CAD/CAM – CAD/ CAM concepts – Types of production.

UNIT – II	GEOMETRIC MODELING	9

Types of curves, Parametric representation of curves– Hermite curve– Bezier curve – B–spline curves – rational curves – surface modeling – surface modeling and entities – surface patch – Coons and bicubic patches – Bezier and B–spline surfaces. Fundamentals of Solid modeling – CSG and B–rep.

UNIT – III	CAD STANDARDS	9

Standards for computer graphics – Need for cad standards–Graphical Kernel System (GKS) – standards for exchange images Open Graphics Library (OpenGL) – Data exchange standards – IGES, STEP, DXF – communication standards, CAD/CAM Integration.

UNIT – IV	CNC AND PART PROGRAMING	9

Introduction to NC systems and CNC – Machine axis and Co–ordinate system – CNC machine tools Principle of operation CNC – Construction features including structure – Drives and CNC controllers – Introduction to Part Programming, Methods of CNC part programming, APT language – Part programming on Lathe & Milling machines using G codes and M codes, Motion commands – Cutting Cycles, Loops, Sub program and Macros – CNC Part programming using CAD/CAM.

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UNIT – V	CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS)	9
Group Technology (GT), Part Families – Parts Classification and coding – Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing–Composite part concept – FMS – Types of Flexibility– FMS Components, Types of FMS – FMS Application & Benefits – FMS Implementation – Quantitative analysis in FMS.		
Total Instructional hours : 45		

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Application of computers in the areas of design and manufacturing.
CO2	Create geometric models using various entities.
CO3	Apply cad standards in CAD/CAM environment.
CO4	Write CNC programs for lathe and milling machines.
CO5	Design, plan and manufacture components with application of computers.

Text Books	
1.	P.N Rao “CAD CAM : Principles and Applications” McGraw Hill Education, Third Edition, 2017.
2.	Mikell. P. Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education, Fourth Edition, 2016.
3.	Radhakrishnan P, Subramanyan S. and Raju V., “CAD/CAM/CIM”, New Age International Publishers, Fourth Edition, 2018.

Reference Books	
1.	Foley, Van Dam, Feiner, “Computer Graphics: Principles and Practice”’. Pearson Education India, Third Edition, 2013.
2.	A. John Rajan, S.Ramachandran “Computer Integrated Manufacturing” Air walk publications, First Edition, 2016.
3.	P.M. Agrawl, V.J. Patel “CNC Fundamentals and programming”, V.J Patel Edition, 2nd Edition, 2017.

BoS Chairman

B.E.	B19MET603 – FINITE ELEMENT ANALYSIS	L	P	TU	C
		3	0	1	3

Course Objectives	
1.	Develop governing Equations for Boundary, Initial and Eigen Value problems, Weighted Residual Methods Ritz Technique and basic concepts of the finite element method
2.	Apply the basic finite element equations for structural applications of bar, truss, beam element, heat transfer problems and longitudinal and transverse vibration frequencies.
3.	Analyze the finite element equations for two dimensional elements of triangular, quadrilateral and higher order elements.
4.	Interpret the finite element equations for axisymmetric, plate and shell elements
5.	Evaluate finite element equations for Isoparametric and serendipity elements and write a computer programs based on finite element methods.

UNIT – I	INTRODUCTION	9

Historical Background – Mathematical Modelling of field problems in Engineering – Basic concepts of the Finite Element Method – Element Equations – Finite Element Modeling – Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique.

UNIT – II	ONE – DIMENSIONAL PROBLEMS	9

One Dimensional Second Order Equations – Discretization – Element types – Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors – Assembly of Matrices – Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.

UNIT – III	TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS	9

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems – Quadrilateral elements Higher Order Elements.

UNIT – IV	TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS	9

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Plate and shell elements.

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UNIT – V	ISOPARAMETRIC FORMULATION	9
Natural co–ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.		
		Total Instructional hours : 45

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Summarize the basics of finite element formulation.
CO2	Apply finite element formulations to solve one dimensional problems.
CO3	Apply finite element formulations to solve two dimensional scalar problems.
CO4	Apply finite element method to solve two dimensional vector problems.
CO5	Apply finite element method to solve problems on isoparametric element and dynamic problems.

Text Books	
1.	Reddy J.N. “An Introduction to the Finite Element Method”, McGraw Hill, International Edition, 2020.
2.	Chandrupatla and Belegundu, “Introduction to Finite Elements In Engineering”, 4th Edition, Pearson India, 2015.

Reference Books	
1.	George R. Buchanan, ” Finite Element Analysis”, Schaum's Outline, 2020.
2.	Dr. S. S. Bhavikatti, “Finite Element Analysis”, 3rd Edition, New Age International (P) Ltd Publishers, 2015.
3.	Daryl Logan, “A First Course in the Finite Element Method”, 1st Edition, Cengage India, 2012.
4.	D.K. Maharaj, “A Textbook of Finite Element Analysis Formulation and Programming”, Wiley, 2019.
5.	M. Asghar Bhatti, “Fundamental Finite Element Analysis and Applications: With Mathematical and Mat lab Computations”, Wiley, 2012.

BoS Chairman

B.E.	B19MEP601 – HEAT AND MASS TRANSFER LABORATORY	L	P	TU	C
		0	4	0	2

Course Objectives	
1.	To provide the fundamental knowledge necessary to understand the behaviour of thermal systems.
2.	To provide a detailed experimental analysis in the field of heat transfer through solids, fluids, and vacuum.
3.	To analyse the thermal properties and performance of heat transfer, heat exchanger, vapour compression refrigerator and air conditioner
4.	To provide the concept of mass transfer operations and able to find the diffusivity and mass transfer coefficient of membrane.

List of Experiments	
1.	Determination of thermal conductivity of guarded plate
2.	Thermal conductivity measurement of pipe insulation using lagged pipe apparatus
3.	Determination of effectiveness on a metallic fin
4.	Determination of overall heat transfer coefficient of a composite wall
5.	Determination of heat transfer coefficient in a free convection on a vertical tube
6.	Determination of heat transfer coefficient in a forced convention flow through a pipe
7.	Determination of Stefan – Boltzmann constant
8.	Determination of emissivity of a black and grey surface
9.	Determination of LMDT and effectiveness in parallel flow heat exchanger
10.	Determination of LMDT and effectiveness in counter flow heat exchanger
11.	Performance test on Vapour compression refrigerator
12.	Performance test on Air – conditioner
13.	Determination of diffusivity of liquid in air
14.	Determination of mass transfer coefficient of vaporization of naphthalene balls in air
	Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Apply the fundamental knowledge in heat transfer and basic principles.
CO2	Classify the heat transfer of various materials
CO3	Illustrate the performance of heat transfer, heat exchanger, vapour compression refrigerator and air conditioner
CO4	Find the thermal conductivity, heat transfer coefficient and emissivity of materials.
CO5	Find the diffusivity and mass transfer coefficient of given medium on air.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Guarded plate apparatus	1 No.
2.	Lagged pipe apparatus	1 No.
3.	Natural convection–vertical cylinder apparatus	1 No.
4.	Forced convection inside tube apparatus	1 No.
5.	Composite wall apparatus	1 No.
6.	Thermal conductivity of insulating powder apparatus	1 No.
7.	Pin–fin apparatus	1 No.
8.	Stefan–Boltzmann apparatus	1 No.
9.	Emissivity measurement apparatus	1 No.
10.	Parallel/counter flow heat exchanger apparatus	1 No.
11.	Single/two stage reciprocating air compressor	1 No.
12.	Refrigeration test rig	1 No.
13.	Air–conditioning test rig	1 No.

BoS Chairman

B.E.	B19MEP602 – CAD / CAM LABORATORY	L	P	TU	C
		0	4	0	2

Course Objectives	
1.	Draw and reproduce a component in 2–D using sketching commands in modelling software's.
2.	Assemble mechanical engineering components, checking for interference, simulate for assembly mechanism.
3.	Generate CNC programs for the given component as per drawing by integrating through CNC (Turning and Milling) machines for machining of products.
4.	Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.
5.	Understand the features of CNC Machine Tool.

List of Experiments			
Expt. No.	**Description of the Experiments**		
PART – A			**10 HRS.**
1.	Introduction of 3D Modeling software		
2.	**Part Modeling :** Development of part drawings of various machine components and Representing the Geometrical Dimensioning and Tolerance in Different Views.		
PART – B			**30 HRS.**
3.	Creation of 3D assembly model of following machine elements using 3D Modelling software		
	a.	Flange Coupling	
	b.	Plummer Block	
	c.	Screw Jack	
	d.	Machine Vice	
	e.	Stuffing box	
	f.	Crosshead	
	g.	Non–return valves	

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PART – C				10 HRS.
4.	Introduction to Surface Modeling			
5.	**Surface Modeling: Development of Surface models by using Sketch, Project to Face, Curve Mesh, Blend Face, Combine, & Fillet Commands.**			
PART – D				**10 HRS.**
6.	Study of Turn CNC Lathe – Study of CNC Milling			
	a.	Part Programming – CNC Machining Centre		
		i.	Linear Cutting	
		ii.	Circular cutting	
		iii.	Cutter Radius Compensation	
		iv.	Canned Cycle Operations	
	b.	Part Programming – CNC Turning Centre		
		i.	Straight, Taper and Radius Turning	
		ii.	Thread Cutting	
		iii.	Rough and Finish Turning Cycle.	
		iv.	Drilling and Tapping Cycle	
Total Instructional hours : 60				

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Draw the 3–D geometric information of machine components including assemblies, and automatically generate 2–D production drawings.
CO2	Understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.
CO3	Model SIMPLE shapes including freeform curves and surfaces.
CO4	Create a computer aided manufacturing (CAM) model and generate the machining codes automatically using the CAM system.
CO5	Demonstrate manual part programming with G and M codes using CAM

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S. No.	**NAME OF THE EQUIPMENT**	**Qty.**
HARDWARE		
1.	Computer Server	1
2.	Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server	30
3.	Laser Printer	1
4.	CNC Lathe	1
5.	CNC milling machine	1
SOFTWARE		
6.	Any High end integrated modeling and manufacturing CAD / CAM software	15
7.	CAM Software for machining centre and turning centre (CNC Programming and tool path simulation for FANUC / Sinumeric and Heidenhain controller)	15
8.	Licensed operating system	Adequate

BoS Chairman

B.E.	B19MEP603 – MECHANICAL MEASUREMENTS AND METROLOGY LABORATORY	L	P	TU	C
		0	4	0	2

Course Objectives

- To familiar with measuring and gauging instruments for inspection of precision linear, angular and surface finish measurements.

List of Experiments

1.	Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge – using gauge blocks.
2.	Calibration and use of measuring instruments – depth micrometer, bore gauge, telescopic gauge.
3.	Measurement of linear dimensions using Comparators.
4.	Measurement of angles using bevel protractor and sine bar.
5.	Measurement of gear parameters – disc micrometers, gear tooth vernier caliper
6.	Non–contact (Optical) measurement using Toolmaker's microscope / Profile projector and Video measurement system.
7.	Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.
8.	Machine tool metrology – Level tests using precision level; Testing of straightness of a machine tool guide way using Autocollimator, spindle tests.
9.	Measurement of force, torque and temperature.

Total Instructional hours : 60

Course Outcomes : Students will be able to

CO1	Experiment with different measurement tools safely and correctly.
CO2	Experiment with different measurement tools safely and correctly.
CO3	Demonstrate different measurement technologies and use them to measure Industrial components.
CO4	Choose suitable measuring technique for any given component.
CO5	Make use of different measurement tools and perform measurements in quality impulsion.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Micrometer	5
2.	Vernier Caliper	5
3.	Vernier Height Gauge	2
4.	Vernier depth Gauge	2
5.	Slip Gauge Set	1
6.	Gear Tooth Vernier	1
7.	Sine Bar	1
8.	Profile Projector / Tool Makers Microscope	1
9.	Mechanical / Electrical / Pneumatic Comparator	1
10.	Autocollimator	1
11.	Temperature Measuring Setup	1
12.	Force Measuring Setup	1
13.	Torque Measuring Setup	1
14.	Surface finish Measuring Equipment	1
15.	Bore Gauge	1
16.	Telescopic Gauge	1
17.	Parallel / counter flow heat exchanger apparatus	1

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B.E.	B19CEP601 – CAREER ABILITY COURSE – III	T	P	TU	C
		0	2	0	0

Sl. No.	Topics	Hours
	FUNDAMENTALS OF APPLIED MECHANICS	
1.	**Engineering Mechanics :** Free–body diagrams and equilibrium; friction and its applications. **Mechanics of Materials :** Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts.	6
	FLUID MECHANICS	
2.	**Fluid Mechanics :** Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; control–volume analysis of mass, momentum and energy; fluid acceleration; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer	6
	FUNDAMENTALS OF THERMAL SCIENCES	
3.	**Thermodynamics :** Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics. **Heat–Transfer :** Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, thermal boundary layer, dimensionless parameters in free and forced convective heat transfer.	6
	MATERIALS AND MANUFACTURING	
4.	**Engineering Materials :** Structure and properties of engineering materials, phase diagrams, heat treatment, stress–strain diagrams for engineering materials. **Casting, Forming and Joining Processes :** Different types of castings, design of patterns, moulds and cores; fundamentals of hot and cold working processes; load estimation for bulk and sheet metal forming processes; principles of powder metallurgy.	6
	INDUSTRIAL ENGINEERING	
5.	**Metrology and Inspection :** Limits, fits and tolerances; linear and angular measurements; comparators; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly; concepts of coordinate–measuring machine (CMM). **Production Planning and Control :** Forecasting models, aggregate production planning, scheduling, materials requirement planning; lean manufacturing.	6
	Total Instructional Hours : 30	

BoS Chairman

Professional Elective – II

B.E.	B19MEE601 – COMPUTER INTEGRATED MANUFACTURING	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand and explain the important concepts in manufacturing system.
2.	To apply the concepts of GT and CAPP in manufacturing.
3.	To familiar with the use of various process control strategies for different manufacturing processes.
4.	To apply computer aided quality control in manufacturing systems.
5.	To understand and discuss the FMS concepts in manufacturing systems.

UNIT – I	INTRODUCTION	9

Objectives of a manufacturing system – identifying business opportunities and problems classification production systems – linking manufacturing strategy and systems analysis of manufacturing operations.

UNIT – II	GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING	9

Introduction – part families – parts classification and cooling – group technology machine cells – benefits of group technology. Process planning function CAPP – Computer generated time standards.

UNIT – III	COMPUTER AIDED PLANNING AND CONTROL	9

Production planning and control–cost planning and control – inventory management – Material requirements planning (MRP) – Shop floor control – Factory data collection system – Automatic identification system – barcode technology – automated data collection system.

UNIT – IV	COMPUTER AIDED QUALITY CONTROL	9

Types of production monitoring systems – structure model of manufacturing process. process control & strategies – direct digital control – supervisory computer control – computer in QC – contact inspection methods non–contact inspection method – computer – aided testing – integration of CAQC with CAD / CAM.

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UNIT – V	INTEGRATED MANUFACTURING SYSTEM	9
Definition – application – features – types of manufacturing systems – machine tools. materials handling system – computer control system – DNC systems manufacturing cell. Flexible manufacturing systems (FMS) – the FMS concept – transfer systems – head changing FMS – variable mission manufacturing system – CAD / CAM system – human labor in the manufacturing system – computer integrated manufacturing system benefits.		
Total Instructional hours : 45		

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Explain the basic concepts of CAD, CAM and computer integrated manufacturing systems.
CO2	Summarize the production planning and control and computerized process planning.
CO3	Explain the computer aided planning and control.
CO4	Explain the concepts of computer aided quality control.
CO5	Summarize the different type of integrated systems.

Text Books	
1.	Mikell. P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2015.
2.	Radhakrishnan P., Subramanyan S. and Raju V., "CAD / CAM / CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2011.

Reference Books	
1.	Groover, M.P., "Automation, Production System and CIM", Prentice Hall of India, 2015.
2.	Alan Weatherall, "Computer Integrated Manufacturing from fundamentals to implementation", Elsevier science, 2013.
3.	Hunt, V.D., "Computer Integrated Manufacturing Handbook", United States, Springer US, 2012.
4.	"Computer – Aided Design, Engineering and Manufacturing: Systems Techniques and Applications", Volume II, Computer – Integrated Manufacturing. United States, CRC Press, 2019.

BoS Chairman

B.E.	B19MEE602 – COMPOSITE MATERIALS	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand and explain the various matrices, reinforcements and their combinations in composite materials.
2.	To familiar with the Metal Matrix Composites.
3.	To understand and discuss the Ceramic Matrix Composites.
4.	To familiar with the Ceramic Matrix Composites.
5.	To provide the material selection details of composite materials for a variety of applications.

UNIT – I	FUNDAMENTALS OF COMPOSITES	9

Need for composites, Role of matrix and fiber reinforcement, Rule of mixtures, Benefits of composites, Classification of composities. Fiber types, Forms of reinforcements, Fiber–matrix compatibility, Effect of reinforcements, Commercial fibers, Fiber extraction of commercial synthetic and natural fibers.

UNIT – II	METALLIC COMPOSITES	9

Engineering metallic materials, Popular MMCs, Composition, Properties, Advantages, Limitations and Applications. Fabrication Methods, such as Powder metallurgy, Slurry casting, Spray deposition and infiltration.

UNIT – III	CERAMIC COMPOSITES	9

Engineering ceramic materials, Popular CMCs, Composition, Properties, Advantages, Limitations and Applications. Fabrication Methods, such as Sintering, Hot pressing, Cold isostatic pressing, and Hot isostatic pressing.

UNIT – IV	POLYMERIC COMPOSITES	9

Engineering polymeric materials, Popular PMCs, Composition, Properties, Advantages, Limitations and Applications. Fabrication Methods, such as Layup processes Filament winding, Liquid molding, Resin film infusion, Pultrusion, Therfoforming, Injection moulding.

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UNIT – V	MODERN COMPOSITES AND SELECTION	9
Recent trends of composite materials, such as nanocomposites, green composites, biocompatible composites, etc. Selection of composites: Factors affecting the selection of composites, measurement of properties, mechanical, electrical and thermal properties of composites, selection of composites for tailor–made applications. Case studies related to selection of composite materials for a variety of applications, such as aerospace, automobile, packaging, structures, etc.		
		Total Instructional hours : 45

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Identify the various matrices, reinforcements and their combinations in composite materials.
CO2	Select composite materials for suitable applications.
CO3	Develop suitable Metal Matrix Composites.
CO4	Identify perfect Ceramic Matrix Composites for high temperature applications.
CO5	Examine the technical information about the recent trends in the field of composites.

Text Books	
1.	Chawla, Krishan K. "Composite Materials: Science and Engineering", Germany, Springer, 2012.
2.	Chawla K.K., "Composite materials", Springer – Verlag, 2012.
3.	Jones, Robert M., "Mechanics of Composite Materials", United States, CRC Press, 2018.

