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 (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
BIOMEDICAL ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING

Vision and Mission of the Department

Vision

◎	To be a renowned centre in offering Biomedical Engineering education and research for the application of knowledge to the benefit of society

Mission

◎	Provide quality education to become a professionally competent engineers relating to engineering and medicine.
◎	Inculcate the fundamental and advanced skills to create innovative ideas in interdisciplinary fields with sense of responsibility towards the society.
◎	Develop entrepreneurship qualities to innovate new technologies for health care applications.

Program Educational Objectives (PEO's)

PEO 1	Graduates will be successful in their professional career as an employee in India or abroad through the core foundation and knowledge acquired in engineering and medicine.
PEO 2	Graduates will have skills to identify and engage query, develop new innovations and products for needs of the society.
PEO 3	Graduates will exhibit leadership, make decisions with societal and ethical responsibilities, function and communicate effectively in multidisciplinary settings.

Programme Outcomes (PO's)

Students graduating from Biomedical 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 environmental considerations.
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 Biomedical Engineering program should be able to	
PSO 1	Adapt to emerging information and communication technologies (ICT) to develop new innovations and solutions thereby developing indigenous medical instruments that are on par with the existing technology.
PSO 2	Design diagnostic and therapeutic equipments those reduces physician burnout and improve the quality of life for the end user by applying fundamentals of Biomedical Engineering.

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.,

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

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	Bio Technology
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

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

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.

18. 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 SI.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

<table>
<tr><td>B</td><td>1</td><td>9</td><td>M</td><td>E</td><td>T</td><td>7</td><td>0</td><td>9</td></tr>
<tr><td>Programme</td><td colspan="2">Regulation</td><td colspan="2">Department Code</td><td>Course Type</td><td>Semester</td><td colspan="2">Sequence Number</td></tr>
</table>

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 - Bio Technology	
BM - Bio Medical Engineering	**Semester**
CS - Computer Science and Engineering	1 - First Semester
EC - Electronics and communication	2 - Second Semester
Engineering	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

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

<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
B19PHT101	Engineering Physics	**BS**	3	3	0	0	3	40	60	100	3
B19CST101	Problem Solving and Python Programming	**ES**	3	3	0	0	3	40	60	100	3
B19MET101	Engineering Graphics	**ES**	6	2	4	0	3	40	60	100	4
B19PHP101	Physics Laboratory	**BS**	4	0	4	0	3	40	60	100	2
B19CSP101	Problem Solving and Python Programming 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
B19CHT101	Engineering Chemistry	**BS**	3	3	0	0	**3**	40	60	100	3
B19ECT201	Circuit Analysis	**PC**	3	3	0	0	**3**	40	60	100	3
B19BMT201	Anatomy and Human Physiology	**PC**	3	3	0	0	**3**	40	60	100	3
B19HST201	தமிழர்மரபு / Heritage of Tamils	**HS**	1	1	0	0	**3**	40	60	100	1
B19CHP101	Chemistry 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
B19BMP201	Human Physiology Laboratory	**PC**	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**	**15**	**14**	**1**	**Total Credits**				**24**

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Semester - III												
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MAT302	Linear Algebra, Transforms and Partial Differential Equations	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19BMT301	Sensors and Measurements	**PC**	3	2	1	0	**3**	40	60	100	**3**
B19ECT303	Signals and Systems	**PC**	4	3	0	1	**3**	40	60	100	**4**
B19ECT306	Electronic Devices and Circuits	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BMT302	Biochemistry	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MCT301	Environmental Sciences	**MC**	3	3	0	0	**-**	40	60	100	**NC**
B19HST301	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	**HS**	1	1	0	0	**3**	40	60	100	**1**
B19ECP201	Circuits and Devices Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19BMP301	Bio chemistry Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
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**	**18**	**10**	**2**	**Total Credits**				**23**
InplantTraining – Minimum ONEWEEK has to be completed (Review will be conducted in first week of semester IV. 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	
B19MAT403	Probability and Statistics	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19BMT401	Pathology and Microbiology	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BMT402	Bio control Systems	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19ECT404	Linear Integrated Circuits	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19ECT405	Digital Circuits and Design	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19MCT302	Indian Constitution	**MC**	3	3	0	0	**-**	100	-	100	**NC**
B19BMP401	Pathology and Microbiology Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19ECP403	Analog and Digital Integrated Circuits Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19CEP401	Career Ability Course - I	**CEC**	2	0	2	0	-	100	-	100	**NC**
B19CEP402	In plant Training	**CEC**	-	-	-	-	-	-	-	-	**NC**
B19CEP403	Online Certification Course	**CEC**	-	-	-	-	-	-	-	-	**NC**
Total Contact Hours/Week			**29**	**18**	**10**	**1**	**Total Credits**				**20**
Summer Internship - Duration 15 days (Review will be conducted in first week of sem v and its credit will be included in sem V) **Online Certificate Courses** (like NPTEL, Coursera, Mathworks certification) has to be completed within second year (NC)												

BoS Chairman

Semester - V

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19ECT505	Analog and Digital Communication	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19ECT502	Discrete Time Signal Process	**PC**	4	3	0	1	**3**	40	60	100	**4**
B19BMT501	Biomedical Instrumentation	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BMT502	Biomechanics	**PC**	3	3	0	0	**3**	40	60	100	**3**
	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**
B19ECP501	Digital Signal Processing Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19BMP501	Biomedical Instrumentation Laboratory	**PC**	2	0	2	0	**3**	40	60	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**	-	-	-	-	**-**	100	-	100	**1**
Total Contact Hours/Week			**29**	**18**	**10**	**1**	**Total Credits**				**25**

Semester - VI

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19ECT601	Microprocessors and Microcontrollers	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BMT601	Diagnostic and Therapeutic Equipment-I	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BMT602	Radiological Equipment	**PC**	3	3	0	0	**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**
B19ECP602	Microprocessors and Microcontrollers Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19BMP601	Diagnostic and Therapeutic Equipment Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**2**
B19BMP602	Mini Project	**PW**	4	0	4	0	**-**	100	-	100	**2**
B19CEP601	Career Ability Course - III	**CEC**	2	0	2	0	**-**	100	-	100	**NC**
B19CEP602	Online Certification Course	**CEC**	-	-	-	-	-	-	-	-	NC
Total Contact Hours/Week			**30**	**18**	**12**	**0**	**Total Credits**				**24**
Online Certificate Courses (like NPTEL, Course, Mathworks certification) 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	
B19BMT701	Fundamentals of Image Processing	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BMT702	Rehabilitation Engineering	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BMT703	Diagnostic and Therapeutic Equipment - II	**PC**	3	3	0	0	**3**	40	60	100	**3**
	Professional Elective - IV	**PE**	3	3	0	0	**3**	40	60	100	**3**
	Open Elective -III	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19BMP701	Image Processing Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**2**
B19BMP702	Hospital Training	**CEC**	4	0	4	0	**3**	40	60	100	**2**
B19BMP703	Project Work Phase - I	**PW**	4	0	4	0	**3**	40	60	100	**2**
Total Contact Hours/Week			**25**	**15**	**10**	**0**	**Total Credits**				**21**

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 -V	**PE**	3	3	0	0	**3**	40	60	100	**3**
	Open Elective IV	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19BMP801	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**
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**
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**
B19MAT201	Integral Calculus and Complex Analysis	**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**
B19MAT302	Linear Algebra, Transforms and Partial Differential Equations	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19MAT403	Probability and Statistics	**BS**	4	3	0	1	**3**	40	60	100	**4**

ENGINEERING SCIENCES (ES)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19CST101	Problem Solving and Python Programming	**ES**	3	3	0	0	**3**	40	60	100	**3**
B19MET101	Engineering Graphics	**ES**	6	2	4	0	**3**	40	60	100	**4**
B19CSP101	Problem Solving and Python Programming Laboratory	**ES**	4	0	4	0	**3**	40	60	100	**2**
B19MEP201	Basic Workshop Practices 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	
B19ECT201	Circuit Analysis	PC	3	3	0	0	3	40	60	100	3
B19BMT201	Anatomy and Human Physiology	PC	3	3	0	0	3	40	60	100	3
B19BMP201	Human Physiology Laboratory	PC	4	0	4	0	3	40	60	100	2
B19BMT301	Sensors and Measurements	PC	3	2	1	0	3	40	60	100	3
B19ECT303	Signals and Systems	PC	4	3	0	1	3	40	60	100	4
B19ECT306	Electronic Devices and Circuits	PC	3	3	0	0	3	40	60	100	3
B19BMT302	Biochemistry	PC	3	3	0	0	3	40	60	100	3
B19ECP201	Circuits and Devices Laboratory	PC	4	0	4	0	3	40	60	100	2
B19BMP301	Bio chemistry Laboratory	PC	2	0	2	0	3	40	60	100	1
B19BMT401	Pathology and Microbiology	PC	3	3	0	0	3	40	60	100	3
B19BMT402	Bio control Systems	PC	3	3	0	0	3	40	60	100	3
B19ECT404	Linear Integrated Circuits	PC	3	3	0	0	3	40	60	100	3
B19ECT405	Digital Circuits and Design	PC	3	3	0	0	3	40	60	100	3
B19BMP401	Pathology and Microbiology Laboratory	PC	4	0	4	0	3	40	60	100	2
B19ECP403	Analog and Digital Integrated Circuits Laboratory	PC	4	0	4	0	3	40	60	100	2
B19ECT505	Analog and Digital Communication	PC	3	3	0	0	3	40	60	100	3
B19ECT502	Discrete Time Signal Processing	PC	4	3	0	1	3	40	60	100	4
B19BMT501	Biomedical Instrumentation	PC	3	3	0	0	3	40	60	100	3
B19BMT502	Biomechanics	PC	3	3	0	0	3	40	60	100	3
B19ECP501	Digital Signal Processing Laboratory	PC	4	0	4	0	3	40	60	100	2
B19BMP501	Biomedical Instrumentation Laboratory	PC	2	0	2	0	3	40	60	100	2
B19ECT601	Microprocessors and Microcontrollers	PC	3	3	0	0	3	40	60	100	3
B19BMT601	Diagnostic and Therapeutic Equipment-I	PC	3	3	0	0	3	40	60	100	3
B19BMT602	Radiological Equipment	PC	3	3	0	0	3	40	60	100	3
B19ECP602	Microprocessors and Microcontrollers Laboratory	PC	4	0	4	0	3	40	60	100	2
B19BMP601	Diagnostic and Therapeutic Equipment Laboratory	PC	2	0	2	0	3	40	60	100	2
B19BMT701	Medical Image Processing	PC	3	3	0	0	3	40	60	100	3
B19BMT702	Rehabilitation Engineering	PC	3	3	0	0	3	40	60	100	3
B19BMT703	Diagnostic and Therapeutic Equipment-II	PC	3	3	0	0	3	40	60	100	3
B19BMP701	Image Processing Laboratory	PC	2	0	2	0	3	40	60	100	2

BoS Chairman

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	
B19BME501	Bio MEMS& Nano Technology	PE	3	3	0	0	**3**	40	60	100	**3**
B19BME502	Medical Physics	PE	3	3	0	0	**3**	40	60	100	**3**
B19CST201	Programming in C	PE	3	3	0	0	**3**	40	60	100	**3**
B19BME503	Biomaterials and Characterization	PE	3	3	0	0	**3**	40	60	100	**3**
B19EEE506	Electrical Engineering	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	
B19BME601	Telehealth Technology	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BME602	Body Area Networks	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BME603	Brain Computer Interface and Applications	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BME604	Artificial Organs and Implants	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BME605	Biosignal Processing	**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	
B19BME606	Medical Data Analytics	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BME607	Physiological Modeling	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19MGE601	Disaster Management	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BME608	Hospital Waste Management	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BME609	Analytical Instruments	**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	
B19BME701	Wearable Systems	PE	3	3	0	0	3	40	60	100	3
B19BME702	Soft computing and Applications	PE	3	3	0	0	3	40	60	100	3
B19BME703	Pattern Recognition and Deep Learning	PE	3	3	0	0	3	40	60	100	3
B19BME704	Neural Engineering	PE	3	3	0	0	3	40	60	100	3
B19BME705	Fiber optics and Lasers in Medicine	PE	3	3	0	0	3	40	60	100	3

SEMESTER – VIII											
ELECTIVE – V											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19BME801	Foundation for Nano Electronics	PE	3	3	0	0	3	40	60	100	3
B19BME802	Embedded Systems	PE	3	3	0	0	3	40	60	100	3
B19BME803	Medical Informatics	PE	3	3	0	0	3	40	60	100	3
B19BME804	Virtual reality in Medicine	PE	3	3	0	0	3	40	60	100	3
B19BME805	Biometric Systems	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
B19BTO501	Food Processing and Preservation	OE	3	3	0	0	3	40	60	100	3
B19CSO501	Fundamentals of Database Management System	OE	3	3	0	0	3	40	60	100	3
B19ECO501	Logic and Distributed Control System	OE	3	3	0	0	3	40	60	100	3
B19EEO501	Rotating Machines & Transformers	OE	3	3	0	0	3	40	60	100	3
B19MEO501	Robotics	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
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
B19MEO601	Entrepreneurship Development	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	Unnamed Aircraft System operation and 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**
B19BTO701	Fundamentals of Nano biotechnology	**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**
B19MEO701	3D Printing and Design	**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	Agricultural finance, Banking and Co-operation	**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 Technology	**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**
B19MEO801	Lean Six Sigma	**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	
B19BMP602	Mini Project	PW	4	0	4	0	3	100	-	100	2
B19BMP703	Project work Phase - I	PW	4	0	4	0	3	40	60	100	2
B19BMP801	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	-	100	-	100	1
B19CEP402	In plant Training	CEC	-	-	-	-	-	-	-	-	NC
B19CEP401	Career Ability Course - I	CEC	2	0	2	0	-	100	-	100	NC
B19CEP403	Online Certificate Courses	CEC	-	-	-	-	-	-	-	-	NC
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	-	-	-	-	-	100	-	100	1
B19CEP601	Career Ability Course - III	CEC	2	0	2	0	-	100	-	100	NC
B19CEP602	Online Certificate Course	CEC	-	-	-	-	-	-	-	-	NC
B19BMP702	Hospital Training	CEC	4	0	4	0	3	40	60	100	2

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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 Science	**MC**	3	3	0	0	**-**	100	-	100	**NC**
B19MCT302	Indian Constitution	**MC**	3	3	0	0	**-**	100	-	100	**NC**

OPEN ELECTIVE COURSES-OFFERED BY DEPARTMENT OF BIOMEDICAL ENGINEERING							
COURSE CODE	COURSE TITLE	CATEGORY	Contact Periods	L	T	P	C
B19BMO501	Introduction to Medical Physics	**OE**	3	3	0	0	3
B19BMO601	Introduction to Biomedical Engineering	**OE**	3	3	0	0	3
B19BMO701	Telemedicine	**OE**	3	3	0	0	3
B19BMO801	Hospital Management	OE	3	3	0	0	3

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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
3.	and comprehend them by asking questions; seeking clarifications.
4.	To help learners develop their speaking skills and speak fluently in real contexts.
5.	To help learners develop vocabulary of a general kind by developing their reading skills.
6.	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

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Language development	Spelling and Punctuations, modal verbs
Vocabularydevelopment	collocations
	Total Instructional hours : 60

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,“InterchangeStudentsBook-2”,NewDelhi, 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	UNCTIONS OFSEVERALVARIABLES	12
Partial differentiation –Total derivative - Change of variables – Jacobians – Taylor's series expansion for functions of two variables–Maxima and minima of function soft wovariables - Lagrange's method of undeterminedmultipliers.		

UNIT - III	DINARYDIFFERENTIAL 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	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 applications relevant to various streams of Engineering and Technology.
6.	To applications relevant to various streams of Engineering andTechnology.

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; Plancks 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”, Dhanpat Rai 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.

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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.

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B.E.	B19CST101- PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to CSE, ECE, EEE & BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To know the basics of problem-solving techniques.
2.	To construct simple python programs.
3.	To develop python programs with conditional statements and loops.
4.	To use python data structures such as lists, tuples, and dictionaries.
5.	To define python functions and use them.

UNIT - I	INTRODUCTION	7

Introduction: Fundamentals of digital computers.

Problem Solving Techniques: Algorithm, Flow Chart, Pseudo code, Program Control Structures, Programming Paradigms.

Programming languages: Generations of Programming Languages, Language Translators, and Features of a Good Programming Languages.

UNIT - II	PYTHON PROGRAMMING BASICS	11

Introduction to Python: Python Interpreter and its working, Syntax and Semantics, Data Types, Assignments and Expressions, operators, comments, Modules and functions.

UNIT - III	CONDITIONAL STATEMENTS AND STRING MANIPULATION	9

Conditional Statements: if, if-else, nested if.Looping: For, while, nested loop.

Control Statements: break, continue and pass.

String Manipulation: Accessing strings, basic operations, string slices, function and methods.

UNIT - IV	LISTS & TUPLES	9

Lists: Introduction, accessing list, Operations, Working with lists, Function and Methods. Tuple: Introduction, Accessing tuples, Operations, Working, Functions and Methods.

Dictionaries: Introduction, accessing values in dictionaries, working with dictionaries, Properties and Functions.

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UNIT - V	FUNCTIONS & MODULES	9
Functions: Defining a function, calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables. **Modules:** Importing module, Math module, Random module, file handling.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Outline the basics of algorithmic problem solving
CO2	Make use of basic elements of Python programming to develop applications
CO3	Experiment with the various control statements in Python
CO4	Summarize the build-in data structures of Python
CO5	Develop Python programs to implement function concepts and modules

Text Books	
1.	Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd edition, Updated for Python 3, Shroff/ O „Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/).
2.	Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python”, Revised and updated for Python 3.2, Network Theory Ltd., 2011.