Reference Books	
1.	Strong, A.B., "Fundamentals of Composite Manufacturing", SME, 2008.
2.	Balasubramanian, M, "Composite Materials and Processing", United States, CRC Press, 2013.
3.	Sharma, Sumit, "Composite Materials: Mechanics, Manufacturing and Modeling", United States, CRC Press, 2021.
4.	Barbero, Ever J. "Introduction to Composite Materials Design", Second Edition, United Kingdom, Taylor & Francis, 2011.

BoS Chairman

B.E.	B19MEE603 – COMPUTATIONAL FLUID DYNAMICS	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce governing equations of viscous fluid flows.
2.	To introduce numerical modeling and its role in the field of fluid flow and heat transfer.
3.	To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
4.	To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.
5.	To facilitate the students to recognize the required mesh generation.

UNIT – I	GOVERNING EQUATIONS AND BOUNDARY CONDITIONS	9

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time–averaged equations for Turbulent Flow – Turbulent – Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD – Elliptic, Parabolic and Hyperbolic equations.

UNIT – II	FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION	9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three – dimensional diffusion problems – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT – III	FINITE VOLUME METHOD FOR CONVECTION DIFFUSION	9

Steady one–dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power–law, QUICK Schemes.

UNIT – IV	FLOW FIELD ANALYSIS	9

Finite volume methods –Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

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UNIT – V	TURBULENCE MODELS AND MESH GENERATION	9
Turbulence models, mixing length model, Two equation (k–Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.		
		Total Instructional hours : 45

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Derive the governing equations and boundary conditions for Fluid dynamics.
CO2	Analyze Finite difference and Finite volume methods for Diffusion.
CO3	Analyze Finite volume method for Convective diffusion.
CO4	Analyze Flow field problems.
CO5	Explain and solve the Turbulence models and Mesh generation techniques.

Text Books	
1.	Ghoshdastidar, P.S., “Computer Simulation of flow and heat transfer”, Tata McGraw Hill Publishing Company Ltd., 2017.
2.	Liu, Chaoqun, et al. “Computational Fluid Dynamics: A Practical Approach”, Germany, Elsevier Science, 2012.

Reference Books	
1.	Sharma, Atul. “Introduction to Computational Fluid Dynamics: Development, Application and Analysis”, United Kingdom, Wiley, 2016.
2.	Jayanti, Sreenivas, “Computational Fluid Dynamics for Engineers and Scientists”, Netherlands, Springer Netherlands, 2018.
3.	“Experimental and Computational Fluid Mechanics”, Austria, Springer International Publishing, 2013.
4.	Muralidhar, K., and Sundararajan, T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 2014.
5.	Zikanov, Oleg. “Essential Computational Fluid Dynamics”, United Kingdom, Wiley, 2019.

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B.E.	B19MEE604 – SUPPLY CHAIN MANAGEMENT	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce concept of logistics and supply chain management.
2.	To introduce supply chain network design and techniques.
3.	To enable the students to understand the logistics in supply chain.
4.	To instigate the role of sourcing and coordination in supply chain.
5.	To introduce the concept and application of computers and information technology in the field of supply chain.

UNIT – I	INTRODUCTION	9
Role of Logistics and Supply chain Management: Scope and Importance – Evolution of Supply Chain – Decision Phases in Supply Chain – Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.		

UNIT – II	SUPPLY CHAIN NETWORK DESIGN	9
Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice – Role of network Design in Supply Chain – Framework for network Decisions.		

UNIT – III	LOGISTICS IN SUPPLY CHAIN	9
Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.		

UNIT – IV	SOURCING AND COORDINATION IN SUPPLY CHAIN	9
Role of sourcing supply chain supplier selection assessment and contracts – Design collaboration – sourcing planning and analysis – supply chain co–ordination – Bull whip effect – Effect of lack of co – ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.		

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UNIT – V	SUPPLY CHAIN AND INFORMATION TECHNOLOGY	9
The role IT in supply chain – The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E–Business in supply chain.		
		Total Instructional hours : 45

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Understand and Develop a sound understanding of the important role of supply chain management in today's business environment.
CO2	Analyze Network design in supply chain.
CO3	Learn to use and apply supply chain in logistics.
CO4	Analyze source and coordination in supply chain.
CO5	Explain and understand the application of IT in supply chain.

Text Books	
1.	Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning and Operation", Pearson Education, 2010.
2.	Weston, Frederick S., and Ross, David Frederick "Introduction to Supply Chain Management Technologies", United States, Taylor & Francis, 2010.

Reference Books	
1.	Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management", PHI, 2010
2.	Christopher, Martin. "Logistics & Supply Chain Management", United Kingdom, Pearson Education Limited, 2016.
3.	Copacino, William C, "Supply Chain Management : The Basics and Beyond", United States, Taylor & Francis, 2019.

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B.E.	B19MEE605 – AUTOMATION IN MANUFACTURING ENGINEERING	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce concept of automation using hydraulic systems.
2.	To introduce concept of automation using pneumatic systems.
3.	To apply the concept of automation in workpiece handling.
4.	To introduce the concept robotics.
5.	To enable the students to understand the modelling and simulation for plant automation.

UNIT – I	AUTOMATION USING HYDRAULIC SYSTEMS	9

Hydraulic fluid, fluid mechanics, design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. and their selection. Practical case studies on hydraulic circuit design and performance analysis. Servo valves, hydraulic servo actuators, electro hydraulic servo–valves, proportional valves and their applications, Modeling and Simulation of Electro–hydraulic Servo systems.

UNIT – II	AUTOMATION USING PNEUMATIC SYSTEMS	9

Pneumatic fundamentals – control elements, position and pressure sensing –logic circuits – switching circuits – fringe conditions modules and these integration – sequential circuits – cascade methods – mapping methods – step counter method – compound circuit design – combination circuit design. Pneumatic equipments – selection of components – design calculations –application – fault finding – hydro pneumatic circuits.

UNIT – III	AUTOMATED WORK PIECE HANDLING	9

Working principles and techniques, job orienting and feeding devices. Transfer mechanisms, automated feed cut of components, performance analysis. Types of automated handling systems including AGV and its various guiding technologies, applications.

UNIT – IV	INTRODUCTION TO ROBOT TECHNOLOGY	9

Robot classification, robot elements, Robot co–ordinate systems, Position, path and speed control systems, robot programming for foundry, presswork, and machining. Collisions free motion planning.

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UNIT – V	MODELING AND SIMULATION FOR MANUFACTURING PLANT AUTOMATION	9
Introduction / need for system Modeling, Building Mathematical Model of a manufacturing plant, Modern Tools – Use of Fuzzy decision making and Artificial Neural Networks in manufacturing automation, AI in manufacturing systems.		
		Total Instructional hours : 45

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Understand the concept of automation using hydraulic system.
CO2	Analyse automation using pneumatic system.
CO3	Learn to use and apply automation in workpiece handling.
CO4	Understand the concept of automation in robotics in automation.
CO5	Explain and understand the concept of plant automation.

Text Books	
1.	Lamb, Frank. “Industrial Automation: Hands On. United States”, McGraw Hill Education, 2013.
2.	Bolz, Roger W, “Manufacturing Automation Management : A Productivity Handbook. United States”, Springer US, 2012.
3.	Raju, Ramesh, and Duraiselvam, M. “Advances in Industrial Automation and Smart Manufacturing: Select Proceedings of ICAIASM 2019”, Germany, Springer Singapore, 2020.
4.	“Advanced Manufacturing and Automation VIII”, Germany, Springer Singapore, 2018.

Reference Books	
1.	Hitomi, Katsundo, “Manufacturing Systems Engineering : A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics”, United Kingdom, CRC Press, 2017.
2.	Mehta, B.R., and Reddy, Y. Jaganmohan. “Industrial Process Automation Systems: Design and Implementation”, Germany, Elsevier Science, 2014.
3.	Boucher, Thomas O, “Computer Automation in Manufacturing: An Introduction”, United States, Springer US, 2012.
4.	Green Manufacturing, “Mechanical and Automation Engineering”, Switzerland, Trans Tech Publications Limited, 2013.

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Professional Elective – III

B.E.	B19MEE606 – RAPID PROTOTYPING	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basic components and Need for the compression in product development, Data preparation.
2.	To understand the principles in Selective Laser Sintering, Fusion Deposition Modelling.
3.	To understand the principles in Solid Ground Curing, Laminated Object Manufacturing.
4.	To understand the basic concepts of Thermal jet printer and object Quadra systems.
5.	To understand the basic of the Rapid tooling.

UNIT – I	INTRODUCTION	9

Need for the compression in product development–history of RP systems – Survey of applications – Growth of RP industry – classification of RP systems. Stereo Lithography Systems – Principle – Process parameter – Process details – Data preparation – data files and machine details – Application.

UNIT – II	SELECTIVE LASER SINTERING	9

Type of machine – Principle of operation – process parameters – Data preparation for SLS – Applications. Fusion Deposition Modelling: Principle – Process parameter– Path generation – Applications.

UNIT – III	SOLID GROUND CURING	9

Principle of operation – Machine details – Applications. Laminated Object Manufacturing: Principle of operation – LOM materials– Process details – application.

UNIT – IV	CONCEPTS MODELLERS	9

Principle – Thermal jet printer – Sander's model market – 3D printer. Genisys Xs 3Dprinter, JP system – Object quadra systems.

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UNIT – V	RAPID TOOLING	9
Indirect Rapid tooling – Silicon rubber tooling – Aluminium filled epoxy tooling – Spray metal tooling – Cast kirksite – 3Q keltool – etc. Direct Rapid Tooling Direct. AIM.		
		Total Instructional hours : 45

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Discuss the basics and Need for the compression in product.
CO2	Calculate the data’s for Selective Laser Sintering, Fusion Deposition Modelling.
CO3	Illustrate the data’s for Solid Ground Curing, Laminated Object Manufacturing.
CO4	Develop Sander's model market–3–D printer, object Quadra systems.
CO5	Develop different tooling methods.

Text Books	
1.	Kah Fai Leong, “Rapid Prototyping: Principles And Applications”, 3rd Edition, World Scientific Publishing Co. Pvt. Ltd., 15 January 2010.
2.	Fuewen Frank Liou, “Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development”, 2nd Edition, CRC Press, February 2019.

Reference Books	
1.	Liou, “Rapid Prototyping Engineering”, Taylor & Francis, August 2017.
2.	Renard Nowak “Rapid Prototyping Technology Principles and Functional Requirements, Scitus Academics”, January 2017.
3.	Ciletti, “Modeling, Synthesis and Rapid Prototyping with The Verlog Hdl”, Pearson India, January 2010.
4.	Hoque M.E., “Advanced Applications of Rapid Prototyping Technology in Modern Engineering”, INTECH, January 2014.

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B.E.	B19MEE607 – CONCURRENT ENGINEERING	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To design and implement a product development program.
2.	To analyze and demonstrate knowledge of computer–aided tolerance analysis.
3.	To evaluate appropriate rapid manufacturing modelling techniques.
4.	To implement Analyze a framework for robust system and process design.
5.	To recall the management and engineering philosophy for improving quality and reducing costs and lead time.

UNIT – I	INTRODUCTION TO CONCURRENT ENGINEERING	9
Extensive definition of CE – CE design methodologies – Organizing for CE – CE tool box collaborative product development.		

UNIT – II	USE OF INFORMATION TECHNOLOGY	9
IT support – Solid modeling – Product data management – Collaborative product commerce – Artificial Intelligence – Expert systems – Software hardware co–design.		

UNIT – III	DESIGN STAGE	9
Life–cycle design of products – opportunity for manufacturing enterprises – modality of Concurrent Engineering Design – Automated analysis idealization control – Concurrent engineering in optimal structural design – Real time constraints.		

UNIT – IV	MANUFACTURING CONCEPTS AND ANALYSIS	9
Manufacturing competitiveness – Checking the design process – conceptual design mechanism – Qualitative physical approach – An intelligent design for manufacturing system – JIT system – low inventory – modular – Modeling and reasoning for computer based assembly planning – Design of Automated manufacturing.		

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UNIT – V	PROJECT MANAGEMENT	9
Life Cycle semi realization – design for economics – evaluation of design for manufacturing cost – concurrent mechanical design – decomposition in concurrent design – negotiation in concurrent engineering design studies – product realization taxonomy – plan for Project Management on new product development – bottleneck technology development.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Design and implement a product development program.
CO2	Analyze and demonstrate knowledge of computer–aided tolerance analysis.
CO3	Evaluate appropriate rapid manufacturing modelling techniques.
CO4	Implement Analyze a framework for robust system and process design.
CO5	Recall the management and engineering philosophy for improving quality and reducing costs and lead time.

Text Books	
1.	Biren Prasad, "Concurrent Engineering Fundamentals", Volume I, Prentice Hall, 2011.
2.	C.S. Syan , U. Menon ,"Concurrent Engineering: Concepts, Implementation and Practice" Springer, 23 October 2012.

Reference Books	
1.	Edward J. Haug , "Concurrent Engineering: Tools and Technologies for Mechanical System Design", 4th Edition, Springer, 16 December 2011.
2.	Jerzy Pokojski , Shuichi Fukuda , Józef Salwiński , "New Directions in Concurrent Engineering", Springer, 2010.
3.	Josip Stjepandić, Nel Wognum, Wim J.C. Verhagen, "Concurrent Engineering in the 21st Century", Springer, 2010.
4.	G.S. Sawhney, "Concurrent Engineering", 1st Edition, Laxmi Publications Pvt Ltd, 2017.

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B.E.	B19MEE608 – DESIGN OF THERMAL SYSTEMS	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the technical knowledge of engineering in design and operation of various thermal systems.
2.	To apply techniques, skills and modern engineering tools necessary for Thermal equipment design.
3.	To identify and formulate to solve internal combustions engine problems.
4.	To apply heat transfer laws to design heat exchanger.
5.	To understand the impact of engineering solutions in economic and environmental context.

UNIT – I	INTRODUCTION	9

Basic consideration in design, Design variable, Analysis of thermal system Manufacturing and material process system Material Selection material properties and characteristics of thermal system Selection of substantial material Environmental and safety system.

UNIT – II	MODELLING OF THERMAL SYSTEM	9

Importance of modeling, Basic features of Modelling , Types of Modelling , Analog modelling, mathematical modeling physical model and Numerical model.

UNIT – III	ANALYSIS & DESIGN OF I.C. ENGINES	9

Review of thermodynamic cycles ideal, fuel air and real cycles, Engine heat transfer and friction Analysis of compression and expansion processes. Modeling of combustion in S.I. and C.I. engines.

UNIT – IV	DESIGN OF HEAT EXCHANGERS	9

Review of heat transfer principles & convection correlation. Introduction to heat exchangers and classification Basic design methodologies, Net Transferable Units method and Logarithmic Mean Temperature Deference method Design of double pipe heat exchangers Shell & tube type heat exchangers.

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UNIT – V	ENERGY ANALYSIS OF THERMAL SYSTEMS	9
Gas turbine plant, Thermal power plant, Cogeneration plant, Captive power plant, Combined Cycle power plant, Refrigeration plant, Chemical plant Linde air liquefaction plant, Heat exchanger.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Solve design and operation of various thermal systems.
CO2	Apply techniques, skills and modern engineering tools necessary for Thermal equipment design.
CO3	Identify and formulate to solve internal combustions engine problems.
CO4	Apply heat transfer laws to design heat exchanger.
CO5	Identify the impact of engineering solutions in economic and environmental context.

Text Books	
1.	Wilbert Stoecker, “Design of Thermal Systems”, 3rd edition, McGraw Hill Education, 2011.
2.	C.Balaji, U. Menon, “Essentials of Thermal System Design and Optimization”, Ane Books Pvt. Ltd., 2011.

Reference Books	
1.	C.Balaji, “Thermal System Design and Optimization”, 2nd Edition, Springer, 29 January 2021.
2.	P.L. Dhar, “Thermal System Design and Simulation”, Academic Press, 2016.
3.	Yogesh Jaluria , “Design and Optimization of Thermal Systems”, 3rd Edition, CRC Press, 2019.
4.	Steven G. Penoncello, “Thermal Energy Systems: Design and Analysis”, 1st Edition, Taylor & Francis, 2015.

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B.E.	B19MEE609 – LEAN MANUFACTURING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To describe about introduction to Six Sigma.
2.	To discuss the importance of Set up time, TQM, 5S, VSM.
3.	To describe about introduction to lean manufacturing.
4.	To study the various tools for lean manufacturing.
5.	To describe about lean involvement and culture.

UNIT – I	INTRODUCTION TO SIX SIGMA	9
Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation.		

UNIT – II	SET UP TIME REDUCTION, TQM, 5S, VSM	9
Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation – Value stream mapping – Procedure and principles.		

UNIT – III	INTRODUCTION TO LEAN MANUFACTURING	9
Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.		

UNIT – IV	LEAN TOOLS AND METHODOLOGY	9
Primary tools – Workplace organization – Stability – Just–In–Time – Takt time – One piece flow – Pull, Cellular systems, Six Sigma. SMED: Single minute exchange of dies – theory and practice of the SMED system – TPM, Pillars of TPM, Conditions for TPM success,TPM implementation process – Overall Equipment Effectiveness – computation of OEE.		

UNIT – V	LEAN INVOLVEMENT AND CULTURE	9
Necessity of involvement – Waste of Humanity – Activities supporting involvement – Kaizen Circle Activity – Practical Kaizen Training – Key factors in Practical Kaizen Training – Lea Culture – Standardization – Standards and abnormality control – 'Five Why' analysis.		
Total Instructional hours : 45		

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Course Outcomes : Students will be able to	
CO1	Understand the fundamental principle of six sigma.
CO2	Apply techniques, skills and modern engineering tools necessary for production design.
CO3	Understand the principles of Lean Manufacturing.
CO4	Identify the various lean tools and methodologies.
CO5	Understand the implementation of lean and work culture in shop floor.

Text Books	
1.	Dennis P "Lean Production Simplified: A Plain Language Guide to the World's Most Powerful Production System", Productivity Press, New York, 2009.
2.	Liker, J and Meier, D "The Toyota Way", Field book, McGraw–Hill, 2010.
3.	N.Gopalakrishnan, "Simplifed Lean Manufacture", PHI, 2010.

Reference Books	
1.	Devadasan S R, Mohan Sivakumar V, Murugesh R and Shalij P R, "Lean and Agile"
2.	"Manufacturing : Theoretical, Practical and Research Futurities", Prentice Hall of India Learning Limited, New Delhi, 2012.
3.	Gopalakrishnan N, "Simplified Lean Manufacture: Elements, Rules, Tools and implementation", Prentice Hall of India Learning Private Limited, India, 2010.
4.	Bill Carrira, "Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Wastes and Maximizing Profits", Prentice Hall of India Learning PrivateLimited, India, 2009.
5.	Don Tapping, Tom Luster and Tom Shuker "Value Stream Management: Eight Steps to Planning, Mapping and Sustaining Lean Improvements", Productivity Press, New York,USA, 2007.

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B.E.	B19MEE610 – RENEWABLE SOURCES OF ENERGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To know the energy use and renewable energy scenario in Tamilnadu, India and around the World.
2.	To understand the method of power generation from Solar Energy.
3.	To understand the method of power generation from Wind Energy.
4.	To understand the method of power generation from Bio Energy.
5.	To know the power production fromother renewable energy sources.