Reference Books	
1.	Reema Thereja, — Python Programming using Problem Solving Approach, 4th Impression, Oxford University Press, 2018.
2.	John V Guttag, — Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013.
3.	Robert Sedgewick, Kevin Wayne, Robert Dondero, — Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd, 2016.
4.	Timothy A. Budd, — Exploring Python, Mc-Graw Hill Education (India) Private Ltd, 2015.
5.	Kenneth A. Lambert, — Fundamentals of Python : First Programs, CENGAGE Learning, 2012.

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B.E / B.Tech	B19MET101 – ENGINEERING GRAPHICS (COMMON TO ALL BRANCHES)	T	P	TU	C
		2	4	0	4

Course Objectives	
1.	Understand the basic principles of engineering drawing and construction of curves used in engineering field.
2.	To explain about standard principles of orthographic projection of points, lines and planes .
3.	Enable the students to be familiar with various positions of simple solids and disseminate them into different orthographic views.
4.	Create intricate details of components through sections and develop its surfaces.
5.	To improve visualization skills in developing pictorial and perspective views.

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.

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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.		

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.

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Text Books	
1.	N.D. Bhattand V.M. Panchal, — Engineering Drawing, Charotar Publishing House, 53rd Edition, 2014.
2.	K. Venugopal and V.Prabhu Raja, — Engineering Graphics, New Age International Publishers, 2017.

Reference Books	
1.	K.R.Gopalakrishna., - Engineering Drawing (Vol. I & II combined) Subhas Publications, Bangalore, 2018.
2.	K.V.Natarajan, - A text book of Engineering Graphics, 28th Edition, Dhana Lakshmi Publishers, Chennai, 2015.
3.	N.S Parthasarathy and Vela Murali, - Engineering Drawing, Oxford University Press, 2015.

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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	
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 ltrasonic Interferometer

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

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

BoS Chairman

B.E.	B19CSP101 - PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY (Common to BME, CSE, ECE & EEE)	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To identify and execute the basic programs in Python.
2.	To create the Python programs by using built-in data types and their methods.
3.	To create the user-defined functions and modules in Python.
4.	To implement the file handling operations.
5.	To learn the list and dictionary concepts in Python.

List of Experiments

Expt. No.	Description of the Experiments	
1.	Compute the GCD of two numbers. Find the square root of a number (Newton_s method)	
2.	Basic Python programs for reading input from console.	
	a.	Calculate area of a circle by prompting the user to enter radius value.
	b.	Compute average of three numbers using simultaneous assignment.
3.	Programs using Decision statements.	
	a.	Find the maximum of a list of numbers
	b.	Exponentiation (power of a number)
4.	Programs using Looping and Loop Control statements.	
	a.	Print a list in reverse order (from last to first item) using while and for loops
	b.	Generate Fibonacci series for a given number.
5.	Programs for math operations and random number generation.	
	a.	Compute area of a triangle, given three sides using math module.
	b.	Generate 50 random numbers from a given range of values, using random module.

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6.		Basic programs using the following Python built-in data types and their methods - String, List, Tuple, Set and Dictionary.
	a.	Count the number of characters in a given word.
	b.	Remove duplicate words from a given string.
	c.	Count the occurrences of the substring in a given string
7.	a.	Implement linear search and binary search using list.
	b.	Matrix operations using Nested List.
8.		Programs using user - defined functions with different types of function arguments.
	a.	Check whether a given number is Prime or not using function.
	b.	Create a simple calculator that can add, subtract, multiply and divide using functions.
	c.	Implement pass by value and pass by reference.
9.		Python programs using Time and Calendar related functions.
	a.	Print the current time using time module.
	b.	Display the calendar of given month of the year using calendar module.
10.		Write a Python program to find the most frequent words from a file.
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Develop basic Python programs.
CO2	Construct Python programs using control statements.
CO3	Experiment with user-defined functions and different types of function arguments.
CO4	Build python programs with modules.
CO5	Develop Python application using file operations.

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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.

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

BoS Chairman

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.

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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.

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

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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, Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2015
3.	Vairam, S Kalyani, P and Suba Ramesh, — Engineering Chemistry, Wiley India Pvt. Ltd., New Delhi, 2013.

Reference Books	
1.	Friedrich Emich, — Engineering Chemistry, Scientific International Pvt. Ltd., New Delhi, 2014.
2.	Prasanta Rath, — Engineering Chemistry, Cengage Learning India Pvt. Ltd., Delhi, 2015.
3.	Shikha Agarwal, — 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.

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

BoS Chairman

B.E.	B19ECT201 - CIRCUIT ANALYSIS (COMMON TO ALL ECE & BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the basic concepts of DC and AC circuits behavior.
2.	To study the application of network the orems.
3.	To study the resonance concepts, Q factor and tuned circuits.
4.	To study the transient and steady state response of the circuits subjected to step and sinusoidalex citations.
5.	To introduce different h parameters and different networks.

UNIT - I	BASIC CIRCUITS ANALYSIS ANDNETWORKTOPOLOGY	9
Ohm's Law – Kirchhoff's laws – Mesh current and node voltage method of analysis for D.C and A.C. circuits - Network terminology - Graph of a network - Incidence and reduced incidence matrices – Trees –Cutsets - Fundamental cutsets - Cutset matrix – Tie sets - Link currents and Tie set schedules -Twig voltages and Cutset schedules, Duality and dual networks.		

UNIT - II	NETWORK THEOREMS FOR DC ANDACCIRCUITS	9
Network theorems -Superposition theorem, Thevenin 's theorem, Norton 's theorem, Reciprocity theorem, Millman 's theorem, and Maximum power transfer theorem, application of Network theorems - Network reduction: voltage and current division, source transformation– star delta conversion.		

UNIT - III	RESONANCE ANDCOUPLED CIRCUITS	9
Resonance - Series resonance - Parallel resonance - Variation of impedance with frequency -Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor -Selectivity. Self-inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysisofmultiwindingcoupledcircu its-Series,Parallelconnectionofcoupledinductors- Single tuned and double tuned coupled circuits.		

UNIT - IV	TRANSIENTANALYSIS	9
Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation		

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UNIT - V	TWOPORTNETWORKS	9
Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid(H) Parameters, Interconnection of two port networks, Symmetrical properties of T and π networks.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Develop the capacity to analyze electrical circuits
CO2	Apply the circuit theorems in real time applications
CO3	Explain the concepts of resonance
CO4	Analyses the transient response of different circuits
CO5	Understand and evaluate the different parameters

Text Books	
1.	William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2016.
2.	Joseph Edminister and Mahmood Nahvi, "Electric Circuits, Schaum's Outline Series", Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

Reference Books	
1.	Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Fifth Edition, McGraw Hill, 9th Reprint 2015
2.	A.Bruce Carlson, "Engineering Concepts and Analysis of Linear Electric Circuits", Cengage Learning, India Edition 2nd Indian Reprint2009
3.	Allan H.Robbins, Wilh
4.	Elm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.

R. Gowri

BoS Chairman

B.E.	B19BMT201 – ANATOMY AND HUMAN PHYSIOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To identify all the organelles of an animal cell and their function
2.	To understand structure and functions of the various types of skeletal, muscular and respiratory system of human body
3.	To demonstrate their knowledge of importance of anatomical features and physiology of human systems
4.	To understand the structure and function of nervous and endocrine system
5.	To understand the function of urinary and digestive system

UNIT - I	CELL AND TISSUESTRUCTURE	9
Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport of Across Cell Membrane - Action Potential – Cell to Cell Signaling – Cell Division. Types of Specialized tissues – Functions		

UNIT - II	SKELETAL, MUSCULAR ANDRESPIRATORYSYSTEMS	9
Skeletal::Types of Bone and function – Physiology of Bone formation – Division of Skeleton –Types of joints and function – Types of cartilage and function. Muscular: Parts of Muscle – Movements. Respiratory: Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration.		

UNIT - III	CARDIOVASCULAR ANDLYMPHATICSYSTEMS	9
Cardiovascular: Components of Blood and functions.- Blood Groups and importance – Structure of Heart – Conducting System of Heart – Properties of Cardiac Muscle - Cardiac Cycle - Heart Beat – Types of Blood vessel – Regulation of Heart rate and Blood pressure. Lymphatic: Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels		

UNIT - IV	NERVOUS AND ENDOCRINE SYSTEMS AND SENSEORGANS	9
Nervous: Cells of Nervous systems – Types of Neuron and Synapses –Mechanisms of Nerveimpulse– Brain:PartsofBrain–SpinalCord–TractandPathwaysofSpines - Reflex Mechanism – Classification of Nerves - Autonomic Nervous systems and its functions. Endocrine - Pituitary and thyroid gland, Sense Organs: Eye and Ear.		

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UNIT - V	DIGESTIVE ANDURINARYSYSTEMS	9
Digestive: Organs of Digestive system – Digestion and Absorption. Urinary: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System –Urinaryre flex.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline the structure and functions of tissues and organs of the human body
CO2	Illustrate the various tissues like skeletal, muscular and respiratory tissues
CO3	Summarize the various components of blood and function of circulatory system and lymphatic system.
CO4	Explain about the nervous tissue, endocrine system and various sense organs.
CO5	Outline the various organs in the digestive system and mechanism of urine Formation

Text Books	
1.	PrabhjotKaur.:"TextBookofAnatomyandPhysiology".LotusPublsihers.2014
2.	Elaine.N. Marieb , "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi,2007.

Reference Books	
1.	Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, "Fundamentals of Anatomy and Physiology". Pearson Publishers,2014.
2.	Gillian Pocock, Christopher D. Richards,' The human Body – An introduction for Biomedical Health Sciences", Oxford University Press, USA,2013.
3.	WilliamF.Ganong,—"ReviewofMedicalPhysiology",22ndEdition,McGrawHill,New Delhi,2010
4.	Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B.Saunders Company,2015
5.	Guyton &Hall, "Medical Physiology", 13thEdition, Elsevier Saunders,2015.

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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

Text - Cum - Reference Books

BoS Chairman

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.

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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	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 alkalinity in 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

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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.

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

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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 lap joint
3.	Cross lap joint

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.

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Exercise in arc welding for making	
1.	Lap joint
2.	Butt joint
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	
1.	Tray Funnel
2.	Funnel
Machine assembly practice and Demonstration	
1.	Machine assembly practice on:
2.	Study of centrifugal pump
3.	Study of air conditioner

GROUP – B (ELECTRICAL & ELECTRONICS)		
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.	30

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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 & de-soldering 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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B.E	B19BMP201 – HUMAN PHYSIOLOGY LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To estimate and quantification of bloodcells
2.	To learn methods for identification of bloodgroups
3.	To estimate haematologicalparameters
4.	To analyse the degree ofinflammation
5.	To analyzethe visual and hearingtest

Expt. No.	Description of the Experiments	
1.	Collection of blood samples	
2.	Identification of Blood groups (Forward and Reverse)	
3.	Bleeding and Clottingtime	
4.	Estimation ofHaemoglobin	30
5.	Total RBCcount	
6.	Total WBCcount	
7.	Differential count of Bloodcells	
8.	Estimation of ESR	
9.	MCH, MCV,MCHC	
10.	Hearing Test- TuningFork	
11.	Visual Activity- Snellen’s Chart and Jaeger’sChart	
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Explain the basics of physiology of the major organs
CO2	Explain the function of blood cells.
CO3	Analyze the blood cells using microscope.
CO4	Estimate the amount of Hemoglobin in the blood.
CO5	Analyze the visual and hearingtest

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B.E. / B.Tech	B19CEP201-SOFT SKILLS I	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-BME & ECE	B19MAT302 - LINEAR ALGEBRA,TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	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 analysis in representation of Periodic signals.
3.	To develop Fourier series techniques in solving wave and heat flow problems.
4.	To develop the concept of Z transforms techniques for discrete times ystems.
5.	To apply the concept of linear algebra in solving engineering problems.

UNIT - I	PARTIALDIFFERENTIAL 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'slinearequation-Linearhomogeneouspartialdifferentialequations of second and higher order with constant coefficients.

UNIT - II	FOURIERANALYSIS	12

Dirichlet's conditions – General Fourier series– Odd and even functions– Half range Fourier series– Parseval's identity – Fourier transform pair – Fourier sine and cosine transforms – Properties(excluding proof) – Transforms of simple functions – Convolutiontheorem(without proof) – Parseval's identity.

UNIT - III	BOUNDARYVALUE 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 he at conduction–Fourier series solutions in Cartesian coordinates.

UNIT - IV	Z - TRANSFORMS	12

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) - Convolution theorem (without proof) - Formation of difference equations – Solution of difference equations using Z - transform.

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UNIT - V	VECTORSPACES	12
Vector spaces – Subspaces – Linear transformation - Eigen values and eigenvectors – Diagonalizability- Innerproduct&norms–Orthogonality-GramSchmidtorthogonalization process.		
Total Instructional hours : 60		

Course Outcomes : Students will be able to	
CO1	Solve problems involving functions of several variables in terms of PDE.
CO2	Develop Fourier analysis to solve boundary value problems.
CO3	Apply Fourier series to solve boundary value problems.
CO4	Make use of Z- transforms to solve difference equations.
CO5	Apply Linear algebra concepts and ideas in solving engineering problems.

Text Books	
1.	Grewal B.S., —Higher Engineering Mathematics, Khanna Publishers, New Delhi, 44th Edition,2020.
2.	William E. Schiesser, "Partial Differential Equation Analysis in Biomedical Engineering Case Studies with MATLAB", Cambridge University Press,2013.

Reference Books	
1.	James, G. —Advanced Modern Engineering Mathematics, Pearson Education,2007.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, Wiley India,2014.
3.	Veerarajan T., "Engineering Mathematics ", Tata McGraw Hill Publications,2015.
4.	Gilbert Strang, "Introduction to Linear Algebra", 5th edition Wellesley- Cambridge Press,2016.
5.	Lay, D.C., —Linear Algebra and its Applications, 5th Edition, PearsonEducation,2015.
6.	Kolman, B. Hill, D.R., —Introductory Linear Algebra, Pearson Education, NewDelhi, First Reprint, 2009.

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B.E	B19BMT301 - SENSORS AND MEASUREMENTS	T	P	TU	C
		2	1	0	3

Course Objectives	
1.	To understand the purpose of measurement, the methods of measurements,errors associated with measurements.
2.	To know the principle of transduction, classifications and the characteristics ofdifferent transducers.
3.	To learn the photoelectric and piezo electric sensors
4.	To know the different bridges for measurement.
5.	To know the different display and recording devices.

UNIT - I	SCIENCEOFMEASUREMENT	12
Measurement System – Instrumentation - Classification and Characteristics of Transducers Static and Dynamic - Errors in Measurements and their statistical analysis – Calibration - Primary and secondary standards.		

UNIT - II	DISPLACEMENT, PRESSURE,TEMPERATURESENSORS	12
Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gauge. Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics.		

UNIT - III	PHOTOELECTRIC AND PIEZOELECTRICSENSORS	12
Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer.		

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UNIT - IV	SIGNALCONDITIONINGCIRCUITS	12
Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters, Impedance matching circuits, Isolation technique, AC and DC Bridges - wheat stone bridge, Kelvin, Maxwell, Hay, Schering.		

UNIT - V	DISPLAY ANDRECORDINGDEVICES	12
Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, LED, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder.		
		Total Instructional hours : 60

LIST OF LABORATORY EXPERIMENTS TO DEMONSTRATE	
Expt. No.	**LABORATORY EXPERIMENTS TO DEMONSTRATE**
1.	Characteristics of Strain Gauge.
2.	Characteristics of various temperature sensors – RTD, Thermistor and Thermocouple
3.	Displacement measurement using LVDT
4.	Characteristics of various light sensors – LDR, Photodiode and Phototransistor
5.	Measurement of resistance using DC bridges
6.	Measurement of inductance using Maxwell bridge
7.	Measurement of capacitance using Schering bridge
8.	Measurement of amplitude, time, frequency using CRO
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Measure various electrical parameters with accuracy, precision, resolution.
CO2	Select appropriate passive or active transducers for measurement of physical phenomenon.

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CO3	Identify the appropriate light sensors for measurement of physical phenomenon.
CO4	Make use of AC and DC bridges for relevant parameter measurement.
CO5	Employ Multimeter, CRO and different types of recorders for appropriate measurement.

Text Books	
1.	A.K.Sawhney, "Electrical & Electronics Measurement and Instrumentation",10th edition, Dhanpat Rai & Co, New Delhi, 19th Revised edition 2011, Reprint2014.
2.	John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi,2015.

Reference Books	
1.	Ernest O Doebelin and Dhanesh N Manik, "Measurement systems, Applicationand design", 6th edition, McGraw-Hill,2012
2.	Khandpur R.S, "Handbook of BiomedicalInstrumentation",3rd edition, Tata McGraw-Hill,New Delhi, 2014.
3.	LeslieCromwell,"BiomedicalInstrumentationandmeasurement",2ndedition,Prentice hall of India, New Delhi, 2015.
4.	Albert D.Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 1st edition,2016.

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B.E	B19ECT303 - SIGNALS AND SYSTEMS	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To understand the basic properties and characterization of signal & systems using MATLAB
2.	To analyse continuous time signals in the Fourier and Laplacedomain
3.	To apply LTI continuous time system in the Fourier and Laplacedomain
4.	To analyse discrete time signals in the Fourier and Z transformdomain
5.	To apply LTI discrete time system in the Fourier and Z transformdomain

UNIT - I	CLASSIFICATION OF SIGNALSANDSYSTEMS	15

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_ Classification of signals – Continuous time (CT) and Discrete Time (DT)signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable &Unstable.

UNIT - II	ANALYSIS OF CONTINUOUSTIME SIGNALS	15

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transformsand properties.