UNIT – I	INTRODUCTION	9
World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamil nadu, India and around the World – Potentials – Achievements / Applications – Economics of renewable energy systems.		

UNIT – II	SOLAR ENERGY	9
Solar Radiation – Measurements of Solar Radiation – Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation – Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.		

UNIT – III	WIND ENERGY	9
Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects.		

UNIT – IV	BIO – ENERGY	9
Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration – Biomass Applications.		

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UNIT – V	OTHER RENEWABLE ENERGY SOURCES	9
Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro–Geothermal Energy – Hydrogen and Storage – Fuel Cell Systems – Hybrid Systems.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Discuss the importance and Economics of renewable Energy.
CO2	Discuss the method of power generation from Solar Energy.
CO3	Discuss the method of power generation from Wind Energy
CO4	Explain the method of power generation from Bio Energy
CO5	Explain the Tidal energy, Wave Energy, OTEC, Hydro energy, Geothermal Energy, Fuel Cells and Hybrid Systems.

Text Books	
1.	Rai. G.D., “Non – Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
2.	Twidell, J.W. & Weir, A., “Renewable Energy Sources”, EFN Spon Ltd., UK, 2006.

Reference Books	
1.	Chetan Singh Solanki, Solar Photovoltaics, “Fundamentals, Technologies and Applications”, PHI Learning Private Limited, New Delhi, 2015.
2.	David M. Mousdale, “Introduction to Biofuels”, CRC Press, Taylor & Francis Group, USA 2017.
3.	Freris. L.L., “Wind Energy Conversion Systems”, Prentice Hall, UK, 1990.
4.	Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.
5.	Johnson Gary, L., “Wind Energy Systems”, Prentice Hall, New York, 1985.

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Open Elective – II

B.E. / B.TECH	B19AEO601 – AIRCRAFT ELECTRICAL AND ELECTRONIC SYSTEMS (Common to all Except AERO)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To know the working principles of aircraft engine and fuel systems.
2.	To understand the lighting technologies and pressurization system of the aircraft cabin.
3.	To realize the warning and protection systems of the aircraft.
4.	To expose on terrain warning systems of the safety of the aircraft.
5.	To gain knowledge on FDR and anti–fire protection system.

UNIT – I	AERO ENGINE AND FUEL MANAGEMENT SYSTEMS	9

Introduction to Starting and Ignition Systems – Primary, secondary and Electronic Indicating Systems. Fuel Management system – Fuel quantity measurement and indication – Fuel feed and distribution – Fuel transfer – Refueling and defueling – Fuel jettison – Fuel Tank Venting and Inerting.

UNIT – II	LIGHTS AND CABIN SYSTEMS	9

Overview of Lighting technologies – Flight compartment lights – Passenger cabin lights – Exterior lights. Cabin systems – Passenger address system – Galley equipment – In–flight entertainment – Satellite communications – Air conditioning – Pressurization – Airstairs.

UNIT – III	WARNING AND PROTECTION SYSTEMS	9

Stall warning and protection – Airframe ice and rain protection – Windscreen ice and rain protection – Anti–skid – Configuration warning – Aural warnings.

UNIT – IV	TERRAIN AWARENESS WARNING SYSTEM	9

System overview – System warnings and protection – External references – Ground proximity modes – Forward – looking terrain avoidance – Rotorcraft TAWS – Architecture and configurations.

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UNIT – V	FLIGHT DATA RECORDER AND FIRE PROTECTION SYSTEM	9
Introduction to FDR – Equipment Requirement – FDR Specifications – Cockpit Voice Recorders – Health and usage monitoring system. Fire Protection – Engine fire Detection – Cargo Bay Area– Fire Extinguishing systems.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the Basics of Ignition and Fuel System of an Aircraft. (K2)
CO2	Illustrate the Flight Compartment Lighting Technologies and Cabin Air Conditioning system. (K2)
CO3	Identify the Warning and Protection Systems for the Ice Formation and Rain in the Airframe of the Aircraft During Flight. (K3)
CO4	Apply the Terrain Warning Systems to avoid the Terrain Collision of an Aircraft. (K3)
CO5	Examine the FDR and Fire Protection System to Monitor the Flying Performance of the Aircraft. (K4)

Text Books	
1.	“Aircraft Electrical and Electronic Systems”, Principles, operation and maintenance by Mike Tooley and David Wyatt.

Reference Books	
1.	Pallet.E.H.J., “Aircraft Instruments and Integrated Systems”, Pearsons, Indian edition 2011.
2.	Spitzer, C.R., “Digital Avionics Systems”, Prentice Hall, Englewood Cliffs, N.J., U.S.A. 1993.
3.	Spitzer. C.R., “The Avionics Hand Book”, CRC Press, 2000.

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B.E. / B.TECH	B19AGO601– INTEGRATED WATER RESOURCES MANAGEMENT (Common to all Except AGRI)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the key elements of IWRM.
2.	To know about the water economics and policies related to IWRM.
3.	To understand the water supply with reference to human health.
4.	To learn the concept of water security for agriculture practices.
5.	To know the water regulation acts and international water scenarios.

UNIT – I	CONTEXT FOR IWRM	9
Water as a global issue: key challenges and needs – Definition of IWRM within the broader context of development – Complexity of the IWRM process – Examining the key elements of IWRM process.		

UNIT – II	WATER ECONOMICS	9
Economic view of water issues: economic characteristics of water good and services – Non–market monetary valuation methods – Water economic instruments, policy options for water conservation and sustainable use – Private sector involvement in water resources management – PPP experiences through case studies.		

UNIT – III	WATER SUPPLY AND HEALTH WITHIN THE IWRM CONSIDERATION	9
Links between water and human health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Health impact assessment of water resources development.		

UNIT – IV	AGRICULTURE IN THE CONCEPT OF IWRM	9
Water for food production: blue‟ versus "green‟ water debate – Conjunctive use of surface and groundwater – Virtual water trade for achieving global water security –– Irrigation efficiencies, irrigation methods and current water pricing.		

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UNIT – V	WATER LEGAL AND REGULATORY SETTINGS	9
Basic notion of law and governance: principles of international and national law in the area of water management. Understanding UN law on non–navigable uses of international water courses – Development of IWRM in line with legal and regulatory framework.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the concepts of IWRM.
CO2	Build an economic conservation of water under PPP and IWRM.
CO3	Identify the linkages between human health and water
CO4	Summarize the water use effectiveness in agriculture.
CO5	Make use of knowledge on regulatory acts and policies of water

Reference Books	
1.	Technical Advisory Committee, “Integrated Water Resources Management”, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
2.	Technical Advisory Committee, “Poverty Reduction and IWRM”, Technical Advisory Committee Background paper no: 8. Global water partnership, Stockholm, Sweden, 2003.
3.	Technical Advisory Committee, “Regulation and Private Participation in Water and Sanitation section”, Technical Advisory Committee Background paper No:1. Global water partnership, Stockholm, Sweden, 1998.
4.	Technical Advisory Committee, “Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management”, Technical Advisory Committee Background paper No: 3. Global water partnership, Stockholm, Sweden. 1999.

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5.	Technical Advisory Committee, “Water as social and economic good: How to put the principles to practice”. Technical Advisory Committee Background paper No: 2. Global water partnership, Stockholm, Sweden, 1998.
6.	Technical Advisory Committee, “Effective Water Governance”.Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003.
7.	Cech Thomas V., “Principles of water resources: history, development, management and policy”, John Wiley and Sons Inc., New York. 2003.
8.	Mollinga .P. etal, “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.
9.	Iyer R. Ramaswamy, “Towards Water Wisdom: Limits, Justice, Harmony”, Sage Publications, New Delhi, 2007.
10.	https://nptel.ac.in/courses/105/105/105105110/

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B.E. / B.TECH	B19BMO601 – INTRODUCTION TO BIOMEDICAL ENGINEERING (Common to all Except BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of biomedical engineering technology
2.	To learn the working principles of diagnostic devices
3.	To study the principles of therapeutic devices
4.	To know the concepts of medical imaging techniques present in biomedical field.
5.	To learn various prevention and safety tools

UNIT – I	INTRODUCTION TO BIOMEDICAL ENGINEERING	9
Introduction – History of medical devices – Characteristics of human anatomy and physiology that relate to medical devices – Electrical signals and conductivity – Physiological monitoring systems.		

UNIT – II	DIAGNOSTIC DEVICES AND MEASUREMENTS	9
ECG Machine – Blood pressure measurements – Temperature measurements – Pulse oximeters – Biochemical analysers – Blood flow detectors – Respiration monitor.		

UNIT – III	THERAPEUTIC DEVICES AND MEASUREMENTS	9
Introduction – Defibrillators– Pacemakers – Ventilators – Heart lung machine – CPAP/BPAP – Humidifiers.		

UNIT – IV	DIAGNOSTIC IMAGING	9
Basic Principles of X–ray– CT –MRI – PET – SPECT		

UNIT – V	PREVENTION AND PATIENT SAFETY TOOLS	9
Electrical Safety – testing methods – other safety considerations – Troubleshooting techniques – general test equipment – Specialized biomedical test equipment – tools.		
		Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Outline the basics of biomedical Engineering
CO2	Discuss about the diagnostic devices and measurements
CO3	Summarize about the therapeutic devices and measurements
CO4	Explain about diagnostic imaging
CO5	Describe about prevention and patient safety tools

Reference Books	
1.	Laurence J. Street, "Introduction to Biomedical Engineering Technology", 3rd Edition, CRC Press, 2017.
2.	John Enderle, "Introduction to Biomedical Engineering", 3rd Edition, Academic Press, 2011.
3.	Germin Nisha. M, John Robert Prince. M, Sivagama Sundari Meenakshi Sundaram, "Bio–Medical Instrumentation: Medical Applications", Lambert Academic Publishing, 2020
4.	Shakti Chatterjee, Aubert Miller, "Biomedical Instrumentation Systems", Thomson Press (India) Ltd, 2012

BoS Chairman

B.E. / B.TECH	B19BTO601 – BASIC BIOINFORMATICS (Common to all Except BT)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the units of various physical parameters, conversion factors.
2.	To understand about the various material balances and difference between steam and heat and their balances.
3.	To explain about the application of energy balance in bioprocesses.
4.	To explain about the fluid flow in packed columns and their flow patterns.
5.	To understand about the process of agitation and various agitator vessels.

UNIT – I	BIOLOGICAL DATABASES	9

Biological databases – types of databases – DNA database: GenBank, EMBL – DNA database: ESTs, STS, HTGS– NCBI, Pubmed, Entrez, BLAST, OMIM – Protein databases: SWISSPORT, PIR – DNA and protein sequences: ExPASy, Locus link, Unigene, Entrez, EBI, IMGT.

UNIT – II	SEQUENCE ALIGNMENT	9

Multiple sequence alignment – models of sequence alighment– databases of sequence alignments: SMART, Pfam – Conserved domains in biomolecules – databases of conserved domains: PRINTS, BLOCKS – integrated multiple sequence alighment – ClustalW, ClustalX, Interpro, MetaFam, PopSet resources of sequence mining.

UNIT – III	DATABASE SEARCH	9

Sequence homology – similarity, identity and sequence gaps – Pairwise alignment, detection, significance and limitations: Needleman Wunsch, Smith Waterman Algorithm – BLAST: List, scan, extent, E value and P value, alignment, search strategies – principles of BLAST search – types of BLAST.

UNIT – IV	STRUCTURE PREDICTION TOOLS	9

Analysis of 3D protein structure data – protein data bank (PDB) – SCOB – CATH – Dali Domain directory – FSSP – Protein structure modeling – comparative modeling – Abinitio prediction – Threading – Protein folding.

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UNIT – V	EVOLUTION ANALYSIS	9
Phylogenetic analysis and molecular evolution – nomenclature of phylogenetic trees – interpretation of phylogenetic data – phenotypic and gene trees – molecular visualization – tools of visualization: Swiss PDB viewer, RasMol, QMol – applications of phylogeny and molecular visualization.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Recall the basics of about Bioinformatics tools
CO2	Outline the numerous algorithms for sequence alignments
CO3	Explain about a brief knowledge on similarity analysis
CO4	Illustrate about the structural genomics of ancestry
CO5	Make use of brief understanding of evolution study

Text Books	
1.	David W M, "Bioinformatics: Sequence and Genome Analysis", CBS publishers, New York, 2004.

Reference Books	
1.	Attwood TK and DJP Smith, "Introduction to Bioinformatics", Addison Wesley Longman Limited, 1999.
2.	Mount DW, "Bioinformatics Sequence and Genome Analysis", Cold Spring Harbour Laboratory Press, 2001.
3.	Pevsner J, "Bioinformatics and Functional Genomics", John Wiley, 2003.
4.	Rastogi SC, Mendiratta N, Rastogi P, "Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery", 3rd Edition, Prentice Hall Inc. 2005.

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B.E. / B.TECH	B19CSO601 – E–COMMERCE TECHNOLOGY AND MANAGEMENT (Common to all Except CSE, AI&DS, CSBS)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn the E–Commerce Platform and its concepts.
2.	To understand the Technology, infrastructure and Business in E–Commerce.
3.	To understand the Security and Challenges in E–Commerce.
4.	To build an own E–Commerce using Open Source Frameworks.
5.	To apply the security and learn the payment systems.

UNIT – I	INTRODUCTION	9

Infrastructure : Working of Web – Web Browsers – Traditional commerce and E commerce – Internet and WWW – role of WWW – value chains – strategic business and Industry value chains – role of E commerce.

UNIT – II	BUILDING E–COMMERCE SITES AND APPS	9

Systematic approach to build an E–Commerce – Planning – System Analysis – System Design – Building the system – Testing the system – Implementation and Maintenance, Optimize Web Performance – Choosing hardware and software – Other E–Commerce Site tools – Developing a Mobile Website and Mobile App.

UNIT – III	E–COMMERCE SECURITY AND PAYMENT SYSTEMS	9

E–Commerce Security Environment – Security threats in E–Commerce – Technology Solutions: Encryption – Securing Channels of Communication – Protecting Networks – Protecting Servers and Clients – Management Policies – Business Procedure and Public Laws – Payment Systems.

UNIT – IV	BUSINESS CONCEPTS IN E–COMMERCE	9

Digital Commerce Marketing and Advertising strategies and tools – Internet Marketing Technologies – Social Marketing – Mobile Marketing – Location based Marketing – Ethical– Social – Political Issues in E–Commerce

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UNIT – V	TOOLS FOR E–COM	9
Web server – performance evaluation – web server software feature sets – web server software and tools – web protocol – search engines – intelligent agents – EC software – web hosting – cost analysis – Mini Project: Develop E–Commerce project in any one of Platforms like Woo–Commerce, Magento or Opencart.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Build Website using HTML CSS and JS.
CO2	Develop Responsive Sites.
CO3	Infer Manage, Maintain and Support Web Applications.
CO4	Choose the marketing and advertising strategies and tools for marketing.
CO5	Identify the security technique and learn the payment systems.

Text Books	
1.	Kenneth C.Laudon, Carol Guercio Traver “E–Commerce”, Pearson, 10th Edition, 2016.
2.	Harvey M. Deitel, Paul J.Deitel, Kate Steinbuhler, “e–business and e–commerce for managers”, Pearson, 2011.

Reference Books	
1.	Robbert Ravensbergen, “Building E–Commerce Solutions with Woo Commerce”, PACKT, 2nd Edition
2.	Parag Kulkarni, Sunita Jahirabad kao, “Pradeep Chande, e–business”, Oxford University Press, 2012.
3.	Kala kota et al, “Frontiers of Electronic Commerce”, Addison Wesley, 2004.
4.	Micheal Papaloelon and Peter Robert, “E–business”, Wiley India, 2006.
5.	Efraim Turban, Jae K.Lee, avid King, Ting Peng Liang, Deborrah Turban, “Electronic Commerce – A managerial perspective”, Pearson Education Asia, 2010.

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B.E. / B.TECH	B19ECO601 – GEOGRAPHIC INFORMATION SYSTEM	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the fundamentals and components of Geographic Information System.
2.	To provide details of spatial data models.
3.	To understand the input topology.
4.	To study the data analysis tools.
5.	To introduce the marketing and business applications.

UNIT – I	FUNDAMENTALS OF GIS	9

Introduction to GIS – Basic spatial concepts – Coordinate Systems – GIS and Information Systems – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software – Types of data – Spatial, Attribute data– types of attributes – scales / levels of measurements.

UNIT – II	SPATIAL DATA MODELS	9

Database Structures – Relational, Object Oriented – ER diagram – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster vs Vector Models – TIN and GRID data models – OGC standards – Data Quality.

UNIT – III	DATA INPUT AND TOPOLOGY	9

Scanner – Raster Data Input – Raster Data File Formats – Vector Data Input – Digitiser – Topology – Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS – Concept GPS based mapping.

UNIT – IV	DATA ANALYSIS	9

Vector Data Analysis tools – Data Analysis tools – Network Analysis – Digital Education models – 3D data collection and utilisation.

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UNIT – V	APPLICATIONS	9
GIS Applicant – Natural Resource Management – Engineering – Navigation – Vehicle tracking and fleet management – Marketing and Business applications – Case studies.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the basic idea about the fundamentals of GIS
CO2	Summarize the types of data models
CO3	Analyse about data input and topology
CO4	Analyse about tools and models used for data analysis
CO5	Interpret the data management functions and data output

Text Books	
1.	Kang – Tsung Chang, “Introduction to Geographic Information Systems”, McGraw Hill Publishing, 2nd Edition, 2011.
2.	Ian Heywood, Sarah Cornelius, Steve Carver, SrinivasaRaju, “An Introduction Geographical Information Systems”, Pearson Education, 2nd Edition, 2007.

Reference Books	
1.	Lo.C.P, Albert K.W. Yeung, “Concepts and Techniques of Geographic Information Systems”, Prentice – Hall India Publishers, 2006.

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B.E. / B.TECH	B19EEO601 – FUNDAMENTALS OF POWER ELECTRONICS (Common to all Except EEE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To get an overview of different types of power semiconductor devices and their switching.
2.	To understand the operation, characteristics and performance parameters of controlled rectifiers.
3.	To study the operation, switching techniques and basics topologies of DC–DC switching regulators.
4.	To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
5.	To understand the operation of AC Voltage controller and Cyclo converter with various Configurations.

UNIT – I	POWER SWITCHING DEVICES	9
Study of switching devices – Diode, SCR, DIAC,TRIAC, GTO, BJT, MOSFET, IGBT – Static and Dynamic characteristics – Gate triggering circuit and commutation circuit for SCR – Introduction to Driver and snubber circuits – Heat sink calculation.		

UNIT – II	AC TO DC CONVERTERS	9
Introduction – Single Phase and Three Phase controlled Rectifiers – Effect of source inductance – performance parameters – Firing Schemes for converter – Dual converters, Applications – Solar PV Systems, Light Dimmer.		