UNIT - III	LINEAR TIME INVARIANT CONTINUOUSTIME SYSTEMS	12

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT - IV	ANALYSIS OF DISCRETETIME SIGNALS	12

Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) - Properties of DTFT - Z Transform & Properties.

UNIT - V	LINEAR TIME INVARIANT-DISCRETETIME SYSTEMS	12

Impulse response – Difference Equations - Convolution sum - Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems - DT systems connected in series and parallel.

Total Instructional hours : 60

R. Gowri

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Classify the various types of continuous and discrete time signals and systems using MATLAB
CO2	Analyze Continuous time signals in the Fourier and Laplace domain
CO3	Apply LTI Continuous time systems in the Fourier and Laplace domain
CO4	Analyze discrete time signals in the Fourier and Z transform domain
CO5	Apply LTI discrete time systems in the Fourier and Z transform domain

Text Books	
1.	Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2015. (Unit I - V)

Reference Books	
1.	B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford,2009.
2.	R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson,2007.
3.	John Alan Stuller, “An Introduction to Signals and Systems”, Thomson,2007.

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B.E	B19ECT306 - ELECTRONIC DEVICES AND CIRCUITS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the structure of basic electronic devices
2.	To be exposed to active and passive circuit elements
3.	To familiarize the operation and applications of transistor like BJT and FET
4.	To explore the characteristics of amplifier gain and frequency response
5.	To learn the required functionality of positive and negative feedback systems

UNIT - I	PN JUNCTION DEVICES	9
PN junction diode – structure, operation and V-I characteristics, diffusion and transition capacitance-Rectifiers–Half Wave and Full Wave Rectifier–Display devices-LED,Laser diodes, Zener diode characteristics - Zener Reverse characteristics – Zener as regulator.		

UNIT - II	TRANSISTORSANDTHYRISTORS	9
BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.		

UNIT - III	AMPLIFIERS	9
BJT small signal model – Analysis of CE, CB, CC amplifiers - Gain and frequency response - MOSFET small signal model – Analysis of CS and Source follower – Gain and frequency response - High frequency analysis.		

UNIT - IV	MULTISTAGE AMPLIFIERS ANDDIFFERENTIAL AMPLIFIER	12
BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).		

UNIT - V	FEEDBACK AMPLIFIERS ANDOSCILLATORS	12
Advantages of negative feedback – voltage / current, series, Shunt feedback – positive feedback– Conditionforoscillations,phaseshift–Wienbridge,Hartley,ColpittsandCrystal oscillators.		
		Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Explain the structure and working operation of basic electronic devices
CO2	Able to identify and differentiate both active and passive elements
CO3	Analyze the characteristics of different electronic devices such as diodes and transistors
CO4	Choose and adapt the required components to construct an amplifier circuit
CO5	Employ the acquired knowledge in design and analysis of oscillators

Text Books	
1.	David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th edition2008.
2.	Sedra and smith, "Microelectronic circuits",7th edition, Oxford University Press.

Reference Books	
1.	Balbir Kumar,Shail.B.Jain,"Electronic devices and circuits",PHI learning private limited, 2nd edition 2014.
2.	Thomas L.Floyd, "Electronic devices", Conventional current version, Pearson prentice hall, 10th Edition,2017.
3.	Donald A Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3rd Edition,2003.
4.	Robert L.Boylestad, "Electronic Devices and Circuit Theory",2002.
5.	RobertB.Northrop,"AnalysisandApplicationofAnalogElectronicCircuitstoBiomedical Instrumentation", CRC Press,2004.

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B.E	B19BMT302 - BIOCHEMISTRY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national / international policies.
2.	To futuristic vision with socio-economic impact and issues
3.	To get a clear idea of biomolecules and their functions.
4.	To know the significance of biomolecules in biological systems.
5.	To understand the metabolic pathways in normal and pathological conditions.

UNIT - I	INTRODUCTION TO BIOCHEMISTRY	9

Introduction to Biochemistry,water asa bio logical solvent,weak acid and bases, pH, buffers, Handerson - Hassel Balch equation, physiological buffers, fitness of the aqueous environmentforlivingorganism. Principleofviscosity,surfacetension,adsorption,diffusion, osmosis and their applications in biological systems.

UNIT - II	CARBOHYDRATES	9

Definition, Classification of carbohydrates- mono, di, oligo and polysaccharides. Isomerism, racemisation and mutarotation. Structure, physical and chemical properties of carbohydrates. Biomedical significance of Carbohydrates. Metabolic pathways and bioenergetics – Glycolysis, glycogenesis, glycogenolysis and its hormonal regulation. TCA cycle and electron transport chain. Oxidative phosphorylation.

UNIT - III	LIPIDS	9

Definition, Classification of lipids- simple, complex and derived lipids. Nomenclature of fatty acid, physical and chemical properties of fat. Biomedical importance of lipids. Acid number, Saponification number, Reichert- Mesial number and iodine number. Metabolic pathways: synthesis and degradation of fatty acid (beta oxidation), hormonal regulation of fatty acid metabolism, ketogenesis, structural architecture and significance of biological membrane.

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UNIT - IV	NUCLEIC ACIDS & PROTEINS	9
Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as a geneticmaterial, Chargaff's rule. Watson and crick model of DNA. Structure of RNA and its types.Definition,Classification-simple, conjugated and derived proteins, properties of proteins, structural organization of proteins, classification and properties of amino acids. Separation of protein: gel filtration, electrophoresis and ultracentrifugation.		

UNIT - V	ENZYME ANDITSKINETICS	9
Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors. Kinetics of enzymes - Michaelis - Menten equation. Factors influencing enzyme activity: temperature, pH, substrate concentration and enzyme concentration. Inhibitors of enzyme action: Competitive, non- competitive, irreversible. Enzyme: Mode of action, allosteric and covalent regulation. Clinical significance of enzymes. Measurement of enzyme activity and interpretation of units.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline the principles of biochemistry & biological characteristics of water
CO2	Infer the structural and functional properties of carbohydrates
CO3	Summarize the structural and functional properties of lipids.
CO4	Infer the structural and functional properties of proteins
CO5	Explain the functions of enzymes and its kinetic behavior.

Text Books	
1.	U.Satyanarayana and U. Chakrapani, Biochemistry, Elsevier Publishers, 4th Edition, 2013

Reference Books	
1.	David L.Nelson, Michael M.Cox, Lehninger "Principles of Biochemistry Macmillan", 7th Edition2017
2.	Harper's Illustrated Biochemistry, Mc Graw Hill Publishers, 30th Edition,2018.

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B.E. / B.Tech	B19MCT301 – ENVIRONMENTAL SCIENCES (COMMON TO ALL BRANCHES)	T	P	TU	C
		3	0	0	NC

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 BIO DIVERSITY	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 functionofthe(a)forestecosystem(b)grasslandecosystem(c) desertecosystem(d)aquatic ecosystems (ponds, streams,lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification ofIndia – valueofbiodiversity:consumptiveuse,productiveuse,social,ethical,aestheticandoption 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	ENVIRONMENTALPOLLUTION	9

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soilpollution(d) Marinepollution(e)Noisepollution(f)Thermalpollution(g)Nuclearhazards - solid waste management: causes, effects and control measures of municipal solidwastes – 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	NATURALRESOURCES	9
Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining,damsandtheireffectsonforestsandtribalpeople–Waterresources:Useandover- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects ofextracting andusingmineralresources,casestudies– Foodresources:Worldfoodproblems,changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewableandnonrenewableenergysources,useofalternateenergysources. casestudies – 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 ANDTHEENVIRONMENT	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,casestudies–roleofnon-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(PreventionandControlofPollution)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- Publicawareness.		

UNIT - V	HUMAN POPULATION ANDTHEENVIRONMENT	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 inenvironment and human health – Case studies.		
Total Instructional hours : 45		

Course Outcomes : Students 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.

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CO3	Discuss various natural resources.
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.	Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi,2006.
2.	GilbertM.Masters,"IntroductiontoEnvironmentalEngineeringandScience",2ndedition, Pearson Education,2004.

Reference Books	
1.	DharmendraS.Sengar,"Environmentallaw",PrenticehallofIndiaPVTLTD,NewDelhi, 2007.
2.	Bharucha, "Textbook of Environmental Studies", Universities Press (I) PVT, LTD, Hydrabad,2015.
3.	Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.
4.	G.TylerMillerandScottE.Spoolman,"EnvironmentalScience",CengageLearningIndia Pvt, Ltd, Delhi,2014

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B.E. / B.Tech.	B19HST301 - தமிழரும் தொழில்நுட்பமும்	T	P	TU	C
		1	0	0	1

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, எ.்.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

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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.

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B.E. / B.Tech.	B19HST301 - TAMILS AND TECHNOLOGY	T	P	TU	C
		1	0	0	1

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

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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.

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B.E.	B19ECP201 - CIRCUITS AND DEVICES LABORATORY (Common to all ECE & BME)	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To gain, hand on experience in Thevenin & Norton theorem, KVL & KCL and Super Position Theorems
2.	To understand the working of RL, RC and RLC circuits.
3.	To learn the characteristics of basic electronic devices such as PN junction Diode and Zener Diode
4.	To learn the characteristics of Clipper, Clamper and FWR
5.	To learn the input - output characteristics using BJT, FET andSCR

List of Experiments

Expt. No.	Description of the Experiments
1.	Verifications of Thevinin & Nortontheorem
2.	Verifications of KVL &KCL
3.	Verifications Of Super PositionTheorem
4.	Verifications of maximum power transfer & reciprocitytheorem
5.	Determination Of Resonance Frequency of Series & Parallel RLCCircuits
6.	Transient analysis of RL and RCcircuits
7.	Characteristics of PN JunctionDiode
8.	Clipper and Clamper &FWR
9.	Zener diode Characteristics & Regulator using Zener diode
10.	Common Emitter input-outputCharacteristics

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11.	Common Base input-outputCharacteristics
12.	FET Characteristics
13.	SCRCharacteristics
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Verify Thevinin & Norton theorem KVL & KCL, Super Position Theorem, maximum power transfer and reciprocity theorem
CO2	Verify Thevinin & Norton theorem KVL & KCL, Super Position Theorem, maximum power transfer and reciprocity theorem
CO3	Analyze the characteristics of basic electronic devices
CO4	Analyze the characteristics of Clipper, Clamper and FWR
CO5	Analyze the characteristics of BJT, FET and SCR

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B.E.	B19BMP301- BIOCHEMISTRY LABORATORY	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	To estimation of bio molecules.
2.	To understand the principles of preparation of buffer
3.	To understands the test for carbohydrates, proteins and lipids
4.	To understand the separation techniques of bio molecules
5.	To understand the purpose of spectro photometry and chromatography

List of Experiments

Expt. No.	Description of the Experiments
1.	General guidelines for working and functional component of biochemistry la
2.	Preparation of solutions: Percentage solutions, Molar solutions, Normal solutions
3.	Standardization of pH meter, preparation of buffers, emulsions
4	Spectrophotometry: Determination of absorption maxima (λmax) of a given solution
5.	General tests for carbohydrates, proteins and lipids.
6.	Identification of Blood Collection Tubes and Phlebotomy equipment
7.	Preparation of serum and plasma from blood.
8.	Estimation of Hemoglobin
9.	Estimation of blood glucose
10.	Estimation of creatinine
11.	Estimation of urea

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12.	Estimation of uric acid
13.	Estimation of cholesterol
14.	Separation of proteins by SDS electrophoresis (Demo)
15.	Separation of amino acids by thin layer chromatography (Demo)
	Total Instructional hours : 30

Course Outcomes : Students will be able to	
CO1	Show the biochemistry laboratory functional components.
CO2	Demonstrate the basics principle of preparation of buffers.
CO3	Experiment with qualitative test of different biomolecules.
CO4	Make use of separation techniques of proteins and amino acids.
CO5	Analyze the hematological parameters with interpretation.

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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 interpersonal skills through integrated activities.
3.	To develop social and professional etiquette.
4.	To identify and apply employability skills for professiona lsuccess

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 Intercultural Competence – Team Work-Problem Solving Skills – Workplace Conflict Management & Resolutions		

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

UNIT - IV	BUSINESS ETIQUETTE	9
Define Etiquette–Types & Importance of Workplace Etiquette – Basic Corporate Etiquette- Telephone Etiquette- Meeting & E- mail Etiquette- Customer Service Etiquette		

UNIT - V	CORPORATESKILLS	9
Work Ethics- Adaptability-Analytical Reasoning- Lateral Thinking-Stress &Time Management-Professionalism in Today's Workforce		
		TOTAL: 30 PERIODS

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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 work place etiquette.

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

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B.E-BME & ECE	B19CEP302 – INTRODUCTION TO MATLAB	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	To understand the MATLABfundamentals
2.	To study simple calculations usingMATLAB
3.	To learn simple numerical computations and analyses usingMATLAB
4.	To learn the optimization algorithmsinMATLAB
5.	To implement the MATLAB applications

UNIT - I	MATLABFUNDAMENTALS	8
Introduction to Matlab - Arithmetic operations and variable assignment - Vector and matrix– Fundamentals-Elementarymatrixoperations-Matrixinversion-Systemsoflinearequations - Eigenvalues and eigenvectors - Matrix transpose special matrices - Functions which perform element-by-element operations on matrices - Functions length, size, sum, mean, max, min - Data input and output - Logical operations.		

UNIT - II	INTRODUCTION TOMATLABPROGRAMMING	8
Scriptfiles-Functionfiles-Controlstructures-Someusefulcommands-Conditionalcontrol structures - Repetitive control structures - The for loop - The while loop - Graphics 2-D & 3- D plots - Fractals and chaos - Exercise on Matlabfundamentals.		

UNIT - III	MATHEMATICSINMATLAB	8
Character strings - Symbolic math - Solving algebraic equations - Numerical integration - Numerical differentiation - Statistical analysis and simulation - Random samples from a uniform distribution - Random samples from a Gaussian distribution - Simple statistical analysis - Functions to calculate mean and standard deviation of data - Representation of polynomials in Matlab - Exercise on Matlab programming		

UNIT - IV	OPTIMIZATION ALGORITHMSINMATLAB	8
Introduction to the optimization toolbox - Fundamentals of the optimization algorithms - Solving optimization problems - Linear programming - Constrained andunconstrained optimization - Continuous and discrete optimization - Exercise on optimization algorithms in Matlab.		

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UNIT - V	APPLICATIONS	8
Digital image processing by Matlab - Basics of Signal Processing Representing Signals Analysis of different Signals Complex Signals - Filter Designing - Using the Filter Designing GUIs Analyzing the filter plots - Filter Designing using Script Files Speech Recording - SpeechProcessing-OtherSignalProcessingFunctions-ComputerVisionSystemsToolbox - Computer based programming exercise - Project design		
		Total Instructional hours : 40

Course Outcomes : At the end of the course the student will be able to	
CO1	Identify the main features of the MATLAB development environment
CO2	Make use of the MATLAB GUI effectively
CO3	Demonstrate statistical data analysis, data interpolation by Matlab, solve equation with Matlab
CO4	Analyze the optimization algorithms in MATLAB
CO5	Solve practical engineering problems using MATLAB

Reference Books	
1.	Amos Gilat Hoboken, N.J., Chichester - MATLAB : an introduction with applications, Wiley 4th ed.,2011.
2.	Edward B Magrab - An engineer’s guide to MATLAB, Prentice Hall,2006.
3.	Brian R Hunt - Aguide to MATLAB for beginners and experience dusers, Cambridge University Press, 2001.

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Semester - IV

B.E	B19MAT403– PROBABILITY AND STATISTICS (COMMON TO AGRI & BME)	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To provide required skills to apply the statistical tools in engineering problems.
2.	To Introduce the basic concepts of probability and random variables.
3.	To understand the basic concepts of two-dimensional random variables.
4.	To acquaint the knowledge in testing of hypothesis for small and large samples with applications in real life problems.
5.	To expose to the basic concepts of classifications of design of experiments which apply in agriculture and statistical quality control.

UNIT - I	PROBABILITY AND DISTRIBUTIONS	12

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT - II	TWO - DIMENSIONALRANDOMVARIABLES	12

Edema, Hyperemia / Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, chronic venous congestion. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas Haemorrhage.

UNIT - III	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, Chisquare and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT - IV	DESIGNOF EXPERIMENTS	9

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 22 factorial design.

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UNIT - V	STATISTICAL QUALITYCONTROL	9
Control charts for measurements (X and R charts) – Control charts for attributes (p, c and n charts) – Tolerance limits - Acceptance sampling.		
		Total Instructional hours : 60

Course Outcomes : At the end of the course the student will be able to	
CO1	Interpret the fundamental knowledge of the concepts of probability and standard distributions.
CO2	Develop the basic concepts of one- and two-dimensional random variables and apply in engineering applications.
CO3	Demonstrate a solid understanding of testing of hypothesis.
CO4	Apply the basic concepts of classifications of design of experiments in the field of agriculture.
CO5	Develop the sampling distributions and statistical quality control techniques Used in engineering and management problems.

Text Books	
1.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition,2015.
2.	Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition,2009.

Reference Books	
1.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences, Cengage Learning, New Delhi, 9th Edition, 2016.
2.	Papoulis. A. and Unnikrishnapillai. S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi,2017.
3.	Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5thEdition, Elsevier,2014.
4.	Iyengar. T. K. V, Krishna Gandhi. B, Ranganthan. S and Prasad. M.V.S.S.N "Probability and Statistics",S.ChandPublications,Edition,2017.
5.	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition,2013.

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B.E	B19BMT401 – PATHOLOGY AND MICROBIOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To explore the mechanisms of disease and how events at the level of the cell affect the patient as an hole
2.	To study the fluid and hemodynamic derangements
3.	To understand the structural and functional aspects of living organisms.
4.	To identify the microbial diseases.
5.	To study about immunopathology

UNIT - I	CELL DEGENERATION, REPAIRAND NEOPLASIA	9

Introduction to cell : types, function. Cell injury – basics, reasons and types : necrosis, pathogenesis, apoptosis reversible and irreversible cell injury. Inflammations – reasons and types. Cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT - II	FLUID ANDHEMODYNAMIC DERANGEMENTS	9

Edema, Hyperemia / Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, chronic venous congestion. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas Haemorrhage.

UNIT - III	BASICS OF MICROBIOLOGY	9

Introduction to Microbiology: Microorganisms, sources, types, structures, pathogenic microorganisms. Bacterialgrowthcurve,growthofpathogensinhumanbody.Sterilisation techniques – physical, chemical and irradiation methods. Microscopes: bright field, dark field, phase contrast, fluorescence, electron microscope (TEM and SEM).

UNIT - IV	MICROBIALDISEASES	8

Identification of microorganisms; Culture media, types, culture techniques. Staining methods : Simple, Gram's, Endospore, Flagella and AFB. hematoxylin and eosin staining. Bacteria, fungi and virus as potential pathogens, mechanism of pathogenicity: Bacterial (Plague, syphilis, Staphylococcus, Streptococcus, Clostridial diseases), Fungal (Dermatophytosis, Mycetoma, Candidiasis, Aspergillosis), Protozoan (Amoebiasis, Helminthes, Filariasis disease), Viruses (HIV, Influenza, SARS and CORONA).

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UNIT - V	IMMUNOPATHOLOGY	8
Immunology–Basics,types,phagocytosis,inflammation,antibodies,antigenandantibody reactions, hypersensitivity reactions. Immunological techniques- immune diffusion, immuno electrophoresis, radioimmunoassay and ELISA, monoclonal antibodies. Immune deficiency syndrome - Primary HIV- Molecular basic of Diabetes. Respiratory disorder - Cystic Fibrosis. Tuberculosis, Neuropsychiatric disorders - Parkinson's disease, Alzheimer's disease, Skin disorders - Eczema, Psoriasis, Renal disorders. Autoimmune disorders. Autopsy and surgical pathology, Histochemistry, Immunohistochemistry : FISH- Molecular pathology – in situ hybridization.		
Total Instructional hours : 45		

Course Outcomes : At the end of the course the student will be able to	
CO1	Identify the mechanisms of disease and how events at the level of the cell affect. The patient as a whole
CO2	Summarize the fluid and hemodynamic derangements
CO3	Outline the structural and functional aspects of living organisms.
CO4	Identify the microbial diseases.
CO5	Explain about the immunopathology

Text Books	
1.	Ramzi SC, Vinaykumar and SL. L Robbins, "Pathologic Basis of Diseases", WB Saunders Co. 7thEd.2005.
2.	Mohan, H, "Text book of Pathology". Jaypee Brothers Medical Publishers Private Limited, 7th Ed.2014.
3.	Anathanarayanan. R and Jayaram Panicker C.R, "Text Book of Microbiology", Orient Longman 4th Ed.1998.
4.	Dubey RC and Maheswari DK, "Microbiology", S Chand Publications, 3rd Ed.2010.
5.	Kuby. J. "Immunology", WH. Freeman and Company, New York, 5th Edition,2003.
6.	SL. and Ramzi SC, "Pathologic Basic of Diseases", W.B. Saunders Co. 7th Ed, 1999.

Reference Books	
1.	Underwood JCE, "General and Systematic Pathology", Churchill Livingstone, 3rd, Ed. 2000.
2.	Prescott, Harley, Klein, "Microbiology", McGraw Hill, 9th Edition,2013.

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B.E	B19BMT402 – BIO CONTROL SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the mathematical techniques for analysis of given system
2.	To study the given system in time domain.
3.	To study the frequency domain analysis.
4.	To study the stability analysis of the given system.
5.	To study the concept of physiological control system.

UNIT - I	SYSTEMS AND THEIRREPRESENTATION	9
Basic elements in control systems, Open and closed loop system, modeling of electrical systems, translational and rotational mechanical systems, and Electrical analogy of physical systems, Transfer function and block diagram, Reduction techniques for block diagram, Signal flow graph, conversion of block diagram to signal flow graph		

UNIT - II	TIMERESPONSE	9
Time domain specifications, Types of test inputs, I and II order system responses, Error coefficients, generalized error series, Steady state error.		

UNIT - III	FREQUENCY RESPONSE	9
Determinationofclosedloopresponsefromopenloopresponse,Bodeplot,Nichol'schart, Polar plot.		

UNIT - IV	STABILITYANALYSIS	9
Characteristic equation, Locationofrootsins, planeforstability, Routh Hurwitzcriterion, Root locus techniques, Construction , Gain margin and phase margin , Nyquist stability criterion.		

UNIT - V	PHYSIOLOGICAL CONTROL SYSTEM	9
Difference between engineering and physiological control systems, linear models of physiological systems, Simple models of muscle stretchre flexaction, Study of steady state analysis of muscle stretch reflex action, Regulation of Cardiac Output, Regulation of Glucose, Regulation of Ventilation, Stability Analysis of the Pupillary Light Reflex		
		Total Instructional hours : 45

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Course Outcomes : At the end of the course the student will be able to	
CO1	Develop mathematical model for a given system
CO2	Analyze the time domain specifications of different systems
CO3	Analyze the frequency response of systems
CO4	Identify stability analysis of the given system using various techniques.
CO5	Ilustrate the concept and model of physiological control systems

Text Books	
1.	J.Nagrath and M.Gopal,“ ControlSystem Engineering”, NewAge International Publishers, 6th Edition, 2008.
2.	CKKhoo,“Physiological control systems”, IEEE Press, Prentice Hall of India, 2005.

Reference Books	
1.	FaridGolnaraghi,BenjaminC.Kuo,“AutomaticControlSystems”,Wiley,9th Edition,2014.
2.	M. Gopal, “Control System, Principles and Design”, McGraw-Hill,2012.
3.	Constantine H.Houpis, Stuart N. Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Press, 6th Edition,2013.
4.	Richard C.Dorf & Robert H. Bishop, “Modern Control Systems”, Prentice Hall, 12th Edition,2010.
5.	Joseph J.DiStefano, Allen R.Stubberud, Schaum’s, ”Outline of Feedback and Control Systems”, McGraw-Hill Education, 2nd Edition,2013.

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B.E	B19ECT404 - LINEAR INTEGRATED CIRCUITS (Common to ECE & BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the basic building blocks of linear integratedcircuits
2.	To learn the linear and non-linear applications of operationalamplifiers
3.	To introduce the theory and applications of analog multipliers andPLL
4.	To learn the theory of ADC and DAC
5.	To introduce the concepts of waveform generation and introduce some special function ICs

UNIT - I	BASICS OF OPERATION ALAM PLIFIERS	9
Current mirror and current sources, Current sources as active loads, Voltage sources, VoltageReferences,BJT Differential amplifier with active loads, Basic information about op-amps–Ideal Operational Amplifier-General operation alam plifierstages-and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – JFET Operational Amplifiers – LF155 andTL082.		

UNIT - II	APPLICATIONS OFOPERATIONALAMPLIFIERS	9
Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.		

UNIT - III	ANALOG MULTIPLIERAND PLL	9
Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable trans-conductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization.		

UNIT - IV	ANALOG TO DIGITAL AND DIGITAL TOANALOGCONVERTERS	9
AnalogandDigitalDataConversions,D/Aconverter–specifications-weightedresistortype, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slopetype.		

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UNIT - V	WAVEFORM GENERATORS AND SPECIALFUNCTIONICS	9
Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator,ICL8038functiongenerator,TimerIC555,ICVoltageregulators–Threeterminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Audio Power amplifier, Video Amplifier, Opto-couplers and fibre opticIC.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the basics of operational amplifier
CO2	Design linear and nonlinear applications of operational amplifiers
CO3	Design applications with analog multiplier and PLL ICs
CO4	Design analog to digital and digital to analog converters with Op-Amps
CO5	Analyze different types of Operational Amplifier based waveform generators and special function ICs

Text Books	
1.	D. Roy Choudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt.Ltd., 2018, Fifth Edition. (Unit I – V)
2.	Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 4th Edition, Tata McGraw-Hill, 2016 (Unit I –V)

Reference Books	
1.	Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2015.
2.	Robert F. Coughlin, Frederick F. Drisco, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.
3.	B.S. Sonde, “System design using Integrated Circuits”, 2nd Edition, New Age Pub, 2001.
4.	GrayandMeyer,“AnalysisandDesignofAnalogIntegratedCircuits”,WileyInternational,5th Edition, 2009.
5.	William D. Stanley, “Operational Amplifiers with Linear Integrated Circuits”, Pearson Education, 4th Edition, 2001.
6.	S. Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH, 2nd Edition, 4th Reprint, 2016.

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B.E	B19ECT405 - DIGITAL CIRCUITS AND DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To present the Digital fundamentals, Boolean algebra and its applications in digital systems
2.	To familiarize with the design of various combinational digital circuits using logic gates
3.	To introduce the analysis and design procedures for synchronous sequential circuits
4.	To introduce the analysis and design procedures for asynchronous sequential circuits
5.	To explain the various semi conductor memories.

UNIT - I	DIGITAL FUNDAMENTALS	9
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1s and 2s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.		

UNIT - II	COMBINATIONALCIRCUIT DESIGN	9
DesignofHalfandFullAdders,HalfandFullSubtractors,BinaryParallelAdder–Carrylook ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Parity generator.		

UNIT - III	SYN CHRONOUS SEQUENTIAL CIRCUITS	9
Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design-Moore/Mealy models,s tate minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal ShiftRegister.		

UNIT - IV	ASYNCHRONOUSSEQUENTIAL CIRCUITS	9
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, ASM Charts, Hazards, Essential Hazards,Pulse mode sequential circuits, Design of Hazard free circuits.		

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UNIT - V	MEMORYDEVICES	9
Basic memory structure – ROM - PROM – EPROM – EEPROM – EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Make use of basic postulates of Boolean algebra and classify the various logic gates and its families.
CO2	Design various combinational digital circuits using logic gates.
CO3	Analyze the procedure for synchronous sequential circuits
CO4	Analyze the procedure for asynchronous sequential circuits
CO5	Explain the concept of memories and programmable logic devices

Text Books	
1.	M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson,2014.

Reference Books	
1.	CharlesH.Roth.,"Fundamental sofLogic Design",6th Edition,Thomson Learning, 2013.
2.	Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc,2011
3.	S.Salivahanan and S.Arivazhagan, "Digital Electronics", Ist Edition, Vikas Publishing House pvt Ltd,2012

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B.E	B19MCT302 - INDIAN CONSTITUTION	T	P	TU	C
		2	0	0	0

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 it sinter pretation
- Fundamental Rights and Duties and the irinter pretation
- State Policy Principles

UNIT - II	UNION GOVERNMENT	6

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

UNIT - III	STATE GOVERNMENT	6

- Governor – Role andPower
- Chief Minister and Council ofMinisters
- StateSecretariat

UNIT - IV	LOCAL ADMINISTRATION	6

- DistrictAdministration
- MunicipalCorporation
- ZilaPanchayat

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UNIT - V	ELECTIONCOMMISSION	6

- Role and Functioning
- Chief Election Commissioner
- State Election Commission

Total Instructional hours : 30

Course Outcomes : At the end of the course the student 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.,“IntroductiontotheConstitutionofIndia”,LexisNexis;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/

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B.E.	B19BMP401 – PATHOLOGY AND MICROBIOLOGY LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To demonstrate the tissue processing and section cutting
2.	To demonstrate cryo processing of tissue
3.	To understand smear preparation techniques
4.	To demonstrate staining techniques
5.	To learn about pathological slides of benign and malignant tumours

List of Experiments

Expt. No.	Description of the Experiments
1.	Basic lab safety and Good laboratory practices.
2.	Sample collection procedures (for sputum, blood, urine and stool samples)
3.	ABO grouping and blood smear preparation.
4.	Study of parts of compound microscope
	Pathology
5.	Manual paraffin tissue processing and section cutting(demonstration)
6.	Cryoprocessing of tissue and cryosectioning(demonstration)
7.	Histopathological slides of benign and malignanttumours.
8.	Haematology slides of anaemia andleukaemia.
9.	Antigen-Antibody reaction (Immuno electrophoresis, Ouchterlony Double Diffusion)
10.	Slides of malarial parasites, microfilaria and Leishmaniadonovani.

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	Microbiology
11.	Bacterial smearpreparation
12.	Simplestaining
13.	Gramstain.
14.	Endospore staining
15.	AFBstain.
16.	Capsulestain
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Demonstrate tissue processing and section cutting
CO2	Demonstrate cryoprocessing of tissue
CO3	Examine the technique of smear preparation
CO4	Test for simple staining technique
CO5	Experiment with pathological slides of benign and malignant tumours.

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B.E.	B19ECP403–ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To expose the students to linear and integrated circuits
2.	To apply operational amplifiers in linear and nonlinear applications
3.	To learn the working of Active filter, special function ICs use simulation software.
4.	To Design and implement the Combinational logic circuits
5.	To Design and implement the Sequential logic circuits

List of Experiments	
Expt. No.	**List of Analog Experiments**
	Design, Simulate and Analyse of following analog circuits
1.	Inverting, Non inverting and Differential amplifiers.
2.	Integrator and Differentiator
3.	Active low-pass and High-pass filter
4.	Schmitt Trigger
5.	RC Phase shift oscillator
6.	Wien bridge oscillator
7.	Astable and monostable multivibrators using NE555 Timer
	Design the following digital circuits
8.	Study of logic gates, Half adder and Full adder
9.	Design and implementation of code converters using logic gates (i) BCD to excess-3 code and vice versa (ii) Binary to gray and vice-versa
10.	Design and implementation of Multiplexer and De-multiplexer using logic gates

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11.	Design and implementation of encoder and decoder using logic gates
12.	Construction and verification of 4 bit ripple counter
13.	Design and implementation of 3-bit synchronous up/down counter
14.	Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Design and implement the circuits for different applications using op-amp
CO2	Design wave form Generators and analyze their characteristics
CO3	Analyze the performance of filters and special function ICs
CO4	Design Combinational Circuits using logic gates
CO5	Design Sequential circuits using logic gates

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Semester - V

B.E	B19ECT505 – ANALOG AND DIGITAL COMMUNICATION	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand analog communication techniques.
2.	To learn data and pulse communication techniques.
3.	To understand digital communication Techniques.
4.	To be familiar with source and Error control coding.
5.	To gain knowledge on multi-user radio communication

UNIT - I	ANALOG COMMUNICATION	9

IntroductiontoCommunicationSystems-Modulation–Types-NeedforModulation.Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM –PM).

UNIT - II	PULSE ANDDATA COMMUNICATION	9

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) -Pulsecode Modulation (PCM) - Comparison of various Pulse Communication System (PAM - PTM - PCM).
Data Communication: History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Data communication Hardware - serial and parallel interfaces.

UNIT - III	DIGITAL COMMUNICATION	9

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) –Phase Shift Keying (PSK)– BPSK–QPSK– Quadrature Amplitude Modulation (QAM) – 8QAM – 16QAM – Bandwidth Efficiency – Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT - IV	SOURCE AND ERROR CONTROL CODING	9

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes -ARQ Techniques.

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UNIT - V	MULTI-USER RADIO COMMUNICATION	9
Global System for Mobile Communications (GSM) - Overview of Multiple Access Schemes - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Satellite Communication – Bluetooth and Zigbee.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Apply analog communication techniques.
CO2	Make use of data and pulse communication techniques.
CO3	Apply digital communication techniques.
CO4	Analyze Source and Error control coding.
CO5	Utilize multi-user radio communication process.

Text Books	
1.	Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.

Reference Books	
1.	Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons,2004.
2.	Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education,2007
3.	H. Taub, D L Schilling and G Saha, "Principles of Communication", 3rdEdition, Pearson Education, 2007.
4.	B.P. Lathi, " Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press,2007.
5.	Blake, "Electronic Communication Systems", Thomson Delmar Publications,2002.

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B.E	B19ECT502 – DISCRETE - TIME SIGNAL PROCESSING (Common to all ECE & BME)	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To make students learn discrete Fourier transforms, properties of DFT and its application to linear filtering
2.	To understand the characteristics of digital IIR filters
3.	To understand the characteristics of digital FIR filters
4.	To understand the effects of finite precision representation on digital filters
5.	To understand the internal blocks of DSP processors and Programming with DSP processors

UNIT - I	DISCRETE FOURIER TRANSFORM	12

Review of discrete-time signals & systems - DFT and its properties, FFT algorithms & its applications, Overlap-add & overlap-save methods.

UNIT - II	DESIGN OF INFINITE IMPULSERESPONSE FILTERS	12

Analog filters – Butterworth filters, Chebyshev Type I filters (upto 3rd order), Analog Transformation of prototype LPF to BPF /BSF/ HPF. Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z transform method- Realization structures for IIR filters – direct, cascade, parallel forms.

UNIT - III	DESIGN OF FINITE IMPULSERESPONSE FILTERS	12

Design of linear phase FIR filters windowing and Frequency sampling methods -Realization structuresforFIRfilters–TransversalandLinearphasestructures-ComparisonofFIR&IIR.

UNIT - IV	FINITE WORDLENGTH EFFECTS	12

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - productquantizationerror-overflowerror-limitcycleoscillationsduetoproductquantization and summation - scaling to preventover flow.