UNIT – III	DC TO DC CONVERTER	9
Step–down and step–up chopper – control strategy – Introduction to types of choppers – A, B, C, D and E – Switched mode regulators – Buck, Boost, Buck – Boost regulator, Introduction to Resonant Converters, Applications – Battery operated vehicles.		

UNIT – IV	DC TO AC CONVERTERS	9
Single phase half bridge inverter and Full bridge inverter – Three phase voltage source inverters (both 120° mode and 180° mode) – Voltage & harmonic control – PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM – Introduction to Space Vector. Pulse Width Modulation – Current Source Inverter – Multilevel Inverter – Applications–Induction heating, UPS.		

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UNIT – V	AC TO AC CONVERTERS	9
Single phase and three phase AC voltage Controllers – Control strategy – Power Factor Control – Multistage sequence control – Single Phase and Three Phase Cyclo Converters – Introduction to Matrix converters, Applications: welding.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline the operation, characteristic and turn on methods of different types of Power semiconductor devices.
CO2	Explain the operation of phase controlled Converters and its performance parameters.
CO3	Classify different types of DC–DC converter and switching regulators and explain its operation with control techniques.
CO4	Choose the different modulation techniques for pulse width modulated inverters and to infer the harmonic reduction methods.
CO5	Explain the operation of AC voltage controller and Cyclo converter with various configurations.

Text Books	
1.	M.H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Pearson Education, Fourth Edition, New Delhi, 2014.
2.	P.S.Bimbra “Power Electronics” Khanna Publishers, Fifth Edition, 2012.
3.	M.D. Singh and K.B. Khanchandani, “Power Electronics”, Mc Graw Hill India, 2013.

Reference Books	
1.	Joseph Vithayathil, “Power Electronics, Principles and Applications”, McGraw Hill Series, 6th Reprint, 2013.
2.	L. Umanand, “Power Electronics Essentials and Applications”, Wiley, 2010.
3.	Ned Mohan Tore. M. Undel and, William. P. Robbins, “Power Electronics: Converters, Applications and Design”, John Wiley and sons, Third Edition, 2003.
4.	S.Rama Reddy, “Fundamentals of Power Electronics“, Narosa Publications, 2014.
5.	J.P. Agarwal, “Power Electronic Systems: Theory and Design”, 1e, Pearson Education, 2002.

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Semester – VII

B.E.	B19MGT701 – TOTAL QUALITY MANAGEMENT	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM Framework, Barriers and Benefits of TQM.
2.	To Explain the TQM Principles for application.
3.	To define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
4.	To describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM and 5S.
5.	To Illustrate and apply ISO 9000 and ISO14000 in any organization.

UNIT – I	INTRODUCTION TO TQM	9

Definition of quality – dimensions of quality. Quality planning – quality costs. Total Quality Management: historical review and principles – leadership – quality council – quality statements – strategic planning – Deming philosophy. Barriers to TQM implementation.

UNIT – II	QUALITY PRINCIPLES	9

Customer focus – Customer orientation, Customer satisfaction, Customer – complaints, Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT – III	TOOLS AND TECHNIQUES	9

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Bench marking process – FMEA – Stages, Types.

UNIT – IV	ADVANCED TECHNIQUES	9

Quality Circles – Cost of Quality – Quality Function Deployment (QFD) – Taguchi quality loss function – 5S – TPM – Concepts, improvement needs – Performance measures.

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UNIT – V	QUALITY MANAGEMENT SYSTEM	9
Need for quality systems – ISO 9000:2000 – Elements of quality systems (such as ISO 9000:2000). Implementation of quality system – documentation – quality auditing – QS 9000–ISO 14000.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Ability to apply TQM concepts in a selected enterprise.
CO2	Ability to apply TQM principles in a selected enterprise.
CO3	Ability to understand Six Sigma and apply Traditional tools, new tools, Benchmarking and FMEA.
CO4	Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM and 5S.
CO5	Ability to apply ISO 9000 and ISO14000 in any organization.

Text Books	
1.	Dale H. Besterfiled, Carol B. Michna,Glen H. Besterfield, Mary B. Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2.	Janakiraman. B and Gopal. R.K., “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2016.
3.	V.S Bagad, “Total Quality Management”, Technical Publications, First Edition, Jan 2018.

Reference Books	
1.	James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 8th Edition, First Indian Edition, Cengage Learning, 2012.
2.	Suganthi.L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2016.
3.	S. Rajaram, “Total Quality Management”, Dreamtech Press, First Edition, Jan 2018.

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B.E.	B19MET701 – INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals and principles of robotic system and its industrial applications.
2.	To demonstrate the distinct drive systems and end effectors to control the robot actuation.
3.	To study the role and application of various types of robotic sensors and vision system.
4.	To apply the concepts of robot kinematics, cell design and safety.
5.	To outline the AI, expert systems and basic grades of robotic programs.

UNIT – I	FUNDAMENTALS OF ROBOTS AND APPLICATIONS	9

Robot – definition – robot anatomy – coordinate systems, work envelope, types and classification – specifications – pitch, yaw, roll, joint notations, speed of motion, pay load– robot parts and their functions – implementation of robots in industries; industrial application of robots – application of robots in processing, assembly, inspection, material handling in automobile, medical, nuclear industries, RGV, AGV.

UNIT – II	ROBOT DRIVE SYSTEMS AND END EFFECTORS	9

Design of drive systems – hydraulic, pneumatic, mechanical, electrical, servo motors, stepper motors – salient features, application; Linear and rotary actuators and control valves – electrohydraulic servo valves. End effectors – types; grippers– mechanical, pneumatic, hydraulic, magnetic, vacuum – limitations.

UNIT – III	ROBOT SENSORS	9

Transducers and sensors – principles, types and applications of proximity (inductive, hall effect, capacitive, ultrasonic and optical); speed, position (resolvers, optical encoders); – force – torque – touch sensors (binary, analog sensor). Robotic vision system – image representation – image grabbing – image processing and analysis – edge enhancement – contrast stretching – band rationing – image segmentation – pattern recognition – training of vision system.

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UNIT – IV	ROBOT KINEMATICS, CELL DESIGN AND SAFETY	9
Forward kinematics and Reverse kinematics of manipulators; two, three degrees of freedom – Introduction to manipulator dynamics, trajectory generator, manipulator mechanism, degeneracy and dexterity. Robot work cell design and control – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Safety in Robotics – Safety considerations for robot operations.		

UNIT – V	ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	9
Methods of Robot Programming – Characteristics of task level languages lead through programming methods. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques – Application of AI and KBES in Robots.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the basic concepts of industrial robots, elements, classification, specifications, and implementation of robots in various industrial applications.
CO2	Illustrate the different types of robot drive systems as well as robot end effectors.
CO3	Apply the different sensors and image processing techniques according to applications.
CO4	Demonstrate the kinematics motions of robot and outline the cell design and robot safety.
CO5	Develop the basic level of robotic programs and make use of the AI and expert systems.

Text Books	
1.	K.S.Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 2017.
2.	Groover M.P., “Industrial Robotics – Technology Programming and Applications”, McGraw Hill, 2012.
3.	Saha S.K., “Introduction to Robotics”, Tata McGraw Hill Education Pvt. Ltd, 2nd Ed., 2014.

Reference Books	
1.	Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, Global Edition, 3rd Edition, 2014.
2.	Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.

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B.E.	B19MEP701– MECHATRONICS LABORATORY	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	To understand the concept of mechatronics through various basic integrated systems such as electronics, electrical, mechanical and control systems.
2.	To study the design, modelling and analysis of basic electrical, hydraulic and pneumatic systems.
3.	To apply the method of programming in 8085 microprocessor and 8051 microcontroller.
4.	To practice the interfacing program of various mechatronics systems.
5.	To execute the various programming on Firebird V mobile robot.

List of Experiments	
1.	Assembly language programming of 8085 – Addition – Subtraction – Multiplication –Division – Sorting – Code Conversion.
2.	Stepper motor interface.
3.	Traffic light interface.
4.	Speed control of DC motor.
5.	Study of various types of transducers.
6.	Study of hydraulic, pneumatic and electro–pneumatic circuits.
7.	Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software
8.	An Experimental Study on Mobile Robots.
	Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Apply the basics of mechatronics.
CO2	Take part in design a pneumatic system/hydraulic system for any innovative ideas.
CO3	Examine circuit for hydraulic and Pneumatic system without prototyping.
CO4	Determine an interface program for mechanical systems.
CO5	Perceive use of mobile robot and executing the program.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Basic Pneumatic Trainer Kit with manual and electrical controls / PLC Control each	1
2.	Basic Hydraulic Trainer Kit	1
3.	Hydraulics and Pneumatics Systems Simulation Software	1
4.	8051 – Microcontroller kit with stepper motor and drive circuit sets	1
5.	Firebird V 260	5

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B.E.	B19MEP702 – SIMULATION AND ANALYSIS LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To understand the stress analysis of various beams by giving suitable loads and constraints.
2.	To study the 2–D structural and non–structural model and perform structural analysis.
3.	To apply the thermal stresses in a component to determine conduction and convection.
4.	To practice the structures based on the vibration and perform harmonic analysis upon them.
5.	To execute the mechanical systems using simulation software.

List of Experiments	
A. SIMULATION	
1.	MATLAB basics, Dealing with matrices, Graphing–Functions of one variable and two variables.
2.	Use of Matlab to solve simple problems in vibration.
3.	Mechanism Simulation using Multibody Dynamic software.
B. ANALYSIS	
1.	Force and Stress analysis using link elements in Trusses, cables etc.
2.	Stress and deflection analysis in beams with different support conditions.
3.	Stress analysis of flat plates and simple shells.
4.	Stress analysis of axi – symmetric components.
5.	Thermal stress and heat transfer analysis of plates.
6.	Thermal stress analysis of cylindrical shells.
7.	Vibration analysis of spring–mass systems.
8.	Model analysis of Beams.
9.	Harmonic, transient and spectrum analysis of simple systems.
	Total Instructional hours : 45

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Apply the stress analysis of various beams by giving suitable loads and constraints.
CO2	Take part in the 2–D structural and non–structural model and perform structural analysis.
CO3	Examine the thermal stresses in a component to determine conduction and convection.
CO4	Determine the structures based on the vibration and perform harmonic analysis upon them.
CO5	Perceive the mechanical systems using simulation software.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Computer Work Station	15
2.	Color Desk Jet Printer	1
3.	Multibody Dynamic Software Suitable for Mechanism simulation and analysis	15 licenses
4.	C / MATLAB	5 licenses

BoS Chairman

B.E.	B19MEP703 – PROJECT WORK – PHASE I	L	P	TU	C
		0	6	0	2

Course Objectives
The students are required to freeze the area of their project work and conduct the literature surveys during Phase – I of the project, under the guidance of any faculty in the department. The students are expected to work on a topic in the field of Mechanical Engineering. They will be evaluated based on the presentations made by them and a report submitted at the end of the semester by a committee of examiners appointed by the Chairman of the Department.

Course Outcome
Upon completion of this course, the students will be able to take up any challenging practical problems and find solution by formulating proper methodology.
Total Instructional hours : 45

BoS Chairman

Professional Elective – IV

B.E.	B19MEE701 – ADVANCED CASTING AND WELDING	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand about melting processing and design techniques.
2.	To analyze about gating and riser.
3.	To analyze various casting defects and its remedies.
4.	To summarize welding processes.
5.	To apply the concepts of thermal modeling and simulation.

UNIT – I	MELT PROCESSING AND DESIGN TECHNIQUES	9

Melt processing techniques for ferrous and non–ferrous alloys such as stainless steels, nickel, titanium alloys. Vacuum melting equipment and practice. Elementary aspects of pattern and mould design using CAD softwares. Resin bonded mould and core making processes and machines. Special casting processes and their applications – low pressure die casting, investment casting, squeeze casting, thixo–forming. Illustrations of automotive and aerospace applications.

UNIT – II	GATING AND RISER DESIGN	9

Gating and riser design – principles of fluid flow, governing equations, heat transfer applied to casting solidification, governing equations, boundary conditions for different casting methods, concept of directional solidification, gating and risers, application of simulation methods. Use of casting software in solving practical problems.

UNIT – III	CASTING DEFECTS AND REMEDIES	9

Casting defects and remedies. Inspection methods – visual, penetrant, magnetic, metallurgical, X – ray and Gamma ray radiography and Mechanization and Automation.

UNIT – IV	ADVANCED WELDING PROCESSES	9

Overview of welding processes and their classification, types of joints, edge preparation, weld symbols, weld nomenclature, bead geometry, power density, heat sources – Gaussian distribution of heat flux, welding techniques – linear and orbital. Arc characteristics. Voltage – current characteristics. Types of welding manipulators and their applications.

Advanced welding processes : submerged arc, TIG, MIG, electro–slag, ultrasonic, electron beam and laser beam welding. Case studies and applications – industrial, automotive and aerospace.

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UNIT – V	THERMAL MODELING AND SIMULATION	9
Thermal modeling and simulation of welding processes – governing heat transfer equations and boundary conditions for various types of welding processes. Estimation of cooling rates. Prediction of mechanical properties, micro/macrostructures of weldments and heat– affected zone. Prediction of weld defects such a crack, segregation, lack of fusion. Modeling and simulation of pulsed arc processes. Use of softwares for simulation. Solidification behaviour of fusion weld: structural zones, epitaxial growth, weld pool shape and columnar grain structures. Weldability of metals – steels, stainless steels, aluminium, copper, nickel and titanium alloys.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the melting processing and design techniques.
CO2	Analyze about gating and riser.
CO3	Analyze various casting defects and its remedies.
CO4	Summarize welding processes.
CO5	Apply the concepts of thermal modeling and simulation.

Text Books	
1.	Jain P. L., “Principles of Foundry Technology”, Tata McGraw Hill, New Delhi, 2011, 3rd Edition.
2.	Khanna O. P., “A Text Book on Welding Technology”, Dhanpat Rai and Sons, New Delhi, 2015, First Edition.

Reference Books	
1.	Heine R.W., Loper C.R. and Rosenthal P.C., “Principles of Metal Castings”, Tata McGraw Hill, New Delhi, 2017, 3rd Edition.
2.	Little R.L., “Welding and Welding Technology”, Tata McGraw Hill, Publishing Company Limited, New Delhi, 2017.
3.	Kou S., “Welding Metallurgy”, John Wiley Publications, New York, 2020, 3rd Edition.

BoS Chairman

B.E.	B19MEE702 – DESIGN OF JIGS AND FIXTURES	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn basic concepts, functions and design principles of Jigs, Fixtures and Dies.
2.	To know the importance of work piece location & clamping.
3.	To summarize various manufacturing processes of various types of solar cells.
4.	To analyze solar module manufacturing process.
5.	To apply the concepts of advanced cell technology and usage of different materials.

UNIT – I	LOCATING AND CLAMPING PRINCIPLES	9

Objectives of tool design– Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation.

UNIT – II	JIGS	9

Design and development of jigs and fixtures for given component– Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs.

UNIT – III	FIXTURES	9

General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems– Quick change fixtures.

UNIT – IV	PRESS WORKING TERMINOLOGIES	9

Press Working Terminologies – operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure.

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UNIT – V	ELEMENTS OF CUTTING DIES	9
Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies. **(Use of Approved Design Data Book is permitted).**		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Develop the tool design parameters.
CO2	Design against standard and parameters.
CO3	Develop prototype / simulation.
CO4	Interpret of output and confirming to specifications.
CO5	Organize with manufacturing line.

Text Books	
1.	Donaldson, Lecain and Goold “Tool Design”, IIIrd Edition Tata McGraw Hill, 2012.
2.	Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.

Reference Books	
1.	K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2019
2.	Kempster, “Jigs and Fixture Design”, Hoddes and Stoughton, 2018

BoS Chairman

B.E.	B19MEE703 – DESIGN OF HEAT EXCHANGERS	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the technical knowledge of engineering in fundamentals of heat exchanger.
2.	To apply techniques, skills to analyze the flow and stress factors.
3.	To design the heat exchanger based on the information provided for a particular application and do the cost economic analysis.
4.	To apply heat transfer laws to design heat exchanger.
5.	To analyze the sizing and rating of the heat exchangers for various applications.

UNIT – I	FUNDAMENTALS OF HEAT EXCHANGER	9
Temperature distribution and its implications types – shell and tube heat exchangers – regenerators and recuperators – analysis of heat exchangers – LMTD and effectiveness method.		

UNIT – II	FLOW AND STRESS ANALYSIS	9
Effect of turbulence – friction factor – pressure loss – stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses – types of failures.		

UNIT – III	DESIGN ASPECTS	9
Heat transfer and pressure loss – flow configuration – effect of baffles – effect of deviations from ideality – design of double pipe – finned tube – shell and tube heat exchangers – simulation of heat exchangers.		

UNIT – IV	COMPACT AND PLATE HEAT EXCHANGERS	9
Types – merits and demerits – design of compact heat exchangers, plate heat exchangers – performance influencing parameters – limitations.		

BoS Chairman

UNIT – V	CONDENSERS AND COOLING TOWERS	9
Design of surface and evaporative condensers – cooling tower – performance characteristics .		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the technical knowledge of engineering in fundamentals of heat exchanger.
CO2	Apply techniques, skills to analyze the flow and stress factors.
CO3	Design the heat exchanger based on the information provided for a particular application and does the cost economic analysis.
CO4	Apply heat transfer laws to design heat exchanger.
CO5	Analyze the sizing and rating of the heat exchangers for various applications.

Text Books	
1.	Arthur P. Faraas, "Heat Exchanger Design", 2nd edition, Wiley India Pvt Ltd, 2011.
2.	Sadik Kakac, "Heat Exchangers: Selection, Rating and Thermal design", CRC Press, 3rd edition 2012

Reference Books	
1.	C. Ranganayakulu, "Compact Heat exchangers: Analysis Design and Optimization using FEM and CFD approach", Wiley – ASME Press Series; 1st edition, 9 March 2018.
2.	Vikrant Chandramohan Aute, "Single and Multiresponse Adaptive Design of Experiments with Application to Design Optimization of Novel Heat Exchangers", Proquest, Umi Dissertation Publishing, 2011.
3.	Marco Fossa, "Design of heat exchangers for heat pump applications", MDPI, AG, 2020.

BoS Chairman

B.E.	B19MEE704 – QUALITY CONTROL AND RELIABILITY ENGINEERING	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the concept of SQC and understand the process control charts.
2.	To understand the control charts from attributes.
3.	Introduce the principles and techniques sampling procedure and their application.
4.	To learn the concept of reliability.
5.	Illustrate the basic concepts and techniques of modern reliability engineering tools and Design of experiments.

UNIT – I	INTRODUCTION AND PROCESS CONTROL FOR VARIABLES	9

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost–Variation in process causes of variation – Theory of control chart – uses of control chart – Control chart for variables – X chart, R chart and σ–chart – process capability – process capability studies and simple problems. Six sigma concepts.

UNIT – II	PROCESS CONTROL FOR ATTRIBUTES	9

Control chart for attributes – control chart for non conformings – p chart and np chart – control chart for nonconformities – C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT – III	ACCEPTANCE SAMPLING	9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producers Risk and consumers Risk. AQL, LTPD, AOQL concepts–standard sampling plans for AQL and LTPD – uses of standard sampling plans.