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UNIT - V	INTRODUCTION TO DIGITAL SIGNAL PROCESSORS	12
DSP functionalities - Circular buffering – DSP architecture TMS320C5x and TMS320C3x – Fixed- and Floating-point architecture principles – Programming – Application examples.		
		Total Instructional hours : 60

Course Outcomes : At the end of the course the student will be able to	
CO1	Apply DFT for the analysis of digital signals and systems
CO2	Design IIR filters
CO3	Design FIR filters
CO4	Characterize the effects of finite precision representation on digital filters
CO5	Understand about the DSP processor

Text Books	
1.	A.V. Oppenheim, R.W. Schafer and J.R. Buck, “Discrete Time Signal Processing”, Pearson, 8th Indian Reprint,2004.
2.	John G Proakis and Manolakis, “Digital Signal Processing Principles Algorithms and Applications”, Pearson, 4th Edition,2007

Reference Books	
1.	I.C.IfeachorandB.W.Jervis,“DigitalSignalProcessingAPracticalApproach”,Pearson, 2002.
2.	M.H.Hayes, “Digital Signal Processing”, Schaum’s outlines, Tata McGraw Hill,2007.
3.	S.K. Mitra, “Digital Signal Processing”, A Computer Based approach, Tata McGraw-Hill, 1998.
4.	D.J.DeFatta,J.G.LucasandW.S.Hodgkiss,”DigitalSignalProcessingAsystemDesign Approach”, John Wiley & sons, Singapore,1988.
5.	Andreas Antoniou, “Digital Signal Processing”, Tata McGraw Hill,2006.

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B.E	B19BMT501 - BIOMEDICAL INSTRUMENTATION	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To illustrate origin of bio potentials and its propagations
2.	To design bio amplifier for various physiological recordings
3.	To know the measurement techniques of electrical parameters
4.	To learn the different measurement techniques for non-physiological parameters.
5.	To summarize different biochemical measurements.

UNIT - I	FUNDAMENTALS OF BIO POTENTIAL ELECTRODES	9

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, Contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits.

UNIT - II	SIGNAL CONDITIONING CIRCUITS	9

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Artifacts and removal.

UNIT - III	MEASUREMENT OF ELECTRICAL PARAMETERS	9

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven‘s triangle, standard 12 lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar,bipolarandaveragemode.EMG–unipolarandbipolarmode.RecordingofERG,EOG and EGG

UNIT - IV	MEASUREMENT OF NON-ELECTRICAL PARAMETERS	9

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement:Indicatordilution,thermaldilutionanddyedilutionmethod,Electromagneticand ultrasound blood flow measurement.

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UNIT - V	BIOCHEMICAL MEASUREMENTANDBIOSENSORS	12
Biochemical sensors - pH, pO_2 and pCO_2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, colorimeter, Sodium PotassiumAnalyser,spectrophotometer,bloodcellcounter,autoanalyzer(simplifiedschematic description) – Bio Sensors – Principles –applications.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Compare the different bio potentials and its propagations.
CO2	Design bio amplifier for various physiological recordings.
CO3	Illustrate the various techniques of electrical parameters.
CO4	Explain various technique of non-electrical phycological measurements.
CO5	Classify different biochemical measurement and biosensors.

Text Books	
1.	Leslie Cromwell, —Biomedical Instrumentation and measurement, 2nd edition, Prentice hall of India, New Delhi, 2015.

Reference Books	
1.	John G. Webster, Medical Instrumentation Application and Design, 4th edition, Wiley India PvtLtd,New Delhi, 2015.
2.	Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 2004.
3.	MyerKutz, Standard Hand book of Biomedical Engineering and Design, McGrawHill Publisher, 2003.
4.	Khandpur R.S, Handbook of Biomedical Instrumentation, 3rd edition, Tata McGraw- Hill, New Delhi,2014.

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B.E	B19BMT502 – BIOMECHANICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the overview of biomechanics.
2.	To learn about the cardiac mechanics.
3.	To learn about the orthopedic mechanics.
4.	To understand the Orthopaedic applications.
5.	To understand the various mathematical models for biomechanics application.

UNIT - I	INTRODUCTION	9

Scope of mechanics in medicine, mechanics of bone structure, determination of in-vivo elastic modulus. Bio fluid mechanics, flow properties of blood. Anthropometry.

UNIT - II	CARDIACMECHANICS	9

Cardio vascular system, Mechanical properties of blood vessels: arteries, arterioles, capillaries, veins, prosthetic heart valves & replacements.

UNIT - III	ORTHOPAEDICMECHANICS	9

Mechanical properties of cartilage, Diffusion properties of articular cartilage, Mechanical properties of bone, Kinetics &Kinematics of joints, Lubrication of joints.

UNIT - IV	ORTHOPAEDIC APPLICATIONS	9

Human locomotion: Gait cycle, Chemistry of normal locomotion, above knee, below knee prosthesis, Foot braces, Multitask exoskeletal walking devices for paraplegics. Biomechanical analysis of scoliotic spine, Use of ISIS.

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UNIT - V	MATHEMATICAL MODELS	12
Introduction to Finite Element Analysis, Mathematical models - pulse wave velocities in arteries, determination of in-vivo elasticity of blood vessel, dynamics of fluid filled catheters. Numerical finite element models in hard tissue mechanics, Soft tissue mechanics.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Interpret the use of mechanics in medicine.
CO2	Explain the cardiac mechanics
CO3	Infer about Orthopaedic mechanics
CO4	Develop the models specific to orthopaedic applications.
CO5	Analyze the biomechanical systems using mathematical models

Text Books	
1.	Y.C.Fung,—Bio-Mechanics, “Mechanical Properties ofTissues’’,Springer- Verilog,1998.
2.	C. Ross Ether and Craig A.Simmons, “Introductory Biomechanics from cells to organisms”, Cambridge University Press, New Delhi,2009.

Reference Books	
1.	Susan J Hall, “Basics of Biomechanics’’, Mc Graw Hill Publishing.co. New York,5th Edition, 2007.
2.	Dhanjoo N.Ghista, “Orthopaedic Mechanics”, Academic Press,1990.
3.	Joseph D.Bronzino, “Biomedical Engineering Fundamentals”, Taylor& Francis, 2006.
4.	John Enderle, Susanblanchard, Joseph Bronzino, “Introduction to Biomedical Engineering’’, Elsevier, 2005.
5.	B.H.Brown, PV Lawford, RH Small wood, DR Hose, Dc Barber, “Medical Physics and Biomedical Engineering’’, CRC Press,1999.
6.	Dhanjoo N.Ghista, “Bio-mechanics of Medical Devices”, Marcel Dekker, 1980. Haufred Clynes, “Bio-medical Engineering Systems’’,McGrawHill,1998.

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Professional Elective - I

B.E	B19BME501 – BIOMEMS AND NANOTECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the outline of MEMS and Nanotechnology.
2.	To study the fabrication techniques in MEMS and Nanotechnology.
3.	To understand different types of sensors and actuators and their principles of operation.
4.	To learn about micro-opto electromechanical systems and microfluidics.
5.	To know the applications of MEMS and Nanotechnology in medicalfield.

UNIT - I	INTRODUCTION TO MEMS&NANOTECHNOLOGY	9
Introduction to BioMEMS and Nanotechnology, Development of MEMS technology- Comparison of microsystems and microelectronics - Materials for MEMS-Smart Materials and Structures- Applications of MEMS.		

UNIT - II	FABRICATIONTECHNIQUES	9
Bottom up and top down methods of synthesis- Self-assembly , lithography techniques, etching - Ion implantation, surface micro machining- LIGA process-CVD technique.		

UNIT - III	MEMS SENSORSANDACTUATORS	9
Sensing and Actuation- Piezo resistive and Capacitive sensing -Electrostatic actuation - Pressure sensors - Accelerometers, Gyroscopes, Nanopore sensors magnetic sensors, Thermal sensors and actuators.		

UNIT - IV	MICRO-OPTO ELECTROMECHANICAL SYSTEMSANDMICROFLUIDICS	9
FundamentalprincipleofMOEMSTechnology-LightModulators,Beamsplitter,Micro-lens, Micromirrors - Digital Micro-mirror Device, Light detectors - Important Consideration on Micro-scalefluid,Propertiesoffluid-FluidActuationMethods,Micro-pumps-TypicalMicro- fluidic Channel, Micro fluid Dispenser.		

UNIT - V	APPLICATIONS OF MEMS AND NANOTECHNOLOGYINMEDICINE	9
Biochip, Drug delivery system, DNA sensor, Micro-dialysis - Monitoring of Glucose & Lactate with a micro-dialysis probe, Ammonia Monitoring - Electronic Nose, Biomolecular sensing for cancer diagnostics using carbon nanotubes, Carbon nanotube biosensors, Magnetic nanoparticles for MR Imaging, Nano-devices in biomedicalapplications.		
		Total Instructional hours : 45

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Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the fundamentals of micro and nanotechnology.
CO2	Classify the fabrication techniques of micro and nanotechnology.
CO3	Explain the types of MEMS sensor and actuators.
CO4	Outline the Micro-opto electromechanical systems & microfluidics.
CO5	Illustrate about the recent applications of MEMS and nanotechnology in medicine.

Text Books	
1.	Steven s Saliterman, "Fundamentals of Biomems and Medical Microdevices" ,Spie press, USA, 2006.
2.	Desai, Sangeeta Bhatia, 'Biomedical Nanotechnology : Therapeutic Micro \ nanotechnology - VOL 3, Springer, New York, 2006.

Reference Books	
1.	Tai Ran Hsu, MEMS and Microsystems design and manufacture, Tata McGraw Hill Publishing Company, New Delhi, 2002.
2.	Stephen D Senturia. Microsystem Design, Springer, New Delhi, 2011.
3.	Chang Liu,' Foundations of MEMS', Pearson Education International, NewJersey, USA, 2006.
4.	Nitaigour Premchand Mahalik, MEMS, Tata McGraw Hill PublishingCompany, New Delhi, 2007.

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B.E	B19BME502 – MEDICAL PHYSICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the the principles of radio active nuclides.
2.	To learn the interaction of radiation withmatter.
3.	To demonstrate the application of ultrasound inmedicine.
4.	To explain the application of opticalradiation.
5.	To understand the concepts of Laser inmedicine.

UNIT - I	PRINCIPLES OFRADIOACTIVENUCLIDES	9
Radioactivity - General properties of alpha, beta and gamma rays - Laws of radioactivity – Half life and Average Life - Laws of successive transformations - Natural radioactive series - Radio active equilibrium - Alpharayspectra - Betaray spectra - Gammaemission – Electron capture - Internal conversion - Nuclear isomerism – Artificial radio activity.		

UNIT - II	INTERACTION OF IONIZING RADIATIONWITHMATTER	9
Interaction of charged particles with matter – Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter - Photoelectric effect, Compton Scattering, Pairproduction, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance.		

UNIT - III	ULTRASOUND INMEDICINE	9
Production, properties and propagation of ultrasonic waves - Bioacoustics – Acoustical characteristics of human body - Ultrasonic Dosimetry - High power ultrasound in theraphy – Ultrasound cardiography (UCG) – Doppler effect - Double doppler shift – doppler systems - ultrasonic tomography - applications of ultrasound in medicine.		

UNIT - IV	APPLICATIONS OFOPTICALRADIATION	9
Introduction to optical radiations - UV, visible and IR sources - Lasers: Theory and mechanism- Lasers in Surgery - fluence measurement from optical sources - Optical properties of tissues – interaction of laser radiation with tissues– photothermal - photochemical – photoablation – electromechanical effect		

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UNIT - V	LASERSIN MEDICINE	9
Lasers in medicine-applications of Ultrafast pulsed Lasers -Lasers indermatology, oncology and cell biology - Lasers in blood flow measurement - Fiber optics in medicine -microscopy in medicine - birefringence - Fluorescence microscope - confocal microscope - Hazards of lasers and their safety measures.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the principle of radio nuclides.
CO2	Explain the interaction of radiation with matter.
CO3	Infer the application of ultrasound in medicine.
CO4	Summarize the application of optical radiation.
CO5	Outline application of Laser in Medicine.

Text Books	
1.	John R Cameron, James G Skofronick, “MedicalPhysics”, John-Wiley & Sons, 2002.
2.	W.J. Meredith and J.B. Massey, “Fundamental Physics of Radiology” Varghese Publishing house, 2011.

Reference Books	
1.	P. Uma Devi, A. Nagarathnam, BS Satish Rao, “Introduction to RadiationBiology”, B.I Chur Chill Livingstone Pvt. Ltd, 2000.
2.	S. Webb, “The Physics of Medical Imaging”, Taylor and Francis,1988.
3.	J.P.Woodcock, Ultrasonic, “Medical Physics Handbook series 1”, Adam Hilger, Bristol, 2002.
4.	Hylton B.Meire and Pat Farrant, “Basic Ultrasound”, John Wiley & Sons,1995.

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B.E	B19CST201 - PROGRAMMING IN C	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	9
Algorithms, building blocks of algorithms(instructions/statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving.		

UNIT - II	ARRAYSAND STRINGS	9
Introduction to C Programming – Operators and Expressions – Data Input and Output – Control Statements. Array: Defining an array – Processing an array –Types Strings : Defining a string –fixed length and variable length strings, strings and characters, string input, output, array of strings, string manipulation functions, sorting of strings.		

UNIT - III	FUNCTIONS, STORAGECLASSES	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 –array of pointers– pointers arithmetic– Dynamic memory allocation.		

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UNIT - V	STRUCTURES, UNIONSANDFILES	9
Structures and Unions: Defining a Structure – Processing a Structure – User defined data types (Typedef) – Unions. Files: Opening and Closing a Data File – Reading and writing a data file – Processing a data file – Unformatted data files – Concept of binary files – Accessing a file randomly using fseek.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student 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”, Schaums Outlines, Fourth Edition, Tata McGraw-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.W and Ritchie, D.M, “The C Programming language”, SecondEdition, Pearson Education,2006.

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B.E	B19BME503 – BIOMATERIALS AND CHARACTERIZATION	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the characteristics and classification of biomaterials
2.	To learn about the metallic and ceramic implant materials.
3.	To learn about the polymeric implant materials
4.	To study tissuere placements implants
5.	To understand the concept of biocompatibility and the methods for biomaterials testing

UNIT - I	STRUCTURE AND PROPERTIESOFBIO-MATERIALS	9
Definition and classification of bio-materials, mechanical properties, visco elasticity, wound healing process, body response to implants, blood compatibility, HLA compatibility.		

UNIT - II	IMPLANTMATERIALS	9
Metallic implant materials, stainless steels, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, carbons, medical applications		

UNIT - III	POLYMERICIMPLANTMATERIALS	9
Polymerization, polyamides, Acrylic polymers, Hydrogels, rubbers, high strength, thermoplastics, medical applications. Bio polymers: collagen and elastin. Medical Textiles: silica, chitosan, PLA, composites, Sutures, wound dressings. Materials for ophthalmology: contact lens, Intra ocular lens. Membranes for plasma separation and blood oxygenation		

UNIT - IV	POINTERS	9
Pointer Fundamentals – Pointer Declaration – Passing Pointers to a Function –array of pointers– pointers arithmetic– Dynamic memory allocation.		

UNIT - V	TESTINGOF BIOMATERIALS	9
Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilisation of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.		
		Total Instructional hours : 45

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Course Outcomes : At the end of the course the student will be able to	
CO1	Outline the different types of Biomaterials.
CO2	Explain metallic and ceramic implant materials.
CO3	Classify polymeric implant materials.
CO4	Summarize tissue replacement implants.
CO5	Select the testing standards applied for biomaterials.

Text Books	
1.	Sujata V. Bhatt, Biomaterials, Second Edition, Narosa Publishing House, 2005. Sreeram Ramakrishna,MuruganRamalingam,T.S.SampathKumar,andO.Winston.
2.	Soboyejo, Biomaterials: A Nano Approach, CRC Press,2010.
3.	John B.Park Joseph D. Bronzino, “Biomaterials - Principles and Applications” CRC Press, 4^{th} edition, 2003.

Reference Books	
1.	MyerKutz, Standard Hand book of Biomedical Engineering & Design, McGraw Hill, 2003.
2.	John Enderle, Joseph D. Bronzino, Susan M. Blanchard, Introduction to Biomedical Engineering, Elsevier, 2005.
3.	Park J.B., Biomaterials Science and Engineering, Plenum Press,1984.
4.	A.C. Anand, J.F. Kennedy, M. Miraftab, S. Rajendran, Wood head Medical Textiles and Biomaterials for Healthcare, Publishing Limited 2006.
5.	D F Williams, Materials Science and Technology: Volume 14, Medical and Dental Materials : A comprehensive Treatment Volume, VCH Publishers1992.
6.	Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. Implant biomaterials : A comprehensive review, World Journal of Clinical Cases, 2015.

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B.E	B19EEE506 – ELECTRICAL ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	Fundamentals of electrical circuit, magnetic-circuit and magnetic materials.
2.	Operation of three phase electrical circuits and measuring instruments for V, I, energy, power and instrument transformers.
3.	Operation on various types of transducers and their principles of operation.
4.	Constructional details, working principles of electrical machines and their performance.
5.	Introduction of electrical power system, renewable sources, protective devices and their field applications.

UNIT - I	INTRODUCTION TO ELECTRICAL ANDMAGNETIC CIRCUITS	9

Fundamentals of Electrical circuits – 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.

UNIT - II	POWER CIRCUITS ANDMEA SUREMENTS	9

Three Phase Supply – Instantaneous, Reactive and Apparent power– Power equation – Star/Delta Conversion – Units and standards – Characteristics of measurement– Errors in Measurement– Classification of errors– Calibration methods – Static calibration –Types of Instruments – moving coil and moving iron meters, Energy meter and watt meter – Instrument Transformers.

UNIT - III	TRANSDUCERS	9

Principle of operation, construction details, characteristics and applications of potentiometer, hot-wire anemometer, humidity sensor, Variable reluctance transducers, Hall Effect transducer,Magnetoelasticsensor,Digitaltransducers–Smartsensors-Fibreopticsensors- Film sensors- Introduction to MEMS and Nanosensors.