UNIT – IV	QUALITY FUNCTION DEPLOYMENT AND RELIABILITY	9

Quality function deployment – House of quality, QFD matrix, and total quality management concepts. Quality information systems, quality circles, introduction to ISO 9000 standards. Reliability – Evaluation of design by tests – Hazard Models, Linear, Raleigh, Weibull. Failure Data Analysis, reliability prediction based on weibull distribution, Reliability improvement.

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UNIT – V	COMPLEX SYSTEM, MAINTAINABILITY AND DESIGN OF EXPERIMENTS (DOE)	9
Reliability, reliability of series, parallel, standby systems, reliability prediction and system effectiveness. Maintainability– Availability, economics of reliability engineering, replacement of items, maintenance costing and budgeting, reliability testing. Design of Experiments (DOE): Introduction to Engineering experiments, Measurement of physical parameters, selection of instruments, static and dynamic characteristics of response, Planning of experiments.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Attain the basic techniques of quality improvement, fundamental knowledge of statistics and probability.
CO2	Use control charts to analyze for improving the process quality.
CO3	Describe different sampling plans.
CO4	Acquire basic knowledge of total quality management.
CO5	Understand the concepts of reliability and maintainability.

Text Books	
1.	Montgomery, D.C., “Introduction to Statistical Quality Control”, John Wiley, 2020.
2.	Ebeling, C., “An Introduction to Reliability and Maintainability Engineering”, Tata McGraw Hill Publishing Company Ltd., 2017.

Reference Books	
1.	Charles Ebeling, “An Introduction to Reliability and Maintainability Engineering”, Associated East West, McGraw Hill Education, 2017.
2.	Lewis E.E., “Introduction to reliability Engineering”, John Wiley & Sons, 2012.
3.	Daniel T. Daley, “Design for Reliability : Developing Assets That Meet the Needs of Owners”, Industrial Press Inc., U.S. – 2011.

BoS Chairman

B.E.	B19MEE705 – INDUSTRY 4.0	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamental concepts of Industry 4.0.
2.	To Elaborate the IoT and machine learning for Industry 4.0.
3.	To study the recent developments in robotics.
4.	To outline the role of augmented reality in the age of Industry 4.0.
5.	To apply the concepts of cyber security in the Industry 4.0.

UNIT – I	INTRODUCTION TO INDUSTRY 4.0	9
Understanding Industry 4.0, A Conceptual Framework for Industry 4.0, Main Concepts and Components of Industry 4.0, Supportive Technologies, Proposed Framework for Industry 4.0, Lean Production Systems for Industry 4.0, and Automation Based Lean Production Applications, Maturity and Readiness Model for Industry 4.0 Strategy.		

UNIT – II	INTRODUCTION TO IOT AND MACHINE LEARNING	9
Internet of Things (IoT) & Industrial Internet of Things (IIoT) , Internet of Services , Smart Manufacturing, Smart Devices and Products, Analytics, Data Analytics in Manufacturing,Power Consumption in Manufacturing, An Introduction to Machine Learning, Types of Machine Learning, and Applications of ML in Mechanical Engineering, Designing a Learning System, Performance Measures for ML Model.		

UNIT – III	ADVANCES IN ROBOTICS IN THE ERA OF INDUSTRY 4.0	9
Introduction, Recent Technological Components of Robots, Advanced Sensor Technologies, Artificial Intelligence, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber–Physical Robotics. Industrial Robotic Applications, Manufacturing, Maintenance, Assembly.		

UNIT – IV	THE ROLE OF AUGMENTED REALITY IN THE AGE OF INDUSTRY 4.0	9
Introduction, AR Hardware and Software Technology, Industrial Applications of AR, Additive Manufacturing (AM) Technologies, Advances in Virtual Factory Research and Applications. Digital Traceability Technologies, Architectural Framework, Project Management in Digital Traceability.		

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UNIT – V	CYBER SECURITY IN THE INDUSTRY 4.0 ERA	9
Introduction, Security Threats and Vulnerabilities of IoT, Industrial, Evolution of Cyber Attacks, Cases (Cyber – Attacks and Solutions), Strategic Principles of Cyber Security, Cyber Security Measures. Business issues in Industry 4.0, Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the drivers and enablers of Industry 4.0.
CO2	Build the smartness in Smart Factories, Smart cities, smart products and smart services along with machine learning.
CO3	Develop the outline of various Robotic systems used in a manufacturing plant and their role in an Industry 4.0 world.
CO4	Acquire the power of Augmented Reality in a networked economy.
CO5	Build the opportunities, challenges brought about by Industry 4.0 and Strategic Principles of Cyber Security.

Text Books	
1.	"Industry 4.0: The Industrial Internet of Things", Alasdair Gilchrist, 2016.
2.	"Quick Start Guide to Industry 4.0", One stop Reference Guide, 2018.
3.	Tom M. Mitchell, "Machine Learning", McGraw Hill Education (India) Private Limited, 2013.

Reference Books	
1.	"Analyzing the Impacts of Industry 4.0 in Modern Business Brunet – Thornton", Richard, Martinez, Felipe, 2018.
2.	"The Concept Industry 4.0", Prof. Alberto J. Alvares, 2019.
3.	"Designing the Internet of Things" (Nov 2015) by Adrian McEwen & Hakim Cassimally 2018.

BoS Chairman

Professional Elective – V

B.E.	B19MEE706 – NON–TRADITIONAL MACHINING	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	Acquire a functional understanding of non–traditional manufacturing equipment.
2.	Understand the terminology used in non–traditional manufacturing industries.
3.	To provide knowledge on the classification of non–traditional machining process.
4.	Know about various process parameters and their influence on performance and their applications.
5.	Impart knowledge on various energy involved in non–traditional machining process.

UNIT – I	UNCONVENTIONAL MACHINING PROCESSES	9

Introduction – Need – Classification – Energies employed in the processes – Brief overview of Abrasive Jet Machining (AJM), Water Jet Machining (WJM), Ultrasonic Machining (USM), Electric Discharge Machining (EBM), Electro–Chemical Machining (ECM), Electron Beam Machining (EBM), Laser Beam Machining (LBM), Plasma Arc Machining (PAM).

UNIT – II	MECHANICAL ENERGY BASED PROCESSES	9

Abrasive Jet Machining, Water Jet Machining and Ultrasonic Machining – Working Principles, Equipment, Process parameters, Material removal rate, Applications.

UNIT – III	ELECTRICAL ENERGY BASED PROCESSES	9

Electric Discharge Machining – Working Principles, Equipment, Process Parameters, Material removal rate, Electrode / Tool, Power Circuits, Tool Wear, Dielectric, Flushing, Wire cut EDM – Applications.

UNIT – IV	CHEMICAL AND ELECTRO–CHEMICAL ENERGY BASED PROCESSES	9

Chemical machining – Etchants, Maskants – techniques. Electro–chemical machining – Working principle, Equipment, Process Parameters, Material removal rate, Electrical circuit. Electro–chemical grinding – Electro–chemical honing – Applications.

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UNIT – V	THERMAL ENERGY BASED PROCESSES	9
Laser Beam machining, Plasma Arc Machining – Principles, Equipment. Electron Beam Machining – Principles, Equipment, Types, Beam control techniques, Material removal rate – Applications.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Summarize the need of Non–Traditional Machining Processes and able to Classify various processes
CO2	Identify the role of mechanical energy in non–traditional machining processes.
CO3	Interpret the knowledge on machining electrically conductive material through electrical energy in non–traditional machining processes.
CO4	Rephrase the concept of machining the hard material using chemical energy and electrochemical energy.
CO5	Choose with various thermal energy based nontraditional machining processes.

Text Books	
1.	P.K. Mishra, “Non–Conventional Machining”, Narosa Publishing House, New Delhi, 2007.
2.	P.C. Pandey and H.S. Shan, “Modern Machining Processes”, Tata McGraw Hill, Publishing Company Pvt Ltd., New Delhi, 2008.
3.	Joao Paulo Davim, “Nontraditional Machining Processes: Research Advances”, Springer, New York, 2013.

Reference Books	
1.	Paul De Garmo, J.T. Black, and Ronald.A. Kohser, “Material and Processes in Manufacturing”, Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
2.	Vijaya Kumar Jain, “Advanced Machining Processes”, Allied Publishers Pvt. Ltd., New Delhi, 2005.
3.	Hassan El–Hofy, “Advanced Machining Processes : Nontraditional and Hybrid Machining Processes”, McGraw–Hill Professional, New Delhi, 2005

BoS Chairman

B.E.	B19MEE707 – DESIGN FOR MANUFACTURING AND ASSEMBLY	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To know the concept of design for manufacturing, assembly and environment.
2.	To know the computer application in design for manufacturing and assembly.
3.	To know the environment friendly manufacturing methods.
4.	To improve knowledge on redesigning of castings.
5.	To understand the recycling and minimizing material usage methods.

UNIT – I	INTRODUCTION	9

General design principles for manufacturability – strength and mechanical factors, mechanisms selection, evaluation method, Process capability – Feature tolerances Geometric tolerances Assembly limits –Datum features – Tolerance stacks.

UNIT – II	FACTORS INFLUENCING FORM DESIGN	9

Working principle, Material, Manufacture, Design– Possible solutions – Materials choice – Influence of materials on form design – form design of welded members, forgings and castings.

UNIT – III	COMPONENT DESIGN – MACHINING CONSIDERATION	9

Design features to facilitate machining – drills – milling cutters – keyways – Doweling procedures, counter sunk screws – Reduction of machined area– simplification by separation – simplification by amalgamation – Design for machinability – Design for economy – Design for clampability – Design for accessibility – Design for assembly.

UNIT – IV	COMPONENT DESIGN	9

Redesign of castings based on parting line considerations – Minimizing core requirements, machined holes, redesign of cast members to obviate cores.

BoS Chairman

UNIT – V	CASTING CONSIDERATION	9
Identification of uneconomical design – Modifying the design – group technology – Computer Applications for DFMA. Design to minimize material usage – Design to regulations and standards.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Select of material, manufacturing process and mechanism for a product.
CO2	Design a component by considering the form design and machining.
CO3	Design a component by considering machining process.
CO4	Design a component based on casting considerations.
CO5	Design an eco–friendly product.

Text Books	
1.	Bralla, "Design for Manufacture handbook", McGraw hill, 2016.
2.	Boothroyd, G, Heartz and Nike, "Product Design for Manufacture", Marcel Dekker, 2014.

Reference Books	
1.	Dickson, John. R, and Corroda Poly, "Engineering Design and Design for Manufacture and Structural Approach", Field Stone Publisher, USA, 2013.
2.	Fixel, J. "Design for the Environment", McGraw Hill., 2011.
3.	Boothroyd. G, "Design for Assembly Automation and Product Design", New York, Marcel Dekker, 2011.

BoS Chairman

B.E.	B19MEE708 – VIBRATION AND NOISE CONTROL	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To apply the fundamental concepts of vibration.
2.	To apply the fundamentals of noise.
3.	To describe the various sources of noise for automotive applications.
4.	To describe the different types of noise and its control measures.
5.	To describe the various sources and control of Noise.

UNIT – I	BASICS OF VIBRATION	9

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT – II	BASICS OF NOISE	9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT – III	AUTOMOTIVE NOISE SOURCES	9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT – IV	CONTROL TECHNIQUES	9

Vibration isolation, tuned absorbers, un–tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

BoS Chairman

UNIT – V	SOURCE OF NOISE AND CONTROL	9
Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Summarize the Basics of Vibration
CO2	Summarize the Basics of Noise
CO3	Explain the Sources of Automotive Noise
CO4	Discuss the Control techniques for vibration
CO5	Describe the sources and control of Noise

Text Books	
1.	Singiresu S. Rao, “Mechanical Vibrations”, 6th Edition, Pearson Education, 2016.
2.	Kewal Pujara “Vibrations and Noise for Engineers”, Dhanpat Rai & Sons, 1992.

Reference Books	
1.	Balakumar Balachandran and Edward B. Magrab, “Fundamentals of Vibrations”, 1st Editon, Cengage Learning, 2009
2.	Benson H. Tongue, “Principles of Vibrations”, 2nd Edition, Oxford University, 2007
3.	Bernard Challen and Rodica Baranescu, “Diesel Engine Reference Book”, Second Edition, SAE International, 1999.
4.	David Bies and Colin Hansen, “Engineering Noise Control – Theory and Practice”, 4th Edition, E and FN Spon, Taylore & Francise e–Library, 2009
5.	Grover. G.T., “Mechanical Vibrations”, Nem Chand and Bros., 2009

BoS Chairman

B.E.	B19MEE709 – PRODUCTION PLANNING AND CONTROL	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the various components and functions of production planning and control.
2.	To understand the various components and functions of work study.
3.	To understand the various components and functions of product planning and process is planning.
4.	To understand the various components and functions of production scheduling.
5.	To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT – I	INTRODUCTION	9

Objectives and benefits of planning and control–Functions of production control – Types of production – job – batch and continuous – Product development and design – Marketing aspect – Functional aspects – Operational aspect – Durability and dependability aspect aesthetic aspect. Profit consideration – Standardization, Simplification & specialization – Break even analysis – Economics of a new design.

UNIT – II	WORK STUDY	9

Method study, basic procedure–Selection–Recording of process – Critical analysis, Development – Implementation – Micro motion and memo motion study – work measurement – Techniques of work measurement – Time study – Production study – Work sampling – Synthesis from standard data – Predetermined motion time standards.

UNIT – III	PRODUCT PLANNING AND PROCESS PLANNING	9

Product planning – Extending the original product information – Value analysis – Problems in lack of product planning – Process planning and routing – Pre requisite information needed for process planning – Steps in process planning – Quantity determination in batch production – Machine capacity, balancing – Analysis of process capabilities in a multi–product system.

UNIT – IV	PRODUCTION SCHEDULING	9

Production Control Systems – Loading and scheduling – Master Scheduling – Scheduling rules – Gantt charts – Perpetual loading – Basic scheduling problems – Line of balance – Flow production scheduling – Batch production scheduling – Product sequencing – Production Control systems – Periodic batch control – Material requirement planning kanban – Dispatching – Progress reporting and expediting – Manufacturing lead time – Techniques for aligning completion times and due dates.

BoS Chairman

UNIT – V	INVENTORY CONTROL AND RECENT TRENDS IN PPC	9
Inventory control – Purpose of holding stock – Effect of demand on inventories – Ordering procedures. Two bin system – Ordering cycle system – Determination of Economic order quantity and economic lot size – ABC analysis – Recorder procedure – Introduction to computer integrated production planning systems – elements of JUST IN TIME SYSTEMS – Fundamentals of MRP II and ERP.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Understand about the various components and functions of production planning and control.
CO2	Analyze about various the various components and functions of such work study.
CO3	Summarize various components and functions of product planning and process planning.
CO4	Analyze the various components and functions of production scheduling.
CO5	Apply the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

Text Books	
1.	M. Mahajan, “Production Planning and Control”, Dhanpat Rai & Co., 2018.
2.	Martand Telsang, “Industrial Engineering and Production Management”, First edition, S. Chand and Company, 2000.

Reference Books	
1.	Chary. S.N., “Theory and Problems in Production & Operations Management”, Tata McGraw Hill, 1995.
2.	Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production / Operations Management”, 8^{th} Edition John Wiley and Sons, 2000.
3.	Jain. K.C. & Aggarwal. L.N., “Production Planning Control and Industrial Management”, Khanna Publishers, 1990.
4.	Kanishka Bedi, “Production and Operations management”, 2^{nd} Edition, Oxford university press, 2007.

BoS Chairman

B.E.	B19MEE710 – SOLAR ENERGY CONVERSION SYSTEMS AND DESIGN	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand about power generation from PV panels. To get an exposure to different cell technologies.
2.	To analyze about advanced cell technologies and usage of different materials.
3.	To summarize various manufacturing processes of various types of solar cells.
4.	To analyze solar module manufacturing process.
5.	To apply the concepts of advanced cell technology and usage of different materials.

UNIT – I	BASICS OF SOLAR CELL	9

Intrinsic, extrinsic and compound semiconductor; Energy levels; Electrical conductivity; Determination of Fermi energy level; Probability of occupation of allowed states; Dynamics of energy density of allowed states; Density of electrons and holes. Carrier transport: Drift, diffusion, continuity equations; Absorption of light; Recombination process; Basic equations of semiconductor devices physics.

UNIT – II	SOLAR CELL PHYSICS	9

PN junction: homo and hetro junctions, Metal semiconductor interface; Dark and illumination characteristics; Figure of merits of solar cell; Variation of efficiency with band–gap and temperature; Spectral response of solar cell, parasitic resistance effect, Working and Efficiency limits: Thermodynamic limit and detailed balance limit of solar cell.

UNIT – III	SILICON	9

Physical and chemical properties relevant to photovoltaic. Preparation of metallurgical; Refining, Casting and crushing. Preparation of semiconductor grade silicon (Polysilicon); Siemens process, Union Carbide Process. Solar grade Silicon; Crystallization, Simplification and Polysilicon method. Growth of single crystal Silicon: Czokralski (CZ) and Float Zone (FZ) method, Multicrystalline Silicon; Ingot fabrication, Doping, Crystal defect, Impurities. Wafering; Multiwire and microscopic process, Saw damage, Description and manufacturing technology.

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UNIT – IV	SOLAR PV CELL AND MODULES	9

Cell structure, Front and back surface, optical properties of solar cell, Different losses and mitigation, Anti–reflective coating; properties and materials, Surface passivation with back surface, Passivation with Hydrogen, Optical confinement. The layers of PV modules, Cell matrix, Lamination and curing, Encapsulation and framing, Testing, Electrical and thermal properties, Module mismatching, Shading and hot–spot formation, Environmental effect on PV module performance.

UNIT – V	MULTI – JUNCTION SOLAR CELL	9

Photo conversion efficiency, Theoretical limits, spectral splitting, Cell configuration; Four–terminal, three terminal voltage–matched interconnections, two terminal series–connected. Current and voltage characteristics, efficiency and band gap. Deposition of GaAs, GaInP, Ge cells. Amorphous Silicon–based solar cell; fabrication techniques and material properties. StaeblerWronski effect. Module manufacturing; Using different substrate, safety and cost.Dye–sensitized solar cells; Introduction, fabrication and development.

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand about power generation from PV panels.
CO2	Analyze about advanced cell technologies and usage of different materials
CO3	Summarize various manufacturing processes of various types of solar cells
CO4	Analyze solar module manufacturing process.
CO5	Apply the concepts of advanced cell technology and usage of different materials.

Text Books	
1.	Jeffrey R.S. Brownson, "Solar Energy Conversion Systems", Academic Press; Illustrated edition (12 December 2013)
2.	Antony Falk, "Photovoltaic for Professionals: Solar Electric Systems Marketing, Design and Installation", Routledge; 1st edition (1 February 2016)

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Reference Books	
1.	R. Rajasekar, “Materials for solar energy conversion: Materials, Methods and Applications”, Wiley Scrivener; 1st edition ,6 February 2012.
2.	Andrés G. Muñoz , “Photo electrochemical Solar conversion systems: Molecular and Electronic aspects”, CRC Press; 1st edition ,12 November 2012.
3.	Ion Visa, “Solar energy conversion systems in the built environment”, Springer; 1st ed. 2020 edition, 23 January 2021.
4.	Kanishka Bedi, “Production and Operations management”, 2nd Edition, Oxford university press, 2007.

BoS Chairman

Open Elective – III

B.E. / B.TECH	B19AEO701 – UNMANNED AIRCRAFT SYSTEMS OPERATION & MRO (Common to all Except AERO)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To apprehend the concepts of UAV and its types.
2.	To gain knowledge regarding the control and communications.
3.	To observe the aerodynamics performance and navigation operation.
4.	To know about the drone alignment maintenance.
5.	To recognize the safety take–off and landing and to manage failure factors.

UNIT – I	DRONE RULES & BASIC PRINCIPLES OF FLIGHT	9

International Rules – Regulations, Standards & Practices, Dos and Do not – Civil Aviation Requirements – AIPs, NOTAM, Classification & Categorization of drones – Type Certification of Drones – Registration – Sale & De–Registration of Drones – Operations of Drones – Dos and Don‟ts – Remote Pilot Licensing – Drone Insurance Fundamentals of flight – Aerodynamics – Take–off, flight, and landing – Maneuvers turns and circuit pattern.

UNIT – II	ATC PROCEDURES & RADIO TELEPHONY (NON FRTOL) WEATHER AND METEOROLOGY	9

Understanding ATC operations – Airspace structure and Airspace – Restrictions with knowledge of no drone zones – RT Phraseology & Communicating with ATC including Position and Altitude Reporting – Flight Planning Procedures including Altimeter setting procedures – Collision avoidance – Radio Telephony (RT) techniques – The standard atmosphere, Measuring air pressure, Heat and temperature, Wind – Moisture, cloud formation, icing and its effects – Effect of atmosphere on RPAS operation & hazardous weather avoidance – Met Terminal Aviation Routine Weather Report (METAR).

UNIT – III	FIXED – WING & ROTORCRAFT OPERATIONS AND AERODYNAMICS	9

Types of fixed wing drones, make, parts, terminology, Operation and maneuvers of fixed wing drones, Flight Performance. Intro to Mission Planning, Instrument Flying & Navigation (GCS) – Applications of fixed–wing UAVs. Pros and Cons of Fixed Wing Drones Rotorcraft– Basic drone terminology & parts, Types of drones, material used and size of drones, Drone Anatomy: Different parts of drones, Avionics & C2 Link, Intro to Mission Planning, Instrument Flying & Navigation (GCS). Applications and operations of Multirotor, Flight Performance. Pros and Cons of Rotorcraft Drones.

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UNIT – IV	HYBRID OPERATIONS, AERODYNAMICS & EQUIPMENT MAINTENANCE	9

Principles of Aerodynamics – Types of Hybrid Drones & Parts – Intro to Mission Planning – Instrument Flying & Navigation (GCS) – Applications of Hybrid UAVs – Comparison with Rotorcraft & Aero plane Drone Equipment Maintenance – Maintenance of drone – flight control box – ground station – Maintenance of ground equipment – batteries and payloads – Scheduled servicing, Repair of equipment, Fault finding and rectification.

UNIT – V	SAFTY MANAGEMENT, PAYLOAD, & DATA & ANALYSIS	9

Drothe Emergency & Handling – Loss of C2–link – Fly–aways (Straying) – Loss of power, Other Emergencies, Control surface failures, Human Performance & Pilot Incapacitation – Fail – Safe Features – Types of payloads – What to carry , what not to carry – Parts of payloads – Installation – Features of payloads – Utilization, Principles of Observation, Elements of Image & Video Interpretation – Introduction to Photogrammetry – Types of Image & Video Data – Analysis.

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Summarize the basic operations and principles of flight (K2)
CO2	Explain about the various avionics hardware operation and ATC procedure (K2)
CO3	Apply the aerodynamic principle on the airframe configuration (K3)
CO4	Examine the operations of the hybrid drones and maintenance of equipment (K4)
CO5	Determine the payload distribution and safety management procedure of the UAV (K5)

Text Books	
1.	Reg Austin “Unmanned aircraft systems UAV design, development and deployment”, Wiley, 2010
2.	Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc,1998.
3.	Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007

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Reference Books	
1.	P.J.Swatton, “Ground studies for pilots, Flight Planning - II”, Sixth edition, 2002.
2.	Ian Heywood., “An Introduction to GIS”, Pearson Education, New Delhi, 2001.
3.	Patel A.N & Surendra Singh, “Remote sensing principles & applications”, Scientific Publishers, Jodhpur 1992.
4.	Lillesand, T.M., and Kiefer, R.W., “Remote Sensing and Image Interpretation, John Wiley and Sons”, New York, 2000.
5.	Unmanned Aerial Vehicle (UAV) application for societal applications (https://www.cbinsights.com/research/drone–impact–society–uav/).

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B.E. / B.TECH	B19AGO701– PRODUCTION TECHNOLOGY FOR AGRICULTURAL MACHINERY (Common to all Except AGRI)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basic concepts of engineering materials
2.	To know the principles of machining and welding concepts
3.	To remember the farm mechanization and sowing implements
4.	To learn about the plant protection equipment
5.	To create knowledge on harvesting machinery

UNIT – I	ENGINEERING MATERIALS	9

Engineering materials – classification – Mechanical properties of materials, strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, toughness, hardness, resilience, machinability, formability, weldability. Steels and cast irons: Carbon steels, their classification – low, mild, medium & high carbon steel, their properties & applications. Wrought iron, cast iron. Alloy steels: Stainless steel, tool steel.

UNIT – II	MACHINING AND WELDING	9

Basic principles of lathe – machine and operations – Basic description of machines and operations of Shaper – Planner, Drilling, Milling & Grinding – classification of welding processes. Gas welding, types of flames and their applications. Electric Arc welding. Resistance welding, Soldering & Brazing processes and their uses.

UNIT – III	TILLAGE AND SOWING IMPLEMENTS	9

Mould board plough – attachments – mould board shapes and types. Disc plough – force representation on disc – Types of disc ploughs – Subsoiler plough – Rotary plough – Chisel plough – Cultivators – types – construction. Disc harrows – Bund former – Rotavator – ridger – leveller. Basin lister – Wetland preparation implements – Crop Planting – methods – row crop planting systems – Devices for meeting seeds – furrow openers – furrow closers – types – Types of seed drills and planters – Seed cum fertilizer drills – paddy transplanters.

UNIT – IV	WEEDING AND PLANT PROTECTION EQUIPMENT	9

Weeding equipment – hand hoe – long handled weeding tools – dryland star weeder – wetland conoweeder and rotary weeder – Engine operated and tractor weeders Sprayers – types – classification – methods of atomization, spray application rate, droplet size determination – volume median diameter, numerical median diameter – drift control.

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UNIT – V	HARVESTING AND THRESHING MACHINERY	9
Principles of cutting crop, types of harvesting machinery, vertical conveyor reaper and binder, combine harvesters, balers, threshers, combine losses.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand concepts of engineering materials and steel properties
CO2	Outline the different machining and welding process
CO3	Understand the different tillage and sowing implements
CO4	Illustrate the concepts of plant protection equipments.
CO5	Summarize the knowledge on harvesting mechanism

Text Books	
1.	"Manufacturing Engineering and Technology", Kalpakjian and Schmid, Pearson, 2010.
2.	Hajra Choudry, "Elements of workshop technology – Vol II", Media promoters, 2002.
3.	Jagdishwar Sahay. "Elements of Agricultural Engineering", Standard Publishers Distributors, Delhi-6, 2010.
4.	Michael and Ohja, "Principles of Agricultural Engineering", Jain brothers, New Delhi., 2005.

Reference Books	
1.	Gupta. K.N., and Kaushik, J.P., 1998, "Workshop Technology", Vol I and II, New Heights, Daryaganj, New Delhi.
2.	Arthur. D., et. al. 1998, "General Engineering Workshop Practice", Asia Publishing House, Bombay.
3.	Chapman W.A.J., "Workshop Technology", 1992, Part I, II, III, E.L.B.S. and Edward Amold Publishers Ltd, London.
4.	Kepner, R.A., et al. "Principles of Farm Machinery", CBS Publishers and Distributers, Delhi. 99, 1997.
5.	Harris Pearson Smith et al., "Farm machinery and equipment", Tata McGraw Hill pub., New Delhi.,1996.
6.	Srivastava, A.C., "Elements of Farm Machinery", Oxford and IBH Pub. Co., New Delhi, 1990.
7.	https://nptel.ac.in/courses/126/105/126105009/

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B.E. / B.TECH	B19BMO701 – TELEMEDICINE (Common to all Except BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To gain the knowledge on the basic principles for telemedicine.
2.	To understand the legal aspects of telemedicine.
3.	To learn the key principles for telemedicine standards.
4.	To study the concepts for secure transmission of data.
5.	To know health education, mobile telemedicine and it applications.

UNIT – I	INTRODUCTION TO TELEMEDICINE	9

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Telehealth, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine.

UNIT – II	ETHICAL, SECURITY AND LEGAL ASPECTS OF TELEMEDICINE	9

Confidentiality, patient rights and consent : confidentiality and the law, the patient – doctor relationship, access to medical records, consent treatment – data protection & security, jurisdictional issues, intellectual property rights, Security in Telemedicine systems – Access control, Fire wall, Encryption, Authentication, Digital certificate, Digital Timestamp.

UNIT – III	TELEMEDICINE STANDARDS	9

Principles of Multimedia – Text, Audio, Video, data, PSTN, POTS, ANT, ISDN, Internet, Wireless Communication – GSM satellite and Micro wave, Modulation techniques, Types of Antenna, Satellite communication, Mobile hand–held devices and mobile communication. Internet technology and telemedicine using worldwide, Video and audio conferencing.

UNIT – IV	DATA ACQUISTION AND STORAGE SYSTEM	9

Acquisition System – Camera, Scanners, Display Systems – Analogue Devices, LCD, Laser Displays, Holographic Representation, Virtual Screen devices, Storage System – Magnetic System, Optical System, Solid State Disk.

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UNIT – V	APPLICATIONS OF TELEMEDICINE	9
Telemedicine access to health care services, health education and self–care. Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e–health services security and interoperability.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course, the student should be able to	
CO1	Recall the basic concepts of telemedicine and health
CO2	Interpret the legal aspects of Telemedicine
CO3	Explain telemedicine standards in communication
CO4	Make use of data acquisition and storage.
CO5	Illustrate about the medical applications and usage of telemedicine

Text Books	
1.	Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002.
2.	Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd., Taylor & Francis 2006.
3.	O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health Informatics and information Systems", Springer, 2003.

Reference Books	
1.	Ferrer – Roca, O., Sosa – Iudicissa, M. (Eds.), "Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics", Volume 54, 2002.
2.	Simpson, W. Video over IP. "A practical guide to technology and applications", Focal Press Elsevier, 2006.
3.	Mohan Bansal, "Medical Informatics", Tata McGraw–Hill, 2004.

BoS Chairman

B.E. / B.TECH.	B19BTO701 – FUNDAMENTALS OF NANOTECHNOLOGY (Common to all Except BT)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of nanomaterials and their characteristics.
2.	To gain knowledge on the relationship between nano and biosystems.
3.	To acquire information on nanobiocomposites.
4.	To enhance skill and knowledge on analysis of nanomaterials and
5.	To apply the knowledge and skills of nanotechnology in medicine and related fields.

UNIT – I	INTRODUCTION TO NANOTECHNOLOGY	9

Definition– history of nanomaterials– classification of nanomaterials, Properties of nanomaterials – concept of nanoscale engineering – size and confinement effects.

UNIT – II	SYNTHESIS AND CHARACTERIZATION OF NANOPARTICLES	9

Strategies for nano architecture, bottom–up, top down and functional approaches; Chemical and physical synthesis of nanoparticles – characteristics of nanoparticles; Characterization of nanoscale materials using UV spectroscopy, TEM, AFM/STM, XRD and FTIR.

UNIT – III	INTERLINKING BIOLOGY WITH NANOTECHNOLOGY	9

Bionanomaterials – DNA, protein and lipids based nanostructures– synthesis, characterization and applications; Bionanopores–Biological synthesis of nanoparticles – bacteria, fungi, yeast and plants– mechanism; Molecular Self–assembly in biology.

UNIT – IV	BIOLOGICAL FUNCTIONALISATION OF NANOMATERIALS	9

DNA / protein – gold nanoparticle conjugates; DNA nanostructures for mechanics and computing; DNA as smart glue – DNA analyser as biochips; Biologically inspired nanocomposites; Peptide nanostructures and their applications – electronics, antibacterial agents.

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UNIT – V	APPLICATION OF NANOBIOTECHNOLOGY	9
Antimicrobial activity of nanoparticles and its mechanism; Nanoanalytics – Quantum dots – Bioconjugates in cell and tissue imaging; Diagnosis of cancer and other diseases using bionanosystems; Drug and gene delivery; Protein targeting– targeting signals, translocation and sorting; Micelles for drug delivery; Proteins and DNA coupled nanoparticles for biosensors; Nanotechnology in agriculture.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Understand the fundamentals of nanoscience and technology.
CO2	Explain synthesis and characterization of nanoparticles.
CO3	Understand the potential applications of bionanomaterials in various fields.
CO4	Understand the design and development of health related nanomaterials.
CO5	Apply bionanomaterials in various fields.

Text Books	
1.	Rao CNR, A Muller and AK Cheetham, “The Chemistry of Nanomaterials – Synthesis, Properties and Applications”, John Wiley & Sons, 2006.
2.	Pradeep T., “Nano: The Essentials”, Tata McGraw Hill, New Delhi, 2007.
3.	Niemeyer C.M., and CA Mirkin, “Nanobiotechnology: Concepts, Applications and perspectives”, John Wiley & Sons, 2004.

Reference Books	
1.	Nicolini C, “Nanobiotechnology and Nanobiosciences”, Pan Stanford Publishing Pvt. Ltd, 2009.
2.	Goodsell SD, “Bionanotechnology – Lessons from Nature”, Wiley–Liss, Inc, 2004.
3.	Bhushan B, “Handbook of Nanotechnology”, Springer, Heidelberg, 2006.

BoS Chairman

B.E. / B.TECH	B19CSO701 – FUNDAMENTAL OF CLOUD COMPUTING (Common to all Except CSE, AI & DS, CSBS)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the basic concepts of Computer Networks and Cloud Computing.
2.	To understand the broad perceptive design of cloud architecture and model.
3.	To study the concept of Virtualization and design of cloud Services
4.	To be familiar with the storing data in cloud and secure to data in cloud.
5.	To apply different cloud programming model as per need and design the trusted cloud Computing system.

UNIT – I	CLOUD COMPUTING FUNDAMENTALS	9

Introduction to computer networks – evolution of computer networks and its uses – Types of Networks – Advantages and Disadvantages of Computer Network – Introduction to Cloud Computing – Essential characteristics, Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On–demand Provisioning.

UNIT – II	CLOUD ARCHITECTURE AND MODELS	9

NIST Cloud Computing Reference Architecture – Cloud Models: Characteristics – Cloud Services – IaaS, PaaS, SaaS – Public vs Private Cloud – Cloud Solutions – Cloud ecosystem – Service management – Computing on demand.

UNIT – III	CLOUD VIRTUALIZATION	9

Basics of Virtualization – Types of Virtualizations – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU, Memory, I/O Devices – Virtual Clusters and Resource management – Virtualization for Data – Center Automation.

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UNIT – IV	CLOUD COMPUTING STORAGES AND SECURITY	9
Cloud Storage – Storage–as–a–Service – Advantages of Cloud Storage – Cloud Storage Providers – S3 – Security Overview – Cloud Security Challenges – Software–as–a–Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.		

UNIT – V	CLOUD TECHNOLOGIES AND ADVANCEMENTS	9
Hadoop – MapReduce – Virtual Box –– Google App Engine – Programming Environment for Google App Engine – Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Compare the strengths and limitations of cloud computing
CO2	Identify the architecture, infrastructure and delivery models of cloud computing
CO3	Outline various virtualization concepts.
CO4	Summarize the core issues of cloud such as storage, security, and privacy.
CO5	Show Cloud Services with appropriate tools.

Text Books	
1.	Curtis Franklin, Jr. ,Brian J.S. Chee, “Securing the Cloud: Security Strategies for the Ubiquitous Data Center”, CRC Press, 2019.
2.	Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management and Security ‖”, CRC Press, 2017.

Reference Books	
1.	Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud Computing”, TMH, 2013.
2.	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach”, Tata Mcgraw Hill, 2009.

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B.E. / B.TECH	B19ECO701 – INTRODUCTION TO COMMUNICATION SYSTEMS (Common to all Except ECE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the concept of basic Analog and Digital Communication Systems.
2.	To understand the various modulation techniques for Analog and digital communication Systems.
3.	To perform a block–diagram design of the transmitter and receiver for a basic Analog and Digital Communications System.
4.	To identify the performance, in terms of bit error rate, of a Digital Communication System.
5.	To study the wireless channel and Mobile Communication Systems.

UNIT – I	ANALOG COMMUNICATIONS	9

Basic concepts of Linear Modulation and Demodulation – Modulation Index – Power relation in AM wave – double and single sideband – Generation and Detection of Amplitude Modulation – Hilbert transform –analytic signal.

UNIT – II	ANGLE MODULATIONS	9

Frequency Modulation–comparison of frequency modulation and amplitude modulation – narrowband and wideband FM – Bessel functions – Carson's rule – bandwidth – Generation and Demodulation of frequency and phase modulation – Phase–locked loops.

UNIT – III	DIGITAL COMMUNICATIONS	9

Nyquist sampling theorem – Pulse amplitude modulation, Pulse code modulation – quantization noise, delta modulation, DPCM, ADPCM, Multiplexing and Multiple Access Techniques – FDM and FDMA, TDM and TDMA, CDMA.

UNIT – IV	DIGITAL MODULATION TECHNIQUES	9

Binary Phase Shift Keying – Binary Frequency Shift Keying – Pulse Amplitude Modulation (PAM), On – Off Keying OOK. Optimum receiver structures for digital communication – matched filtering, co–relation detection, probability of error.

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UNIT – V	WIRELESS CHANNEL AND MOBILE COMMUNICATION	9
Overview of wireless systems – capacity of wireless channel – Examples of Wireless Communication Systems – Paging system, Cordless telephones systems, Cellular telephone Systems – Cellular concept – Large and small Scale Fading.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the basic concepts of Analog Communication Systems.
CO2	Use of Angle Modulation techniques for Analog Communication.
CO3	Identify and describe different techniques in modern Digital Communications.
CO4	Explore various Digital Modulation Techniques.
CO5	Analyse the performance of wireless channels for Mobile Communication.

Text Books	
1.	Thepdore. S. Rapport, “Wireless Communications: principles and practice”, 2nd Eidtion, pearson education, india, 2009.
2.	B.P. Lathi, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford university press, 2010.
3.	S. Haykin, “Communication Systems”, 3/e John Wiley, 2007.