UNIT - IV	ELECTRICAL MACHINES	9

DC Machines: D.C generators & D.C motors: Principle of operation, constructions, types, Applications-A. CMachines:Types-IntroductiontoAlternators-SinglePhaseandThreephase induction motors: principle of operation, Types and Applications-Transformers: Principles of operation, Constructional Details, Types and Applications- Auto Transformers- Basics of Stepper Motor – Brushless DCmotors.

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UNIT - V	ELECTRICAL POWER SYSTEM ANDITS APPLICATION	9
Introduction to Power generation, distribution and Transmission of electrical energy – PowersupplycircuitswithSMPS,UPS,Batteries:Types,Principleofoperation.SmartGrid based on solar and wind energy systems-Power quality issues- Protection need for earthing, fuses and circuit breakers-Evolution of Smart Grid challenges and issues – Application of IOT in modern Power system-Impact Analysis.		
Total Instructional hours : 45		

Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the magnetic circuits and introduce the magnetic materials.
CO2	Explain the concept of three phase power circuits, measurements and instrument transformers.
CO3	Analyze the various types of transducers.
CO4	Explain the knowledge on electrical machines and on its efficient operating principle.
CO5	Analyze existing power distribution and hence apply technology in electrical Applications.

Text Books	
1.	D.P. Kothari and I.J Nagrath, "Basic Electrical Engineering", McGraw Hill Education (India) Private Limited, Third Edition, New Delhi,2010.
2.	T. Thyagarajan, K.P Sendur Chelvi, T.R.Rangaswamy" Engineering Basics - Electrical, Electronics and Computer Engineering", New Age International Private Limited, ThirdEdition, New Delhi, 2015.

Reference Books	
1.	S.Salivahanan,R.Rengaraj and G.R.Venkatakrishnan,-"Basic Electrical, Electronics and Measurement Engineering", McGraw Hill Education (India), Private Limited, Third Edition, New Delhi, 2018.
2.	A.K.Sawhney,-"Electrical & Electronics Measurement and Instrumentation",10th edition, DhanpatRai & Co, New Delhi, 19th revised edition 2011, Reprint 2014.

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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 SPEEDAEROFOILS	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	LEVELINGOF FLIGHT	9

Forces Acting on the Aircraft - Balancing the four forces - Loads on tail plane - Effects of downwash - Tailload 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	TRANSONICFLIGHTS	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 : At the end of the course the student will be able to	
CO1	Explain the Characteristics, Design and Nomenclature of Airfoil Sections.
CO2	Identify the Forces Acting on the Aircraft and Its Effects to make the Aircraft Flying for Maximum Range and Endurance.
CO3	Illustrate the different types of Aircraft maneuvering during flight.
CO4	Outline the effect of shock waves, critical Mach number during transonic
CO5	Identify the supersonic flow over an Aero foil and able to examine its

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.
2.	Cook MV. “Flight dynamics principles: a linear systems approach to aircraft stability and control”. Butterworth-Heinemann; 2012.
3.	Miele A. “Flight mechanics: theory of flight paths”. Courier Dover Publications; 2016.
4.	Kermode AC. “Mechanics of flight”. Longman Scientific & Technical”; 1987.
5.	Von Mises R. “Theory of flight. Courier Corporation”; 1959

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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	9

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	ENVIRONMENT ALIMPACTS	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	9

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

UNIT - IV	ECOLOGICAL DIVERSITYAND AGRICULTURE	9

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	9
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	Studentswillbeabletounderstandtheenvironmentalconcernsandimpacts in agriculture.
CO2	They are able to acquire knowledge on technological interventions like mechanization, watershed development and irrigation in agriculture.
CO3	They are able to apply climate change and its issue in agriculture.
CO4	They are able to create a Capacity building on the focus areas for ecological farming and agriculture biotechnology issues.
CO5	They are able to apply 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/

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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,freezingpointandfreezingrate,freezingmethods:Airfreezing,plate freezing, liquid immersion freezing and cryogenic freezing. Freezer selection. Advantages and disadvantages of freezing.

Drying:Definition,freeandboundmoisture,conceptofwateractivity,factorsaffectingdrying, Dryingmethodsandequipments:sun/solardrying,Cabinetdrying,tunneldryer,spraydryer, 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).

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.

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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 lifeof 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 Potterand Joseph H.Hotchkiss. “Food Science”, 5th Ed.,CBS Publishers and Distributors,1996.
3.	Barbosa-Canovas. “Novel Food Processing Technologies”, Tapia &Cano CRC Press,2004.
4.	Gould GW, “New Methods of Food Preservation”, Springer Science &Business Media. 2012.
5.	Rahman MS. “Food Preservation”, In: Handbook of Food Preservation, 2nd Ed. (pp. 14- 29). CRC press, 1999.
6.	Subbulakshmi G and AS Udipi. “Food Processing and Preservation”, New Age Publications, 2006.

Reference Books	
1.	ManayS and MSSwamy, “Foods: Facts and Principles”, 4^{th} Ed. NewAge Publishers,2004.
2.	DemanJM.“PrinciplesofFoodChemistry”,2^{nd} Ed.,VanNostrandReinhold,NY.,1990.

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B.E./ B.TECH	B19CSO501 – FUNDAMENTALS OF DBMS (Common to all Except CSE)	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 Systems – An Over View – Meaning, Definition – Components – Objectives – Advantages and Disadvantages – Evolution.		

UNIT - II	MODELS	9
DBMSArchitecture–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
SQLDataDefinitionandDataTypes-SQL-SpecifyingConstraints-KeyandReferentialIntegrity Constraints - Basic Retrieval Queries in SQL- Joins –Sub queries –Nested subquery.		

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

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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 unit50%)
3.	C.J.Date,A.Kannan,S.Swamynathan,"AnIntroductiontoDatabaseSystems",EighthEdition, Pearson Education,2006.
4.	Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, McGraw-Hill College Publications, 2015.

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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 inDCS

UNIT - I	PROGRAMM ABLELOGIC 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	Understand the PLC
CO2	Apply PLC in various applications
CO3	Understand the concepts of Computer Controlled Systems
CO4	Acquire knowledge about various architectures of DCS
CO5	Analyze the various interfaces in DCS

Text Books	
1.	F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw 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.	KrishnaKant, “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 Engineers Guide, Elsevier,2013

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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 - Fluxlinkage, 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

Principleandoperations-typesofDCMotors–SpeedTorqueCharacteristicsofDCMotors startingandspeedcontrolofDCmotors–Plugging,dynamicandregenerativebrakingtesting and efficiency – Permanent Magnet DC (PMDC) motors-applications of DC Motor (Qualitative Only).

UNIT - IV	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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B.E./ B.TECH	B19MEO501 – ROBOTICS (Common to all Except Mechanical)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of the basic components of arobot
2.	To apply the distinct drive systems and end effectors to control the robot actuation
3.	To study the role and application of various types of sensors and machine vision system
4.	To make use of the knowledge in the robot kinematics and to write Robot Programs
5.	To identify the social and economic challenges while implementing the robot systems

UNIT - I	FUNDAMENTALSOF ROBOT	9

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification-Specifications-Pitch,Yaw,Roll,JointNotations,SpeedofMotion,PayLoad- Robot Parts and their Functions-Different Applications - A view on Global and Indian manufacturers of Robots - Need for Robots in Indian environment.

UNIT - II	ROBOT DRIVE SYSTEMS AND END EFFECTORS	9

Drives - hydraulic, pneumatic, mechanical, electrical, Servo motors, Stepper motors- salient features, application; End effectors – types; Grippers- mechanical, pneumatic, hydraulic, magnetic, vacuum - limitations, Multiple grippers.

UNIT - III	SENSORS AND MACHINE VI	9

Requirements of sensors, principles, types and applications of Proximity (Inductive, Hall effect, Capacitive, Ultrasonic and Optical); – Range (Triangulation, Structured light approach);Speed,Position(resolvers,opticalencoders);–Force–Torque–Touchsensors (binary, analog sensor). Introduction to Machine Vision; applications, functions; image processing and analysis; training the vision system.

UNIT - IV	ROBOT KINEMATICS AND ROBOT PROGRAMMING	9

ForwardkinematicsandReversekinematicsofmanipulators;two,threedegreesoffreedom, homogeneous transformation matrix; introduction to manipulator dynamics, trajectory generator, manipulator mechanism, Degeneracy and Dexterity; Lead through programming, Robot programming languages; VAL programming, motion commands, sensor commands, endeffectercommands,simpleprograms(forloading,unloadingandpalletizingoperations), introduction to advances in RobotProgramming.

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UNIT - V	APPLICATION, IMPLEMENTATION AND ROBOT ECONOMICS	9
Robot cell design; types, application of robots in processing, assembly, inspection, material handling in automobile, medical, Nuclear Industries, RGV, AGV; Implementation of Robots in Industries; Safety considerations for robot operations, safety codes, Economic analysis of robots.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the concepts of industrial robots, classification, specifications and coordinate systems.
CO2	Illustrate the different types of robot drive systems as well as robot end effectors.
CO3	Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
CO4	Develop robotic programs for different operations and familiarize with the kinematic smotions of robot.
CO5	Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

Text Books	
1.	Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2012.
2.	Deb S R and Deb S, “Robotics Technology and Flexible Automation”, TataMcGraw Hill Education Pvt. Ltd,2010.
3.	Saha S K, “Introduction to Robotics”, Tata McGraw Hill Education Pvt. Ltd, 2010, 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.
3.	Ashitava Ghoshal, “Robotics-Fundamental Concepts and Analysis”, OxfordUniversity Press, Sixth impression,2010

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B.E.	B19ECP501 - DIGITAL SIGNAL PROCESSING LABORATORY (Common to ECE and BME)	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To implement generation of sequences
2.	To realize Linear and Circular Convolution
3.	To design and realize FIR and IIR filters
4.	To implement signal processing algorithms using digital signal processor

List of Experiments	
Expt. No.	**List of Analog Experiments**
	MATLAB / Equivalent Software package
1.	Generation of sequences
2.	Linear and Circular Convolutions
3.	Auto correlation and Cross Correlation
4.	DFT
5.	FIR filter design
6.	IIR filter design
7.	Finite word length effects
	DSP Processor (TMS320C5x and TMS320C3x) Implementation
8.	Study of architecture of Digital Signal Processor
9.	MAC operation using various addressing modes
10.	Implementation of difference equations

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11.	Linear Convolution and Circular Convolution
12.	Waveform generation
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Ability to implement simulation of signal processing algorithms.
CO2	Ability to demonstrate the frequency domain analysis using DFT.
CO3	Ability to demonstrate system realization using digital signal processor.

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

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B.E.	B19BMP501 – BIOMEDICAL INSTRUMENTATION LABORATORY	T	P	TU	C
		0	2	0	2

Course Objectives	
1.	To demonstrate on designing of ECG and EMG acquisition system
2.	To measure physiological parameters and biochemical parameters.
3.	To demonstrate the optical Isolation amplifiers
4.	To design EOG acquisition system
5.	To design a PCB layout using software tool

List of Experiments

Expt. No.	Description of the Experiments
1.	Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC's
2.	Design of ECG Amplifiers to detect QRS complex and measure heartrat.
3.	Design of EMG amplifier
4.	Design of frontal EEG amplifier.
5.	Design of EOG amplifier to detect eye blink.
6.	Design and study the characteristics of optical Isolation amplifiers.
7.	Measurement of pulse-rate using Photo transducer.
8.	Measurement of blood pressure using a sphygmomanometer.
9.	Measurement and recording of peripheral blood flow using Doppler Flow meter.
10.	Design a PCB layout for any bio amplifier using a suitable software tool.
	Total Instructional hours : 30

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Course Outcomes : Students will be able to	
CO1	Design preamplifiers and amplifiers for various ECG, EMG and EEG
CO2	Measure various non-electrical parameters using suitable sensors/transducers
CO3	Design optical isolation amplifier
C04	Design amplifier for EOG
C05	Design PCB layout for any bio amplifier

Lab Requirements for a Batch of 30 Students	
1.	Photo transducer for pulse measurement: 1No.
2.	Sphygmomanometer and Stethoscope: 1No.
3.	Blood flow measurement system: 1No.
4.	Multiparameter (ECG, EMG, EEG) Simulator: 2No.
5.	Function generator, DSO, Regulated Power supplies, Bread boards – 8each
6.	IC LM 324, AD 620, INA series (126,128 etc.), 555 Timer: 20each
7.	Opto Isolator IC: MCT2E – 1No.
8.	Software tool for PCB design:1

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

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B.E.	B19CEP502- OPERATION AND TESTING OF BIOMEDICAL EQUIPMENTS	T	P	TU	C
		0	2	0	2

Course Objectives	
1.	To demonstrate the working of Biomedical Equipment
2.	To perform testing and calibration of Biomedical Equipment

List of Biomedical Equipment	
1.	Patient Monitor
2.	ECG Machine
3.	EEG Machine
4.	Defibrillator
5.	Oxygen Concentrator
6.	Syringe pump and Infusionpump
7.	Fetal Monitor
8.	Electro surgery Unit
9.	Ventillator
10.	Equipment testing and calibration

Total Instructional hours : 30

Course Outcomes : At the end of the course the student will be able to	
CO1	Demonstrate the working of diagnostic &therapeutic equipment
CO2	Take part in the testing and calibration of equipment

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Semester - VI

B.E	B19ECT601 – MICROPROCESSORS AND MICROCONTROLLERS (COMMON TO ECE, CSE AND BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the architecture of 8085,8086.
2.	To explore the need and use of Peripherals and Interfacing.
3.	To study the architecture of8051.
4.	To develop skill to explore system design technique.
5.	To study the ARM architecture

UNIT - I	8 - BIT and 16 – BITMICRO PROCESSOR	9

Indrodution to 8085,8086 Architecture, Instruction set and programming, Addressing modes, Minimum and Maximum mode configurations, Coprocessor, Multiprocessor.

UNIT - II	PERIPHERAL SANDINTER FACING	9

Programmable Peripheral Interface (8255), Keyboard display controller (8279), ADC0808 and DAC0808 Interface, Programmable Timer Controller (8254), Programmable interrupt controller (8259), Serial Communication Interface (8251), DMA controller (8257).

UNIT - III	MICROCONTROLLER	9

8051 – Architecture, Special Function Registers (SFRs), Instruction set, Addressing modes, Assembly language programming, I/O Ports, Timers / counters, Interrupts and serial communication.

UNIT - IV	ORTHOPAEDIC APPLICATIONS	9

Interfacing to: matrix display, (16x2) LCD, high power devices, optical motor shaft encoder, Stepper Motor, DC Motor speed Control using PWM, RTC and EEPRO Minter face using I 2C protocol.

UNIT - V	32 - BIT ARMPROCESSOR	12

RISCVs CISC Architecture, ARM Processor Architecture, ARM Coredata flow model, Barrel Shifter, ARM processor modes and families, pipelining , ARM instruction Set and its Programming.

Total Instructional hours : 45

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Course Outcomes : At the end of the course the student will be able to	
CO1	Outline the architectures of 8085 and 8086
CO2	Build and verify applications using peripheral interfacing with8085/8086
CO3	Construct the 8051 microcontroller based systems
CO4	Apply the 8051 microcontroller programs in various interfacing circuits
CO5	Discriminate among different processor organization

Text Books	
1.	Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085". Penram International Publishing reprint, 6th Edition,2017.
2.	Douglas V. Hall, "Microprocessor and Interfacing, Programming and Hardware", Tata McGraw Hill, Revised 2 nd Edition 2006, 11th reprint2015.
3.	Raj kamal, "Embedded Systems: Architecture, Programming And Design", 3rd edition McGraw-Hill Education,2008

Reference Books	
1.	Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education 2008. 12th impression 2018
2.	Krishna Kant, "Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096'', PHI, 2007, 7th Reprint,2015.
3.	Kenneth J. Ayala., "The 8051 Microcontroller, 3rd Edition, Thompson DelmarLearning'', 2012.
4.	A.K.Ray,K.M.Bhurchandi,"Advanced Microprocessor and Peripherals'',TataMcGraw- Hill, 2 nd Edition, 2010.
5.	Barry B.Brey,"The Intel Microprocessors Architecture, Programming and Interfacing'',Pearson Education, 2007, 2 nd impression, 2010.

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B.E	B19BMT601 - DIAGNOSTIC AND THERAPEUTIC EQUIPMENT - I	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To classify the medical equipment used in the measurement of parameters related to cardiology
2.	To explain the equipment used in neurology
3.	To demonstrate EMG recording unit and its uses.
4.	To explain diagnostic and therapeutic devices related to respiratory parameters.
5.	To Illustrate the various sensory measurements that hold clinical importance.

UNIT - I	CARDIAC EQUIPMENT	9
Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker- Internal and External Pacemaker– Batteries, Synchronous Defibrillator, A.C., D.C. Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter.		

UNIT - II	NEUROLOGICAL EQUIPMENT	9
Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential–Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio-Feedback Instrumentation. EEG system maintenance and troubleshooting.		

UNIT - III	MUSCULAR AND BIOMECHANICAL MEASUREMENTS	9
Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio-Feedback Instrumentation. Static Measurement – Load Cell, Pedobarograph. Dynamic Measurement – Velocity, Acceleration, GAIT, Limb position.		

UNIT - IV	RESPIRATORY MEASUREMENT SYSTEM	9
Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, Pneumotacho meter – Airway resistance measurement, Whole body Plethysmograph, Intra-Alveolar, and Thoracic pressure measurements, Apnoea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.		

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UNIT - V	SENSORY MEASUREMENT	12
Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the working and recording setup of all essential cardiac equipment.
CO2	Summarize the working and recording of all essential neurological equipment.
CO3	Illustrate muscular and biomechanical measurements
CO4	Explain about respiratory measurement system.
CO5	Show the measurement techniques of sensory responses.

Text Books	
1.	Joseph J. Carr and John M. Brown, “Introduction to Biomedical equipment technology”, Pearson Education, 4th Edition, 2014.
2.	John G.Webster, “Medical Instrumentation Application and Design”, John Wiley and Sons, New York, 4th Edition, 2009.

Reference Books	
1.	Myer Kutz, “Biomedical Engineering & Design Handbook: Volume 2”, McGraw-Hill Publisher, 2nd Edition, 2009.
2.	L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, John Wiley and Sons, 3rd Edition, Reprint 2008.
3.	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, “Biomedical Instrumentation and Measurements”, Pearson Education India; 2nd Edition, 2015.
4.	Antony Y.K.Chan, Biomedical Device technology, Principles and design”, Charles Thomas Publisher Ltd, Illinois, USA, 2008

BoS Chairman

B.E	B19BMT602 – RADIOLOGICAL EQUIPMENT	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand generation of x-rays and its applications in imaging.
2.	To explain the principle of Computed Tomography.
3.	To learn the concepts of Magnetic Resonance Imaging
4.	To know techniques of nuclear imaging system
5.	To gain the knowledge of ultrasound imaging system

UNIT - I	MEDICAL X-RAY EQUIPMENT	9

Nature of X-rays, X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-RayTube, collimator, Bucky Grid, power supply. Digital Radiography-discrete digital detectors, storage phosphor and film scanning. Computed Radiography, Fluoroscopy - X-ray Image Intensifier tubes – Digital Fluoroscopy. Angiography - cine Angiography, Digital subtraction Angiography. Mammography.

UNIT - II	MAGNETICRE SONANCE IMAGING	9

Principles of tomography, CT Generations - X- Ray sources, collimation, X- Ray detectors, Viewing systems, spiral CT scanning, ultra-fast CT scanners, Image reconstruction techniques, back projection and iterative method.

UNIT - III	MUSCULAR AND BIOMECHANICAL MEASUREMENTS	9

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radiofrequency wave, rotation and precession. Induction of magnetic resonance signals – bulk Magnetization, Relaxation processes T1 and T2.Slice Selection, Phase encoding and Frequency Encoding, Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), Gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components. fMRI.

UNIT - IV	NUCLEAR IMAGING SYSTEM	9

Radio Isotopes, Radiopharmaceuticals, Radiation detectors –gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors.Gamma camera- Principle of operation, collimator, photo multiplier tube, pulse height Analyzer, Nuclear imaging – Anger scintillation camera –Nuclear tomography – Single Photon Emission Computed Tomography, Positron Emission Tomography.

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UNIT - V	ULTRASONIC IMAGING SYSTEM	12
Diagnostic Ultrasound, Physics of Ultrasonic waves, Basic pulse-echo apparatus, Principles of A-Mode, B-Mode, M-Mode, Real time Ultrasonic (B-Scan) imaging systems, Requirements, Multielement Linear array scanners, Digital scan converters, Biological effects of ultrasound.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Ilustrate the X ray and fluoroscopic principles and its working
CO2	Show the principles and working of CT machines, and differentiate its Reconstruction techniques.
CO3	Translate about the principles of MRI techniques
CO4	Make use of the techniques of nuclear imaging systems
CO5	Explain the concept of ultrasound imaging system

Text Books	
1.	Steve Webb, "The Physics of Medical Imaging'', Adam Hilger,Philadelpia, 1988.
2.	Jerrold T.Bushberg, J.Anthony Seibert, Edwin M.Leidholdt,Jr, John M.Boone, 'The Essential Physics of Medical Imaging'', Lippincott Williams and Wilkins, 3rd Edition, 2012.
3.	R.Hendee and Russell Ritenour, "Medical Imaging Physics", William,Wiley- Liss, 4th Edition, 2002.

Reference Books	
1.	Gopal B. Saha, "Physics and Radiobiology of Nuclear Medicine'', Springer, 3rd Edition 2006
2.	B.H.Brown, PV Lawford, RH Smallwood, DR Hose, DC Barber, "Medical physics and Biomedical Engineering'', - CRC Press,1999.
3.	Myer Kutz, "Standard handbook of Biomedical Engineering and design", McGraw Hill, 2003.
4.	P.Ragunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine concepts and Techniques'', Orient Longman,2007. M. Analoui, J.D. Bronzino, D.R.Peterson, "Medical Imaging: Principles and Practices", CRC Press, 2012.

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Professional Elective - II

B.E	B19BME601 - TELEHEALTH TECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn the key principles for telemedicine and health.
2.	To understand telemedicine technology.
3.	To study the telemedicine standards
4.	To know the concepts of mobile telemedicine
5.	To understand different applications of telemedicine

UNIT - I	TELEMEDICINE AND HEALTH	9

History and Evolution of telemedicine, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT - II	TELEMEDICINE TECHNOLOGY	9

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication, Mobile communication.

UNIT - III	TELEMEDICINE STANDARDS	9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series Video Conferencing, Security and confidentiality of medical records, Cyber laws related to telemedicine

UNIT - IV	MOBILE TELEMEDICINE	9

Tele radiology: Image Acquisition system Display system, Tele pathology, Medical information storage and management for telemedicine- patient information, medical history, test reports, medical images, Hospital information system

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UNIT - V	TELEMEDICINE APPLICATIONS	9
Telemedicine – health education and self care. • Introduction to robotics surgery, Telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Business aspects - Project planning and costing, Usage of telemedicine.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Ilustrate the basic concept of telemedicine and health
CO2	Explain the various telemedicine technology
CO3	Summarize about telemedicine standards
CO4	Utilize mobile telemedicine in hospitals
CO5	Plan telemedicine application for healthcare

Text Books	
1.	Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002
2.	Khandpur.R.S ," Handbook of Biomedical Instrumentation", TataMc Graw Hill, New Delhi,2003

Reference Books	
1.	Khandpur.R.S ," Telemedicine –Technology and Applications", PHI Learning Pvt.Ltd, New Delhi 2017
2.	O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health
3.	Informatics and Information Systems", Springer, 2003.
4.	Ferrer-Roca, O., Sosa - Iudicissa, M. (Eds.), "Handbook of Telemedicine", IOS Press (Studies in Health Technology and Informatics), Volume 54, 2002

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B.E	B19BME602 - BODY AREA NETWORKS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of BAN
2.	To know the hardware requirement of BAN
3.	To understand the communication and security aspects in the BAN
4.	To learn about the issues with BAN
5.	To know the applications of BAN in the field of medicine

UNIT - I	INTRODUCTION	9
Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.		

UNIT - II	HARDWARE FOR BAN	9
Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.		

UNIT - III	WIRELESS COMMUNICATION AND NETWORK	9
RF communication in Body, Antenna design and testing, Propagation, Base Station-Network Topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee.		

UNIT - IV	COEXISTENCE ISSUES WITH BAN	9
Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory Issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.		

UNIT - V	APPLICATIONS OF BAN	9
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.		
		Total Instructional hours : 45

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Course Outcomes : At the end of the course the student will be able to	
CO1	Summarize the significance and role of this course in the present contemporary world.
CO2	Design a BAN for appropriate application in medicine.
CO3	Assess the efficiency of communication and the security parameters.
CO4	Explain the need for medical device regulation and regulations followed in various regions.
CO5	Extend the concepts of BAN for medical applications.

Text Books	
1.	Annalisa Bonfiglio, Danilo De Rossi, “Wearable Monitoring Systems”, Springer, 2011.
2.	Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013.

Reference Books	
1.	Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.
2.	Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006.
3.	Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012.

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B.E	B19BME603 - BRAIN COMPUTER INTERFACE AND APPLICATIONS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basic concepts of brain computer interface
2.	To study the various signal acquisition methods
3.	To study the feature extraction methods
4.	To learn various feature translation methods
5.	To explain the applications of BCI

UNIT - I	INTRODUCTION TO BCI	9
Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Pre-processing – Artifacts removal.		

UNIT - II	ELECTROPHYSIOLOGICAL SOURCES	9
Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.		

UNIT - III	FEATURE EXTRACTION METHODS	9
Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR,MA, ARMA models – PCA – Linear and Non-Linear Features.		

UNIT - IV	FEATURE TRANSLATION METHODS	9
Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Machine Learning Techniques		

UNIT - V	APPLICATIONS OF BCI	9
Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.		
		Total Instructional hours : 45

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Course Outcomes : At the end of the course the student will be able to	
CO1	Summarize BCI system and its potential applications.
CO2	Analyze event related potentials and sensory motor rhythms.
CO3	Explain features suitable for BCI.
CO4	Design classifier for a BCI system.
CO5	Infer BCI for various applications.

Text Books	
1.	Chang S. Nam (Editor), Anton Nijholt (Editor), Fabien Lotte, " Brain–Computer Interfaces Handbook: Technological and Theoretical Advances", CRC Press, UK. 2018.
2.	Maureen Clerc, Laurent Bougrain, Fabien Lotte, "Brain Computer Interfaces 2: Technology and Applications", Wiley Publisher, 2016.

Reference Books	
1.	Portal Banerjee and Pallab Banerje., "Neural Network : Pattern Recognition using Neural Network", Lambert Academic Publishing, 2020.
2.	Furtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010.

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B.E	B19BME604 - ARTIFICIAL ORGANS AND IMPLANTS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To Learn about artificial organs & transplants
2.	To understand the principles of implant design with a case study
3.	To elaborate the implant design parameters and solution in use
4.	To classify various blood interfacing implants
5.	To study about soft tissue replacement and hard tissue replacement

UNIT - I	ARTIFICIAL ORGANS & TRANSPLANTS	9
Artificial organs-Introduction, outlook for organ replacements, design consideration, evaluation process. Transplants-Overview, Immunological considerations, Blood transfusions, individual organs –kidney, liver, heart and lung, bone marrow, cornea.		

UNIT - II	PRINCIPLES OF IMPLANT DESIGN	9
Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cellsand regulators criteria for materials selection, Case study of organ regeneration		

UNIT - III	IMPLANT DESIGN PARAMETERS AND ITS SOLUTION	9
Biocompatibility, local and systemic effects of implants, Design specifications for tissue bondingand modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wearand tear, Implants for Bone, Devices for nerve regeneration.		

UNIT - IV	BLOOD INTERFACING IMPLANTS	9
Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificialheart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.		

UNIT - V	IMPLANTABLE MEDICAL DEVICES AND ORGANS	9
Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair,replacement and augmentation, recent advancement and future directions.		
		Total Instructional hours : 45

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Course Outcomes : At the end of the course the student will be able to	
CO1	Outline the basics of artificial organs & transplants
CO2	Conclude the principles of implant design
CO3	Examine the implant design parameters and its solution
CO4	Explain about blood interfacing implants
CO5	Compare different types of soft tissue replacement and hard tissue replacement

Text Books	
1.	Kopff W.J, Artificial Organs, John Wiley and sons, New York, 1st edition, 1976.
2.	Park J.B., Biomaterials Science and Engineering, Plenum Press, 1984.

Reference Books	
1.	J D Bronzino, Biomedical Engineering handbook Volume II, (CRC Press / IEEE Press), 2000.
2.	R S Khandpur, Handbook of Biomedical Instrumentation,Tata McGraw Hill, 2003
3.	Joon B Park, Biomaterials – An Introduction, Plenum press, New York, 1992.
4.	Yannas, I. V, Tissue and Organ Regeneration in Adults, New York, NY: Springer, 2001. ISBN:9780387952147.
5.	Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition,2010.
6.	Standard Handbook of Biomedical Engineering and Design – Myer Kutz, McGraw- Hill, 2003

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B.E	B19BME605 - BIOSIGNAL PROCESSING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the characteristics of different bio signals
2.	To know the concepts of time series analysis
3.	To learn linear and non-linear filtering techniques to extract desired information
4.	To understand various techniques for automated classification and decision making to aiddiagnosis
5.	To understand the concepts of time frequency and multivariate analysis

UNIT - I	BIOSIGNAL AND SPECTRAL CHARACTERISTICS	9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiologicalnoises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectra Idensity and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT - II	TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION	9

Time series analysis – linear prediction models, process order estimation, lattice representation, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCGsignals, Time varying analysis of Heart-rate variability, model-based ECG simulator. Spectralestimation –Blackman Tukey method, periodogram, and model-based estimation. Application inHeart rate variability, PCG signals

UNIT - III	ADAPTIVE FILTERING AND WAVELET DETECTION	9

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering inECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

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UNIT - IV	BIOSIGNAL CLASSIFICATION AND RECOGNITION	9
Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.		

UNIT - V	TIME FREQUENCY AND MULTIVARIATE ANALYSIS	9
Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA,ICA.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Explain biosignal and spectral characteristics
CO2	Analyze biosignals in time domain & to estimate the spectrum.
CO3	Apply wavelet detection techniques for biosignal processing.
CO4	Classify biosignals using neural networks and statistical classifiers.
CO5	Infer the features using multivariate component analysis.

Text Books	
1.	Arnon Cohen, “Bio-Medical Signal Processing Vol I and Vol II”, CRC Press Inc., Boca Rato, Florida, 1999.
2.	Rangaraj M. Rangayyan, “Biomedical Signal Analysis-A case study approach”, Wiley, 2nd Edition, 2016.

Reference Books	
1.	Willis J. Tompkins, “Biomedical Digital Signal Processing”, Prentice Hall of India, New Delhi, 2003.

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2.	Emmanuel C. Ifeachor, Barrie W.Jervis, “Digital Signal processing-A Practical Approach’’,Pearson education Ltd., 2004.
3.	Raghuveer M. Rao and Ajith S.Bopardikar, “Wavelets transform – Introduction to theory and its applications”, Pearson Education, India, 2000.
4.	K.P.Soman, K.Ramachandran, “Insight into wavelet from theory to practice”, PHI, New Delhi, 3rd Edition, 2010.
5.	John L.Semmlow, “Biosignal and Biomedical Image Processing Matlab Based applications’’, Taylor& Francis Inc, 2004.
6.	Kayvan Najarian and Robert Splerstor, “Biomedical signals and Image processing’’, CRC –Taylor and Francis, New York, 2nd Edition, 2012.
7.	D.C.Reddy, “Biomedical Signal Processing – Principles and Techniques’’, Tata McGraw-Hill Publishing Co. Ltd, 2005.
8.	Gari D. Clifford, Francisco Azuajeand Patrick E.McSharry, “Advanced Methods and Tech for ECG Data Analysis”, ARTECH House, Boston, 1st Edition, 2006.

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

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Professional Elective - III

B.E	B19BME606 - MEDICAL DATA ANALYTICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn about data analytics
2.	To study different statistical tools related to medical data application.
3.	To gain knowledge on the key principles of various algorithms for regression
4.	To gain knowledge on various algorithms for classification
5.	To know about various computational tools

UNIT - I	INTRODUCTION TO HEALTHCAREDATA	9

Typical problems of data analysis , descriptive statistics , predictive modelling , health surveys - measure of disease risk and association , standardization of data - Introduction to spreadsheet - importing, coding and manipulating data , writing formulas and linking tables , pivot tables, what-if analysis and data displays.

UNIT - II	INTRODUCTION TO STATISTIC ALL EARNING	9

Probability - Bayes Rule - types of distributions - estimation of unknown function, prediction accuracy and model interpretability, supervised versus unsupervised learning, regression versus classification, modelling data, principles of guesstimation.

UNIT - III	ALGORITHMS FOR REGRESSION	9

Linear regression, ridge regression, the lasso, logistic regression, linear discriminant analysis- case studies.

UNIT - IV	ALGORITHMS FOR CLASSIFICATION	9

Introduction to R Package: Basic commands, Graphics, Indexing data, loading data, time series analysis, graphical multivariate analysis - analytics in clinical trials- predicting the medical devices life cycle-predicting deterioration of patient’s condition using EMR.

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UNIT - V	COMPUTATIONALTOOLS	9
Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid(H) Parameters, Interconnection of two port networks, Symmetrical properties of T and π networks.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Outline the basics of health care data
CO2	Identify the various statistical learning methods
CO3	Discuss and apply algorithms for regression
CO4	Analyze the algorithms for classification
CO5	Use various data computational tools

Text Books	
1.	Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani , "An Introduction to Statistical Learning ", Springer,2013.
2.	Trevor Strome, "Healthcare Analytics for Quality and Performance Improvement, Hoboken", John Wiley & Sons Inc.,2013

Reference Books	
1.	Victor A. Bloomfield, "Using R for Numerical Analysis in Science and Engineering", Chapman & Hall, CRC, 2014.
2.	Sarah Stowell, "Instant R: An Introduction to R for Statistical Analysis", Jotunheim Publishing,2012.
3.	Philipp K. Janet , "Data Analysis with Open Source Tools A hands-on guide for programmers and data scientists", O' Reilly Media,2010.

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B.E	B19BME607 – PHYSIOLOGICAL MODELLING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand basic ideas related to modeling.
2.	To learn different modelling techniques of physiological systems.
3.	To know the thermal regulatory systems.
4.	To learn the modelling of ultrafiltration system.
5.	To know about simulation of various physiological models

UNIT - I	BASICS OF PHYSIOLOGICALCONTROLSYSTEMS	9
Overview of physiological control systems, Physical, chemical and rheological properties of blood, problems associated with extracorporeal blood flow, dynamics of circulatory system.		

UNIT - II	ANALYSIS OFPHYSIOLOGICALMODELS	9
Static and dynamic analysis of physiological systems: regulation of cardiac output, blood glucose regulation, chemical regulation of ventilation, electrical model of neural control mechanism.		

UNIT - III	THERMALREGULATORYSYSTEM	9
Parameters involved, Control system model etc. Biochemistry of digestion, types of heat loss from body, models of heat transfer between sub system of human body and systems like within body and body-environment		

UNIT - IV	MODELING OFULTRAFILTRATIONSYSTEM	9
Ultra-FiltrationSystem:Transportthroughcellsandtubules,diffusion,facilitateddiffusionand active transport, methods of waste removal, counter current model of urine formation in nephron, Modeling Henle'sloop.		