Reference Books	
1.	David Tse and Pramod Viswanath, “Fundamentals of wireless communications”, Wiley series in Telecommunications, Cambridge University Press, 2005.
2.	J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”, Pearson education, 2006.
3.	H. P. Hsu, Schaum outline series, “Analog and Digital Communications”, TMH, 2006.
4.	Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.

R. Gowri

BoS Chairman

B.E. / B.TECH	B19EEO701 – HYBRID ELECTRIC VEHICLE (Common to all Except EEE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To present a comprehensive overview of Electric and Hybrid Electric Vehicles.
2.	To understand the concept of hybrid electric vehicles and its operations.
3.	To impart knowledge on applications of drives in hybrid electric vehicles.
4.	To impart knowledge on vehicular communication in hybrid electric vehicles.
5.	To provide knowledge about various possible energy storage technologies that can be used in hybrid electric vehicles.

UNIT – I	INTRODUCTION TO HYBRID ELECTRIC VEHICLES	9

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive–trains on energy supplies. Basics of vehicle performance, vehicle power source characterization, transmission characteristics and mathematical models to describe vehicle performance.

UNIT – II	HYBRID ELECTRIC DRIVE – TRAIN	9

Basic concept of electric traction, Transmission configuration – Components – Gears – Differential – Clutch – Brakes, Regenerative braking, motor sizing. Hybrid traction: Various hybrid drive–train topologies, Power flow control in hybrid drive–train topologies, Fuel Efficiency Analysis.

UNIT – III	ELECTRIC COMPONENTS IN HYBRID AND ELECTRIC VEHICLES	9

Electric Drives in HEV/EVs, Classification and Characteristics, configuration and Control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives and Switched Reluctance Motor drives for HEV/EVs applications, Drive System efficiency.

UNIT – IV	SIZING THE DRIVE SYSTEM	9

Performance matching of Electric Machine and the Internal Combustion Engine (ICE), Sizing the propulsion motor, Communications, supporting subsystems, sizing the power electronic devices and Energy Storage Technology.

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UNIT – V	ENERGY MANAGEMENT STRATEGIES	9
Introduction to energy management strategies used in hybrid and electric vehicle, classification – implementation issues. Battery based energy storage: fuel cell based and super capacitor based energy storage and its analysis. Hybridization of different energy storage devices. Case study: Volvo XC90 T8 Plug–In Hybrid, Nissan X–Trial hybrid		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Infer the hybrid electric vehicles and its impact on environment.
CO2	Outline the working of hybrid electric drive train.
CO3	Interpret the electric components used in hybrid and electric vehicles.
CO4	Illustrate the various communication protocols and technologies used in vehicle. networks
CO5	Explain the different energy storage systems for vehicle applications.

Text Books	
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 Hussain, “Electric & Hybrid Vechicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
3.	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2009.

Reference Books	
1.	Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug–in Hybrid Electric Vehicles”, Springer, 2013.
2.	Chris Mi, MA Masrur, and D W Gao, “Hybrid Electric Vehicles– Principles and Applications with Practical Perspectives”, Wiley, 2011.

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3.	Davide Andrea, “Battery management Systems for Large Lithium–Ion Battery Packs”, Artech House, 2010.
4.	Sira – Ramirez, R. Silva Ortigoza, “Control Design Techniques in Power Electronics Devices”, Springer, 2006.
5.	James Larminie and John Lowry, “Electric Vehicle Technology”, Wiley Publishers, 2003.

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Semester – VIII

B.E.	B19MEP801 – PROJECT WORK – PHASE II	L	P	TU	C
		0	16	0	8

Course Objectives	
1.	To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
2.	To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Course Outcomes : At the end of the course student will	
CO1	Identify real world problems of Mechanical Engineering and related systems.
CO2	Interpret the working of Mechanical Engineering systems.
CO3	Apply the principles of Mechanical Engineering in real world systems.
CO4	Criticize and experiment to arrive at solutions for real world Mechanical Engineering problems.
CO5	Analyse and evaluate to obtain solution for problems in Mechanical Engineering systems.
	Total Instructional hours : 300

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Professional Elective – VI

B.E.	B19MEE801 – FLEXIBLE MANUFACTURING SYSTEM	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of FMS and its applications.
2.	To understand the different types of layouts, softwares used and optimization of FMS.
3.	To design and analyse FMS.
4.	To understand concepts of group technology and justification of FMS.
5.	To learn FMS application and FMS development in industries.

UNIT – I	OVERVIEW OF FMS	9

An overview, need for FMS, classification of FMS,benefits and limitations of FMS, Components of FMS, flexibility in manufacturing, building blocks of FMS,FMS control, FMC vs. FMS.

UNIT – II	COMPUTER CONTROL AND SOFTWARE FOR FMS	9

Concepts of distributed numerical control, programmable controllers, hardware configurations, FMS softwares,FMS installation, computer control of work center and assembly lines, functions of computers, computer process interface, computer process monitoring.

UNIT – III	MODELLING AND SIMULATION OF FMS	9

Modeling, simulation and analysis of FMS design, scheduling and loading of FMS network, economic considerations.

UNIT – IV	GROUP TECHNOLOGY AND JUSTIFICATION OF FMS	9

Introduction matrix formulation, mathematical programming formulation, graph formulation knowledge based system for group technology, economic justification of FMS, application of possibility distributions in FMS systems justification.

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UNIT – V	APPLICATIONS OF FMS AND FACTORY OF THE FUTURE	9
FMS application in machining, sheet metal fabrication, prismatic component production, aerospace application, FMS development towards factories of the future, artificial intelligence and expert systems in FMS , design philosophy and characteristics for future.		
		Total Instructional hours : 45

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Define FMS, its need, benefits and limitations.
CO2	Outline layout, configuration and optimization of FMS.
CO3	Design and analyse FMS for a given application
CO4	Propose suitable FMS configuration for various applications.
CO5	Identify the applications of FMS and future of FMS in industries.

Text Books	
1.	Shivanand H.K, Benal M.M,Koti, “Flexible manufacturing system”, New Age, International Pvt Ltd, New Delhi 2016.
2.	Jha, N.K. “Handbook of Flexible manufacturing systems”, Academic Press Inc., 2012.

Reference Books	
1.	Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education, Fourth Edition 2016.
2.	Radhakrishnan P, Subramanian S.and Raju V., “CAD/CAM/CIM”, New Age International Publishers, Fourth Edition,2018.
3.	Kalpakjian, “Manufacturing Engineering and Technology”, Addison – Wesley Publishing Co., 2014.

BoS Chairman

B.E.	B19MEE802 – AUTOMOBILE ENGINEERING	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To make the students familiar with the various parts of the automobile and their functions and materials.
2.	To understand about the engine Auxiliary systems as fuel injection system, electrical system and ignition system.
3.	To make the students familiar with the different types Transmission system such as clutch, gearboxes torque converters
4.	To analyze about the Steering, Brakes and Suspension System
5.	To summarize various alternative energy sources such as natural gas LPG, hydrogen fuel cells

UNIT – I	VEHICLE STRUCTURE AND ENGINE	9

Types of Automobiles – Vehicle Construction and different layouts, Chassis, Frame and Body – resistances to vehicle motion and need for a gear box. Components of Engine – Their forms, Functions and Materials.

UNIT – II	ENGINE AUXILIARY SYSTEMS	9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector, Rotary distributor type, and common rail direct injection system), Electronic ignition system, Turbochargers, Engine emission control by three way catalytic converter system.

UNIT – III	TRANSMISSION SYSTEMS	9

Clutch – Types and Construction, Gear Boxes, Manual and Automatic – Simple Floor Mounted Shift Mechanism.

Over Drives – Transfer Box, Fluid flywheel, Torque convertors, Propeller shaft, Slip Joint, Universal Joints, Differential and Rear Axle, Hotchkiss Drive and Torque Tube Drive.

UNIT – IV	STEERING, BREAKS AND SUSPENSION SYSTEMS	9

Steering Geometry and Types of steering gear box – Power Steering – Types of Front Axle, Types of Suspension systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System and traction control.

BoS Chairman

UNIT – V	ALTERNATIVE ENERGY SOURCES	9
Use of Natural Gas, LPG, Biodiesel, bio ethanol, Gasohol and Hydrogen in Automobiles. Engine modifications required–Performance, combustion and emission characteristics of SI and CI engines with these alternate fuels– Electric and Hybrid Vehicles, Fuel Cells.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand about the various parts of the automobile and their functions and, materials.
CO2	Analyze about the engine Auxiliary systems as fuel injection system, electrical system and ignition system.
CO3	Summarize the different types Transmission system such as clutch, gearboxes torque converters.
CO4	Analyze the Steering, Brakes and Suspension System.
CO5	Apply the concepts of various alternative energy sources such as natural gas LPG, hydrogen fuel cells.

Text Books	
1.	R.B.Gupta, “Automobile Engineering”, Satya prakashan, New Delhi, 2016.
2.	Kirpal singh “Automobile Engineering” VOL1 & 2”, Standard Publishers, Seventh edition 2018, New Delhi.
3.	Jain R.K. and Ashhana R.B. “Automobile Engineering” Tata MCGraw Hill Publishers, New Delhi, 2020.

Reference Books	
1.	William Crouse, “Automobile Engineering”, series McGraw–Hill 2016.
2.	Newton, Steeds and Garet, “Motor vehicles”, Butterworth Publishers, 2018.
3.	Joseph Heitner, “Automotive Mechanics”, 2nd edition, East–West Press, 2020.

BoS Chairman

B.E.	B19MEE803 – MANUFACTURING SYSTEM ENGINEERING	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn the role of computers and information technology in manufacturing system.
2.	To understand the concepts of part family and group technology.
3.	To learn concepts of FMS and material handling systems.
4.	To learn basics of robotics and its application in manufacturing.
5.	To learn the advanced manufacturing process.

UNIT – I	INTRODUCTION	9

Evolution of transformation & manufacturing systems. Need of attitude, knowledge & skill required for application of manufacturing systems. Need for system approach. Role of computers and information technology in manufacturing and manufacturing systems. Product life cycle & its importance.

UNIT – II	GROUP TECHNOLOGY (GT) & CELLULAR LAYOUT	9

GT – concept, definition, need, scope & benefits. Production layout – types, GT Layout – method of coding and examples. Part features – concept, types and examples. Part family – concept, method to form and approach to form cell using part families. Types and comparison of cell: manual and automatic cell, assembly cell. Steps of cell design and cell layout.

UNIT – III	FLEXIBLE MANUFACTURING SYSTEM AND MATERIAL HANDLING	9

Flexible Manufacturing System (FMS) – concept, definition and comparison with other manufacturing systems. Major elements of FMS and their functioning, FMS layout – concept, types and applications. FMS Planning and Control – Quantitative analysis in FMS Material handling system. Automated guided vehicles (AGV). Automated storage and retrieval system (AS / RS).

UNIT – IV	ROBOTICS	9

Robots – concept, definition, benefits and various areas of application in manufacturing systems. Terminology used in robotics. Robots – types, physical configuration, classification and selection criterion. Axes nomenclature. Types and uses of Manipulators & Grippers. Sensors – types, classifications, Overview of robot programming methods & languages.

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UNIT – V	RECENT TRENDS IN MANUFACTURING	9
Computer Aided Process Planning (CAPP) – concept, types, Computer Integrated Manufacturing (CIM. Computer Aided Inspection (CAI) – concept, benefit, types, Coordinate Measuring Machine (CMM) – its working and applications. Rapid Prototyping (RP): working principles, methods, applications and limitations, rapid tooling, techniques for rapid prototyping. Lean manufacturing – concept, sources of waste, benefits and applications.		
		Total Instructional hours : 45

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	Identify role of computers and information technology in manufacturing system.
CO2	Outline GT layout and create part family for various components.
CO3	Develop FMS layout for a given part family.
CO4	Recognize use of robotics in manufacturing applications.
CO5	Identify advanced manufacturing process used in industry.

Text Books	
1.	Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, Fourth Edition 2016.
2.	Radhakrishnan P, Subramanian S. and Raju V., "CAD/CAM/CIM", New Age International Publishers, Fourth Edition, 2018.

Reference Books	
1.	Shivanand H.K, Benal M.M,Koti V "Flexible manufacturing system", New Age International Pvt Ltd, New Delhi 2016
2.	Kalpakjian, "Manufacturing Engineering and Technology", Addison–Wesley Publishing Co., 2014.
3.	Bedworth. K, Anderson. H "Computer integrated design and manufacturing" McGraw Hill Publication,2014

BoS Chairman

B.E.	B19MEE804 – INDUSTRIAL SAFETY	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
2.	To familiarize students with powers of inspectorate of factories.
3.	To help students to learn about Environment act 1948 and rules framed under the act.
4.	To provide wide exposure to the students about various legislations applicable to an industrial unit.
5.	To analyse industrial hazards and its risk assessment.

UNIT – I	INTRODUCTION	9

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT – II	CHEMICAL HAZARDS	9

Chemical exposure – Toxic materials – Ionizing Radiation and Non–ionizing Radiation – Industrial Hygiene – Industrial Toxicology.

UNIT – III	ENVIRONMENTAL CONTROL	9

Industrial Health Hazards – Environmental Control – Industrial Noise – Noise measuring instruments, Control of Noise, Vibration – Personal Protection.

UNIT – IV	HAZARD ANALYSIS	9

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

BoS Chairman

UNIT – V	SAFETY REGULATIONS	9
Explosions – Disaster management – catastrophe control, hazard control, Safety education and training – Factories Act, Safety regulations Product safety – case studies.		
		Total Instructional hours : 45

Course Outcomes : Upon the completion of this course the students will be able to	
CO1	To list out important legislations related to health, Safety and Environment.
CO2	To list out requirements mentioned in factories act for the prevention of accidents.
CO3	To understand the health and welfare provisions given in factories act.
CO4	To understand the statutory requirements for an Industry on registration, license and its renewal.
CO5	To prepare onsite and offsite emergency plan.

Text Books	
1.	D.A. Crowl and J.F. Louvar, "Chemical Process Safety (Fundamentals with Applications)", Prentice Hall, 2011.
2.	Subramanian.V., "The Factories Act 1948 with Tamilnadu factories rules 1950", Madras Book Agency, Chennai, 21st edition., 2010.

Reference Books	
1.	Kohn, James P., Friend, Mark A. "Fundamentals of Occupational Safety and Health", United States: Bernan Press, 2018.
2.	Yates, W. David, "Safety Professional's Reference and Study Guide", Third Edition. United States: CRC Press, 2020.
3.	Hafey, Robert, "Lean Safety : Transforming Your Safety Culture with Lean Management", United States: Taylor & Francis, 2017.
4.	Rieske, David W., Asfahl, C. Ray, "Industrial Safety and Health Management", United Kingdom: Prentice Hall, 2010.

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B.E.	B19MEE805 – POWER PLANT ENGINEERING	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand about the thermal power plant and its components.
2.	To illustrate diesel, gas and hydroelectric power plants.
3.	To explain the layout, construction and working of the components inside nuclear power plants.
4.	To understand the layout, construction and working of the different Renewable energy power plants.
5.	To interpret the power distribution parameters, operating cost and impact of pollution from power plants.

UNIT – I	STEAM POWER PLANT	9
Layout of Thermal Power Plant, Fuel And Ash Handling, Dust collection, Super Critical & FBC Boilers, Super heaters, Air pre heaters, Economizer, Condensers, Feed water heaters and evaporators – Draught System, Cooling pond and cooling towers, Feed Water Treatment.		

UNIT – II	DIESEL, GAS, HYDRO ELECTRIC POWER PLANT	9
Layout and Components of Diesel – Gas Turbine and Hydro Electric Power Plants – site selection, operations, Advantages – Disadvantages – Applications.		

UNIT – III	NUCLEAR POWER PLANT & COMBINED POWER PLANT	9
Nuclear Engineering, Layout and components of Nuclear Power Plants, Working of Nuclear Reactors: BWR, PWR, CANDU, Fast Breeder, Gas Cooled and Liquid Metal Cooled Reactors, Combined and Binary Cycle Power Plants. Integrated Gasifier Combined Cycle power plants.		

UNIT – IV	NON–CONVENTIONAL POWER GENERATION	9
Principle, Construction and Working of Wind, Tidal, Solar Thermal, Solar Electrical, Geothermal, Biogas and Fuel Cell Power Systems, Different Direct Energy conversion systems.		

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UNIT – V	ECONOMIC AND ENVIRONMENTAL ISSUES	9
Load Distribution Parameters, Load Curve, Capital and Operating Cost of Different Power Plants – Power Tariff Types – Pollution Control Technologies Including Waste Disposal Options for Thermal and Nuclear Power Plants.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the construction of steam power plant, its working and significance.
CO2	Illustrate thermodynamic cycles of Diesel, gas turbine power plant.
CO3	Explain the layout, construction and working of the components inside nuclear power plants.
CO4	Understand basic concepts of Non–Conventional Power Generation & its importance.
CO5	Interpret the power generation, Distribution cost and impact of pollution from power plants

Text Books	
1.	Rajput R.K, “Power Plant Engineering”, 5th Edition, Laxmi Publications, 2016.
2.	Nag. P.K., "Power Plant Engineering", 4th Edition, Tata McGraw – Hill Publishing Company Ltd., 2012

Reference Books	
1.	Nagpal G.R., Sharma. S.C, “Power Plant Engineering”, 16th Edition, Khanna Publishers, 2012.
2.	Domkundwar, “Power Plant Engineering”, Dhanpat Rai & Sons, Delhi, 2016.
3.	Rai G.D, “Non–Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
4.	Dr. P.C, Sharma, “Power Plant Engineering”, S.K. Kataria & Sons Publishers, 2013.

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Open Elective – IV

B.E. / B.TECH	B19AEO801 – VEHICLE AERODYNAMICS (Common to all Except AERO)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basic concepts of vehicle and its internal design.
2.	To know the principles of process, planning, and ventilation system.
3.	To know the different type of noises and acoustics.
4.	To learn about the ergonomics and occupant accommodation.
5.	To create knowledge on various control systems.

UNIT – I	INTRODUCTION TO VEHICLE DESIGN	9
Timeline developments in design – Mass production – Streamlining for style and low drag – Commercial vehicles – Engine developments – Transmission system development – Steering – Suspension – Brakes – Interior refinement – Safety design.		

UNIT – II	VEHICLE BODY DESIGN	9
The styling process – Working environment and structure – Product planning – Concept sketching and package related sketching – Full sized tape drawing – Clay modelling – Aerodynamics – Aerodynamic forces – Drag & Drag reduction – Stability during cross – winds – Wind Noise – Under–hood ventilation – Cabin ventilation – Introduction to Computational fluid dynamics – Wind tunnel testing of scale models.		

UNIT – III	NOISE AND VIBRATION	9
Vibration – fundamentals & control – Acoustics – fundamentals – Human response to sound – Sound measurement – Automotive noise criteria – Drive–by noise tests, Noise from stationary vehicles, Interior noise in vehicles, Automotive noise sources and control techniques – Engine noise, Transmission noise, Intake & exhaust noise, Aerodynamic noise, Tyre noise, Brake noise.		

UNIT – IV	CRASHWORTHINESS AND ERGONOMIC APPROACH	9
Accident and injury analysis – Vehicle impacts: general dynamics & crush characteristics – Structural collapse and its influence upon safety – Occupant accommodation – Ergonomics in the automotive industry – Ergonomics methods and tools – Case studies of Fiat Punto – Strategies for improving occupant accommodation and comfort.		

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UNIT – V	VEHICLE CONTROL SYSTEMS	9
Automotive application of sensors – Chassis control systems – Anti–lock braking systems, Traction control systems, Electronically controlled power – assisted steering – Vehicle safety and security systems – Air–bag and seat belt pre–tensioner systems, Remote keyless entry and vehicle immobilization, Introduction to On–board navigation systems.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline the periodical developments in design, production and various components of vehicle bodies. (K2)
CO2	Make use of sketching concept like tape drawing and clay modelling to reduce the aerodynamics drag on vehicle body. (K3)
CO3	Analyze the various automotive noise sources and its control techniques. (K4)
CO4	Evaluate the vehicle crash worthiness requirements for improving passengers and comfort. (K5)
CO5	List the different control system and sensors used in controlling the vehicle. (K4)

Text Books	
1.	"An Introduction to Modern Vehicle Design", Julian Happian – Smith, Butterworth – Heinemann Ltd (2002)

Reference Books	
1.	"Aerodynamics of Road Vehicles: From Fluid Mechanics to Vehicle Engineering", Wolf–Heinrich Hucho (Eds.), Butterworth–Heinemann Ltd (1987).
2.	"Sensors and Transducers", Ian R Sinclair, Butterworth – Heinemann Ltd (2001).
3.	"The Motor Vehicle" T.K. Garrett, K. Newton & W. Steeds, Butterworth– Heinemann Ltd (2001).

BoS Chairman

B.E. / B.TECH	B19AGO801– AGRICULTURE FINANCE, BANKING AND COOPERATIVES (Common to all Except AGRI)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on principles basic agriculture finance system.
2.	To understand the different farm financial analysis
3.	To acquire the knowledge on different functions of financial institutions
4.	To understand banking and cooperation for agricultural and agro based industries and financial system
5.	To know the functions of various institutions involved in farm financing crop insurance products.

UNIT – I	AGRICULTURAL FINANCE – NATURE AND SCOPE	9
Agricultural Finance: Definition, Importance, Nature and Scope – Agricultural Credit: Meaning, Definition, Need and Classification – Sources of credit – Role of institutional and non–Institutional agencies: Advantages and Disadvantages – Rural indebtedness: consequences of rural indebtedness – History and Development of rural credit in India.		

UNIT – II	FARM FINANCIAL ANALYSIS	9
Principles of Credit – 5C's, 5R's and & 7P's of Credit – Project Cycle and Management – Preparation of bankable projects / Farm credit proposals – Feasibility – Time value of money: Compounding and Discounting – Appraisal of farm credit proposals – Undiscounted and discounted measures – Repayment plans – Farm Financial Statements: Balance Sheet, Income Statement and Cash Flow statement – Financial Ratio Analysis.		

UNIT – III	FINANCIAL INSTITUTIONS	9
Institutional Lending Agencies – Commercial banks: Nationalization, Agricultural Development Branches – Area Approach – Priority Sector Lending – Regional Rural Banks, Lead bank, Scale of finance – Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India – Microfinance and its role in poverty alleviation – Self–Help Groups – Non –Governmental Organizations – Rural credit policies followed by State and Central Government – Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme – Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC).		

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UNIT – IV	CO–OPERATION	9
Co–operation: Philosophy and Principles – History of Indian Cooperative Credit Movement: Pre and Post–Independence periods and Cooperation in different plan periods – Cooperative credit institutions: Two tier and three tier structure, Functions: provision of short term and long term credit, Strength and weakness of cooperative credit system, Policies for revitalizing cooperative credit: Salient features of Vaithiyananthan Committee Report on revival of rural cooperative credit institutions, Reorganisation of Cooperative credit structure in Andhra Pradesh and single window system and successful cooperative credit systems in Gujarat, Maharashtra, Punjab etc, – Special cooperatives: LAMPS and FSS: Objectives, role and functions – National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd., (NAFSCOB) – Objectives and Functions.		

UNIT – V	BANKING AND INSURANCE	9
Negotiable Instruments: Meaning, Importance and Types – Central Bank: RBI – functions – credit control – objectives and methods: CRR, SLR and Repo rate – Credit rationing – Dear money and cheap money – Financial inclusion and Exclusion: Credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap – Non – Banking Financial Institutions (NBFI) – Preparation of Bankable Projects – Assessment of crop losses, Determination of compensation – Crop insurance: Schemes, Coverage, Advantages and Limitations in implementation – Estimation of crop yields – Livestock, insurance schemes – Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the knowledge on sources of Agricultural Micro–Macro financing and credit systems.
CO2	Outline the history of financing agriculture in India.
CO3	Relate the significance and limitations of crop insurance.
CO4	Infer the knowledge on cooperative systems.
CO5	Summarize the knowledge on insurance policies and financial system.

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Text Books	
1.	Muniraj, R. 1987. "Farm Finance for Development", Oxford & IBH, New Delhi.
2.	Subba Reddy, S and P. Raghu Ram. 2011. "Agricultural Finance and Management", Oxford & IBH. New Delhi.
3.	Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray. 1998. "Agricultural Finance", Kalyani Publishers. New Delhi.
4.	Mammoria, C.B. and R.D. Saxena. 1973. "Co-operation in India", Kitab Mahal, Allahabad.
5.	Patnaik, V.E. and A.K. Roy. 1988. "Co-operation and Cooperative Management", Kalyani Publishers, Ludhiana.

Reference Books	
1.	Ghosal, SN., "Agricultural Financing in India", Asia Publishing House, Bombay, 1966.
2.	John, J.Hamptron., "Financial Decision Making: Concepts, Problems and Cases", Prentice Hall of India , New Delhi, 1983
3.	https://www.nabard.org/

BoS Chairman

B.E. / B.TECH	B19BMO801– HOSPITAL MANAGEMENT (Common to all Except BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals of hospital administration.
2.	Learn human resource management in hospital.
3.	Know the market–related research process.
4.	Explore various information management systems and relative supportive services.
5.	Learn the quality and safety aspects of the hospital.

UNIT – I	OVERVIEW OF HOSPITAL ADMINISTRATION	9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning – Equipment Planning – Functional Planning – Current Issues in Hospital Management – Telemedicine – Bio–Medical Waste Management.

UNIT – II	HUMAN RESOURCE MANAGEMENT IN HOSPITAL	9

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD – Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT – III	MARKETING RESEARCH PROCESS	9

Marketing information systems – assessing information needs, developing & disseminating information – Market Research process – Other market research considerations – Consumer Markets & Consumer Buyer Behavior – Model of consumer behavior – The buyer decision process – Model of business buyer behavior – Major types of buying situations – WTO and its implications.

UNIT – IV	HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES	9

Management Decisions and Related Information Requirement – Clinical Information Systems – Administration Information Systems – Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Service – Laundry Services.

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UNIT – V	QUALITY AND SAFETY ASPECTS IN HOSPITAL	9
Quality system – Elements, Implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course, the student should be able to	
CO1	Explain the principles of Hospital adminstration.
CO2	Identify the importance of Human resource management.
CO3	List various marketing research techniques.
CO4	Identify Information management systems and its uses.
CO5	Summarize the quality and safety procedures followed in hospitals

Text Books	
1.	R.C. Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006.
2.	G.D. Kunders, “Hospitals – Facilities Planning and Management – TMH”, New Delhi, Fifth Reprint 2007.

Reference Books	
1.	Cesar A. Caceres and Albert Zara, “The Practice of Clinical Engineering”, Academic Press, New York, 1977.
2.	Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3.	Peter Berman, “Health Sector Reform in Developing Countries”, Harvard University Press, 1995.
4.	William, A. Reinke, “Health Planning For Effective Management”, Oxford University Press, 1988.
5.	Blane, David, Brunner, “Health and Social Organization: Towards a Health Policy for the 21st Century”, Eric Calrendon Press 2002.
6.	Arnold D. Kalcizony & Stephen M. Shortell, “Health Care Management”, 6th Edition Cengage Learning, 2011.

BoS Chairman

B.E. / B.TECH	B19BTO801 – BIOLOGICAL WASTE MANAGEMENT (Common to all Except BT)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To develop conceptual schematics for biological treatment of wastes.
2.	To understand the role of microbes in waste treatment
3.	To equip students to understand the basics of biodegradation and bioremediation.
4.	To provide the overview integrated biotechnology approaches for effective waste management.

UNIT – I	INTRODUCTION	9

Industrial waste generation, disposal and environmental impacts; Toxicity of industrial effluents and Bioassay tests; Brief introduction about Regulatory requirements and pollution control boards. Biological treatment processes – objectives; Choice of treatment method; Environmental impact and other considerations in planning the treatment.

UNIT – II	MICROBIAL TREATMENT OF WASTE WATER	9

Biological waste water treatment – Aerobic suspended growth; Aerobic attached – growth (TF, RBC, PBR); Anaerobic suspended growth; Anaerobic attached growth; Advanced tertiary process:–Solids removal; Biological nitrogen removal; Biological phosphorus removal; Disinfection.

UNIT – III	BIODEGRADATION	9

Aerobic vs. anaerobic Degradation; Mechanism of biodegradation; Microbial basis of Biodegradation; Biodegradation of Xenobiotics; Microbial degradation of pesticides. Role of nanoparticles in biodegradation.

UNIT – IV	BIOREMEDIATION	9

Introduction of Bioremediation; advantages and applications; Types of bioremediation; Natural (attenuation); ex situ and in situ; Bioaugmentation and biostimulation; Solid phase and slurry phase bioremediation; Phytoremediation. Case study on bioremediation of xenobiotic compounds.

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UNIT – V	INTEGRATED BIOTECHNOLOGY FOR WASTE MANAGEMENT	9
Bioenergy – biogas and biodiesel; Biosorption, mechanism of biosorption; Biosensors and its application in environmental issues; Biomonitoring; Biotransformation, mineral leaching, mining and mineral biotechnology – reference to copper and iron.		
Total Instructional hours : 45		

Course Outcomes : At the end of the course, the student should be able to	
CO1	Understand the industrial waste generation and its environmental impact
CO2	Understand the role microbes in waste water treatment.
CO3	Explain the mechanism of biodegradation of organic wastes.
CO4	Understand the bioremediation of toxic compounds.
CO5	Understand the integrated biotechnology methods for waste management.

Text Books	
1.	Eckenfelder WW, “Industrial Water Pollution Control”, Mc–Graw Hill, 1999.
2.	Metcalf and Eddy, “Waste Water Engineering – Treatment and reuse”, Tata McGraw–Hill, New Delhi, 2003.
3.	Agarwal S.K., “Environmental Microbiology”, APH Publishing Corporation, New Delhi, 2009.
4.	Chatterji A.K., “Introduction to Environmental Biotechnology”, PHI Learning Pvt. Ltd., New Delhi, 2011.
5.	Maier RM, IL Pepper and CP Gerba, “Environmental Microbiology”, Academic Press. 2000.
6.	Pelczar MJ, ECS Chan and NR Kreig, “Microbiology”, 5th Ed., Tata McGraw Hill, New Delhi, 2002.

BoS Chairman

B.E. / B.TECH	B19CSO801 – FUNDAMENTAL OF IOT (Common to all Except CSE, AI & DS, CSBS)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand and gain complete knowledge about internet of things.
2.	To study about network protocols.
3.	To learn basic programming and IoT tools.
4.	To understand the basics of embedded systems in IoT.
5.	To explore various IoT applications

UNIT – I	INTRODUCTION	9
Basics of IoT, Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, Functional Blocks of IoT, Communication Models & APIs, Machine to Machine, Difference between IoT and M2M.		

UNIT – II	NETWORK AND COMMUNICATION ASPECTS	9
Wireless Medium Access Issues, MAC Protocol Survey, Survey Routing protocols, Sensor Deployment & Node Discovery, Data Aggregation & Dissemination.		

UNIT – III	ISSUES AND CHALLENGES IN IOT	9
Design Challenges, Development Challenges, Security Challenges, Issues related to Privacy, Standards and Regulation.		

UNIT – IV	DEVELOPING INTERNET OF THINGS	9
Introduction to different IoT Tools, Developing Applications through IoT Tools, Developing Sensor based Application through Embedded System Platform, Implementing IoT concepts with examples.		

UNIT – V	DOMAIN SPECIFIC APPLICATIONS	9
IoT applications – Home Automation–Agriculture– Health care – Surveillance Applications – Smart Grid – Introduction to Industrial IoT (IIoT).		
Total Instructional hours : 45		

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Explain the concepts of Internet of Things.
CO2	Analyze basic protocols in Wireless Sensor Network.
CO3	Outline the issues of IoT application design in different domains.
CO4	Illustrate the use of IoT tools and its performance.
CO5	Identify the IoT concepts and applications.

Text Books	
1.	Perry Lea, “Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security”, Packt, 2018.
2.	David Hanes, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Cisco press, 2017.

Reference Books	
1.	Samuel Greengard, “The Internet of Things”, MIT Press, 2015.
2.	Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, 2nd Edition, Wiley, 2012.
3.	Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks: Theory and Practice”, 2010.

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B.E./ B.TECH	B19ECO801 – WIRELESS TECHNOLOGIES (Common to all Except ECE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide basic understanding about wired and wireless communication.
2.	To have an exposure to Internet of Things and applications.
3.	To know the basic wireless network security.
4.	To get exposed to antenna systems.
5.	To understand various satellite communication.

UNIT – I	FUNDAMENTALS OF COMMUNICATION	9
Basics of Communication, Spectrum – FCC, Transceiver design and its Components, Wired and wireless communication. Modulation techniques, OSI Layers, TCP/IP Protocols 1G to 5G developments; 3G, 4G and 5G cell architecture.		

UNIT – II	INTERNET OF THINGS	9
Introduction, IoT– Architecture, IEEE 802.15.4, M2M and IoT Protocols, SCADA and RFID Protocols, Architecture and Applications – Bluetooth, Zigbee, LORA, 6LOWPAN, Wi–Fi, WIMAX.		

UNIT – III	WIRELESS NETWORK SECURITY	9
Cryptography, Integrity, Authentication and Key management, Wireless Threats – Hacking 802.11, Eavesdropping, Jamming, Cyber–crimes and awareness – countermeasures, Wireless Security.		

UNIT – IV	ANTENNA SYSTEMS	9
Introduction, Types of Antennas, Radiation Mechanisms and Measurements, Dipole, Monopole, Mobile Phone Antenna, Smart Antennas, RFID antennas, Automotive Antenna, Reconfigurable Antennas, SAR measurements.		

UNIT – V	SATELLITE COMMUNICATION	9
Basic principles, Kepler's law, Types of satellites – LEO, MEO and GEO. Launch Vehicles, Satellite Subsystems and Satellite links, Applications – GPS, Mobile communication and TV broadcast, Navigation systems, Modern Navigation systems.		
		Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Analyze the wired and wireless communication and networks.
CO2	Develop Internet of Things for various applications
CO3	Apply security protocols in Wireless Networks
CO4	Discover various antenna systems for Wireless Technologies
CO5	Explain the Satellite Communication technologies

Text Books	
1.	John G Proakis, MasoudSalehi, “Communication Systems Engineering” Prentice Hall, 1994.
2.	Oliver Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley 2012.

Reference Books	
1.	Dennis Roddy, “Satellite Communication”, 4^{th} Edition, Tata McGraw–Hill, 2009.
2.	Behrou A. Forouan, “Data Communication and Networking”, 5^{th} Edition, Tata McGraw Hill, 2013.
3.	Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands–on Approach)”, VPT, 1^{st} Edition, 2014.
4.	AfifOsseiran, Jose.F.Monserrat and Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016.
5.	KasunMaduranga Silva Thotahewa(Author), Jean–Michel Redoute(Author), Mehmet RasitYuce, “Ultra Wideband Wireless Body Area Networks”, Springer, 2016.
6.	Timothy Pratt and Charles W.Bostain, “Satellite Communications”, John Wiley and Sons, 2^{nd} Edition, 2012.
7.	M. Richharia, "Satellite Systems for Personal Applications", John Wiley, 2010.
8.	Balanis. A, “Antenna Theory Analysis and Design”, 3^{rd} Edition, John Wiley and sons, New York, 1982.
9.	William Stallings, “Cryptography & Network Security – Principles and Practices”, Pearson Education, 4^{th} Edition, 2006.

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B.E./ B.TECH	B19EEO801 – ENERGY CONSERVATION AND MANAGEMENT (Common to all Except EEE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To acquire the knowledge about the current energy scenario and importance of energy conservation, audit and management.
2.	To understand about the economics associated with energy conservation..
3.	To understand about the different electrical systems and the methods of improving energy efficiency.
4.	To improve the thermal efficiency by designing suitable systems for heat recovery and co–generation.
5.	To understand how to conserve energy in Major utilities

UNIT – I	INTRODUCTION	9
Energy – Power – Past and Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers – Instruments for energy auditing – energy security – Material and energy balance diagrams.		

UNIT – II	ECONOMICS	9
Energy Economics – energy pricing – Fixed and variable costs, Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing – ESCO concept.		

UNIT – III	ELECTRICAL SYSTEMS	9
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors – Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.		

UNIT – IV	THERMAL SYSTEMS	9
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation – Steam Distribution and Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization and Insulators – Waste Heat Recovery – Cogeneration.		

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UNIT – V	ENERGY CONSERVATION IN MAJOR UTILITIES	9
Energy conservation in Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Interpret the basic knowledge of current energy scenario and importance of energy conservation and management.
CO2	Summarize the knowledge of economics associated with energy conservation.
CO3	Apply the methods of improving energy efficiency in different electrical systems.
CO4	Make use of the heat utilization, saving and recovery in different thermal systems.
CO5	Interpret the knowledge of energy conservation in Major utilities.

Text Books	
1.	Murphy W.R. and G. Mckay Butter worth, “Energy Management”, Heinemann Publications, 2013.
2.	Guide books for “National Certification Examination for Energy Managers and Energy Auditors”, Book 1, 2, 3 & 4. Bureau Energy Efficiency, a statutory body under Ministry of Power, Government of India, New Delhi. 2005.
3.	W.C.Turner, “Energy Management Handbook”, John Wiley and Sons, Fifth edition, 2013.

Reference Books	
1.	Amlan Chakrabarti, “Energy Engineering and Management”, Prentice hall India 2011.
2.	John.C.Andreas, “Energy Efficient Electric Motors”, Marcel Dekker Inc Ltd – 2nd edition; 2015.
3.	Paul o’ Callaghan, “Energy Management”, Mc–Graw Hill Book Company – 1st edition; 2012.
4.	Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publications, Washington, 1988.
5.	www.em–ea.org/gbook1.asp

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