UNIT - V	OTHER PHYSIOLOGICAL MODELSANDSIMULATION	9
Modelling oxygen uptake by RBC and pulmonary capillaries, Mass balancing by lungs, Gas transport mechanisms of lungs, oxygen and carbon di oxide transport in blood and tissues		
Total Instructional hours : 45		

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Course Outcomes : At the end of the course the student will be able to	
CO1	Summarize the basic of physiological control system
CO2	Analyze the physiological modeling
CO3	Outline the parameters involved in thermal regulatory system
CO4	Explain the Modelling of ultra-filtration system
CO5	Make use of the lung physiological models and its simulation

Text Books	
1.	David O Cooney, “Biomedical Engineering Principles”, Marcel Decker Pub. Co2002
2.	Michael C.K.Kho, “Physiological Control Systems”, Prentice Hall ofIndia,2000

Reference Books	
1.	John Enderly, Joseph Bronzino, “Introduction to Biomedical Engineering”,Third Edition, Academic Press Series in Biomedical Engineering,2012.
2.	Willian B.Blesser, “A System Approach to Biomedicine”, McGraw Hill Book Co.,New York, 2009
3.	ManfreoClynesandJohnH.Milsum,“BiomedicalEngineeringSystem”,McGrawHill and Co., New York , 2001

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B.E	B19MGE601– DISASTER MANAGEMENT	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the basics of disaster management
2.	To learn various approaches to disaster risk reduction
3.	To learn the relationship between disasters and development
4.	To study the disaster risk management in India.
5.	To know about various real time applications of disaster management

UNIT - I	INTRODUCTIONTODISASTERS	9
Definition:Disaster,Hazard,Vulnerability,Resilience,Risks–Disasters:Typesofdisasters– Earthquake, Landslide, Flood, Drought, Fire etc. – Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability – Global trends in disasters: urban disasters,pandemics,complexemergencies, Climatechange-DosandDon'tsduringvarious types of Disasters.		

UNIT - II	APPROACHES TO DISASTER RISKREDUCTION(DRR)	9
Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- non-structural measures, Roles and responsibilities of- community,PanchayatiRajInstitutions/ UrbanLocalBodies(PRIs/ULBs),States,Centre,and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.		

UNIT - III	INTER-RELATIONSHIP BETWEEN DISASTERSANDDEVELOPMENT	9
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources.		

UNIT - IV	DISASTER RISK MANAGEMENTININDIA	9
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Componentsin Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment		

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UNIT - V	DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES NDFIELD WORKS	9
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Madedisasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.		
Total Instructional hours : 45		

Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the types of disasters, causes and their impact on environment and society.
CO2	Assess vulnerability and various methods of risk reduction measures as well as Mitigation
CO3	Infer inter-relationship between disaster and development
CO4	Explain the hazard and vulnerability profile of India
CO5	Evaluate disaster damage assessment and implement disaster management Measures

Reference Books	
1.	Singhal J.P. “Disaster Management”, Laxmi Publications,2010.
2.	TusharBhattacharya,“DisasterScienceandManagement”,McGrawHillIndia Education Pvt.Ltd., 2012.
3.	Gupta Anil K, Sreeja S. Nair. “Environmental Knowledge for Disaster Risk Management”, NIDM, New Delhi,2011.
4.	Kapur Anu,” Vulnerable India: A Geographical Study of Disasters”, IIAS and Sage Publishers, New Delhi,2010.
5.	Govt. of India: “Disaster Management Act”, New Delhi,2005
6.	Government of India, “National Disaster Management Policy”,2009.

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B.E	B19BME608 - HOSPITAL WASTE MANAGEMENT	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To know about the healthcare hazard control and accidents
2.	To understand biomedical waste management
3.	To know the hazardous materials
4.	To learn the facility guidelines
5.	To gain knowledge about infection control, Prevention and patient safety.

UNIT - I	HEALTHCARE HAZARD CONTROL ANDUNDERSTANDINGACCIDENTS	9
Healthcare Hazard Control: Introduction, Hazard Control: Management & Responsibilities, Hazard Analysis, Hazard Correction, Personal Protective Equipment, Hazard Control Committees, Accident Causation Theories, Accident Reporting, Accident Investigations, AccidentAnalysis,AccidentPrevention,Workers"Compensation,Orientation,Education,and Training.		

UNIT - II	BIOMEDICAL WASTE MANAGEMENT	9
Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling and disposal.		

UNIT - III	HAZARDOUS MATERIALS	9
Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Respiratory Protection.		

UNIT - IV	FACILITYSAFETY	9
Introduction, Facility Guidelines: Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Tool Safety, Electrical Safety, Control of Hazardous Energy, Landscape and Ground Maintenance, Fleet and Vehicle Safety.		

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UNIT - V	INFECTION CONTROL, PREVENTION ANDPATIENT SAFETY	9
Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilant, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Healthcare-Associated Infections, Medication Safety.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Outline the healthcare hazard control and understanding accidents
CO2	Explain the biomedical waste management
CO3	Summarize the various hazardous materials
CO4	Illustrate the facility and safety guidelines
CO5	Extend the infection control, prevention and patient safety

Reference Books	
1.	Tweedy, James T., “Healthcare hazard control and safety management”,CRC Press, Taylor and Francis, 2014.
2.	Anantpreet Singh, Sukhjit Kaur, “Biomedical Waste Disposal”, Jaypee Brothers Medical Publishers (P) Ltd, 2012.
3.	Suharshi Gupta., “Biomedical Waste Management”, Lambert Academic Publishing, 2021.
4.	Ramya Arumugam,”A study on the Biomedical Waste Management System in Hospitals”, Lambert Academic Publishing, 2019

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B.E	B19BME609 – ANALYTICAL INSTRUMENTS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the working of an instrument for a particular analysis with its merits, demerits and limitations.
2.	To learn chromatography and its applications
3.	To know the gas analyzers and pollution monitoring instruments
4.	To know about pH meters and dissolved component analyzers
5.	To learn about electromagnetic resonance & microscopic techniques

UNIT - I	COLORIMETRY AND SPECTRO PHOTOMETRY	9

Special methods of analysis – Beer-Lambert law – Colorimeters – UV-Visible spectrophotometers – Single and double beam instruments – Sources and detectors – IR Spectrophotometers – Types – Attenuated total reflectance flame photometers – Atomic absorptionspectrophotometers–Sourcesanddetectors–FTIRspectrophotometers–Flame emission photometers – Fluorescence spectrophotometer

UNIT - II	CHROMATO GRAPHY	9

Different techniques – Gas chromatography – Detectors – Liquid chromatographs –Applications – High pressure liquid chromatographs – Applications.

UNIT - III	GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS	9

Types of gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

UNIT - IV	pH METERS AND DISSOLVEDCOMPONENT ANALYZERS	9

Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selectiveionelectrodes,ammoniaelectrodes,cyclicvoltametry,biosensors,dissolvedoxygen analyzer – Sodium analyzer – Siliconanalyzer.

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UNIT - V	ELECTRO MAGNETIC RESONANCE &MICROSCOPICTECHNIQUES	9
NMR – Basic principles – NMR spectrometer - Applications. Electron Spin Resonance spectroscopy– Basic principles, Instrumentation and applications. Scanning Electron Microscope (SEM),Transmission Electron Microscope (TEM), different types of Mass spectrometers– Applications		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Identify various techniques and methods of analysis which occur in the various regions of the spectrum.
CO2	Summarize the unique methods of separation of closely similar materials, the most powerful being gas chromatography.
CO3	Outline the important analytical methods of industrial gases and pollution monitoring instruments.
CO4	Explain the principle involved in pH and dissolved component analyzers
CO5	Illustrate the methods of electromagnetic resonance and microscopic methods of Analysis

Text Books	
1.	R.S. Khandpur, "Hand book of Analytical Instruments", TataMc Graw Hill publishing Co. Ltd., 2007.
2.	Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice hall of India, New Delhi, 2007.
3.	Sivasankar, "Instrumental Methods of Analysis", OUP India,2012

Reference Books	
1.	Robert D. Braun, 'Introduction to Instrumental Analysis', McGraw Hill, Singapore, 2016.
2.	Liptak, B.G, Process Measurement and Analysis, CRC Press, 2003
3.	G.W. Ewing, 'Analytical Instrumentation Hand book', McGraw Hill, 2005.
4.	H.H. Willard, L.L. Merritt, J.A. Dean, F.A.Settle,' Instrumental Methods of Analysis', CBS publishing & distribution, 2017.

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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.
CO2	Illustrate the Flight Compartment Lighting Technologies and Cabin Air Conditioning system
CO3	Identify the Warning and Protection Systems for the Ice Formation and Rain in the Airframe of the Aircraft During Flight
CO4	Apply the Terrain Warning Systems to avoid the Terrain Collision of an Aircraft
CO5	Examine the FDR and Fire Protection System to Monitor the Flying Performance of the Aircraft

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/

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

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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 – cDNA 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, 10thEdition, 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, 2ndEdition.
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.

R. Gowri

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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	SPATIAL DATA MODELS	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 (both1200 mode and 1800 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, 6thReprint, 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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B.E./ B.TECH	19MEO601 - ENTREPRENEURSHIP DEVELOPMENT (COMMON TO ALL EXCEPT MECH)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To interpret the entrepreneurial aspects.
2.	To comprehend the distinct inspirational practices to execute entrepreneurial plans.
3.	To introduce various elements involved in establishing a business.
4.	To understand the sources of finance and accounting.
5.	To throw the light on various supporting institutions for the entrepreneurs.

UNIT - I	ENTREPRENEURSHIP	9
Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.		

UNIT - II	MOTIVATION	9
Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.		

UNIT - III	BUSINESS	9
Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.		

UNIT - IV	FINANCING AND ACCOUNTING	9
Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.		

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B.E.	B19ECP602 - MICROPROCESSORS AND MICROCONTROLLERS LABORATORY (Common to ECE, CSE and BME)	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To Study the Architecture of 8085 & 8086microprocessor.
2.	To Learn the design aspects of I/O and Memory Interfacingcircuits.
3.	To Study the Architecture of 8051microcontroller

List of Experiments	
Expt. No.	**Description of the Experiments**
	PROGRAMMING WITH 8085 and 8086 MICROPROCESSOR
1.	Arithmetic and Logical operations
2.	Code conversion
3.	Sorting
4.	Searching
5.	Stepper Motor Control
6.	Serial interface / Parallel interface
7.	A/D and D/A interface
8.	Waveform Generation
9.	Develop an application using Microprocessor
	PROGRAMMING WITH 8051
10.	Arithmetic and Logical operations
11.	Square and Cube program, Find 2"s complement of a number
12.	Unpacked BCD to ASCII
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Design and implement programs on 8085 microprocessor.
CO2	Design and implement programs on 8086 microprocessor.
CO3	Design interfacing circuits with 8086.
C04	Design and implement 8051 microcontroller based systems
C05	Understand the concepts related to I/O and memory interfacing

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B.E.	B19BMP601 – DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	To demonstrate recording and analysis of different Bio potentials
2.	To study about the measurement of non-eletectrical parameters
3.	To examine different diagnostic and therapeutic techniques
4.	To study about electrical safety measurements
5.	To know the analysing techniques of different bisignals

List of Experiments

Expt. No.	Description of the Experiments
1.	Measurement of visually evoked potential
2.	Galvanic skin resistance (GSR) measurement
3.	Study of shortwave and ultrasonic diathermy
4.	Measurement of various physiological signals using biotelemetry
5.	Study of hemodialysis model
6.	Electrical safety measurements
7.	Measurement of Respiratory parameters using spirometry.
8.	Study of medical stimulator
9.	Analyze the working of ESU – cutting and coagulation modes
10.	Recording of Audiogram
11.	Study the working of Defibrillator and pacemakers
12	Acquisition and analysis of ECG signal
13.	Acquisition and analysis of EEE signal
14.	Acquisition and analysis of EMG signal
15.	Study of ventilators
16.	Study of Ultrasound Scanners
17.	Study of heart lung machine model
	Total Instructional hours : 30

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Course Outcomes : Students will be able to	
CO1	Measure different bioelectrical signals using various methods
CO2	Compare different non-electrical parameters using various methodologies
CO3	Illustrate various diagnostic and therapeutic techniques
C04	Examine the electrical safety measurements
C05	Analyze the different bio signals using suitable tools.

Lab Requirements for a Batch of 30 Students	
1.	Visually evoked potential setup: 1 No.
2.	GSR setup: 1 No.
3.	Multi-output power supply (+15v, -15v, +30V variable, +5V, 2A): 2 Nos.
4.	Short wave Diathermy 1 No.
5.	Ultrasound diathermy 1 No.
6.	Multiparameter biotelemetry system 1 No.
7.	Electrical Safety Analyser 1 No.
8.	Spirometry with associated analysis system: 1 No.
9.	ECG Simulator 1 No.
10.	Medical stimulator 1 No
11.	Surgical diathermy with analyzer 1 No
12.	Audiometer 1No
13.	Pacemaker and Defibrillator: 1 No. each
14.	Haemodialysis model and Heart lung Model: 1 No. each
15.	Ventilator: 1 No.
16.	Ultrasound Scanner: 1 No.
17.	Software to Analyze ECG,EEG and EMG: 1 No.

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B.E.	B19BMP602 – MINI PROJECT	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To enable a student to do an individual project work (mini project) which may involve design, modelling, simulation and/or fabrication.
2.	To analyse a problem both theoretically and practically.
3.	To motivate the students to involve in research activities leading to innovative solutions for industrial and societal problems.
4.	To improve the team building, communication and management skills among the students.
5.	To train the students in preparing project reports and viva voce examination.

Course Description

Mini Project work shall be carried out by maximum three member batch of student under the supervision of a faculty of the department. The student batch shall meet the supervisor periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in single phase during the entire semester. There will be three reviews for continuous internal assessment and one final review and viva voce at the end of the semester. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the department.

Course Outcomes : Students will be able to	
CO1	Identify the area of the work to be done.
CO2	Inspect the problem thoroughly and provide an appropriate solution.
CO3	Summarize systematic literature survey which helps to build the knowledge in the chosen field by using the existing models and references.
CO4	Test for the software / Hardware modules and communicate effectively the developed project.
CO5	Develop the confidence for the self education and ability for life long learning.

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Semester - VII

B.E	B19BMT701 - FUNDAMENTALS OF IMAGE PROCESSING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study about digital image fundamentals
2.	To know simple image enhancement techniques
3.	To explain image thres holding and segmentation techniques.
4.	To learn concepts of degradation and restoration techniques
5.	To understand image reconstruction algorithms.

UNIT - I	DIGITIZED IMAGE FUNCTIONS	9

Dirac distributions, convolution, Fourier transform, Images as linear system. Image digitization, sampling, Quantization, color images. Digital image properties, Metric and topological properties, Histogram visual perception, Image quality, Noise. Nature of Biomedical images, Objectives of biomedical image analysis, Difficulties in biomedical image acquisition and analysis.

UNIT - II	IMAGE ENHANCEMENT	9

Contrast manipulation, histogram equalization, Laplacian derivatives, Sobel and Klisch operators, rank operators –textural analysis. Image preprocessing – pixel brightness transformations, Geometric transformations, local preprocessing, Image restoration. Imaging filters. Biomedical applications.

UNIT - III	THRESHOLDING AND SEGMENTATION	9

Detection methods, optimal thresholding, multi-spectral thresholding. Edge based segmentation, Region based segmentation, Matching, Advanced optimal border and surface detection approaches.

UNIT - IV	IMAGE RESTORATION	9

Deterministic, geometric linear filtration, inverse filtering, power spectrum equalization, stochastic. Wiener filtering. Registration, anatomy based, object based, scene based. Biomedical applications.

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UNIT - V	IMAGE RECONSTRUCTION	12
Image reconstruction from projections, Radon transform, Methods for generating projection data, Transmission tomography, Reflection tomography, Emission tomography, Magnetic resonance imaging, Fourier slice theorem, Back-projection theorem. Image Coding and Compression: Lossy verses lossless compression, Fundamental concepts of coding, Image coding and compression standards, Case studies-biomedical applications.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the principles of image processing.
CO2	Interpret images using enhancement techniques.
CO3	Develop thresholding and segmentation techniques in medical images.
CO4	Apply image restoration techniques.
CO5	Summarize various algorithms used in image reconstruction.

Text Books	
1.	Jayaram, Kudupa and Gabor Herman, “3D imaging in medicine”, 2nd Edition, CRC press, 2000.
2.	Rangaraj M. Rangayyan, “Biomedical Image Analysis”, CRC Press, 2000.
3.	R C Gonzalez, Wintz Paul, “Digital Image Processing”, Pearson, 3rd Edition, 2010.

Reference Books	
1.	A K Jain, “Fundamental of Digital Image Processing”, Prentice Hall, 2002.
2.	William K Pratt, “Digital Image Processing”, John Wiley,New York, 2002.

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B.E	B19BMT702 – REHABILITATION ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To explain the need for medical aids.
2.	To understand the sensory rehabilitation systems
3.	To learn the use of the prosthetics and orthotics in rehabilitation
4.	To study the virtual reality in rehabilitation.
5.	To outline the legal aspects for building rehabilitation aids for the needed people

UNIT - I	INTRODUCTION	9

Definition - Impairments, disabilities and handicaps, Primary and secondary disabilities, Activities of daily living, Appropriate Technology, Residual function. Rehabilitation. Rehabilitation team – members and their functions. Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

UNIT - II	SENSORY REHABILITATION ENGINEERING	9

Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution. Tactual systemTactual augmentation, Tactual substitution, Computerized wheel chairs.

UNIT - III	MOTOR REHABILITATION	9

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

UNIT - IV	VIRTUAL REALITY IN REHABILITATION	9

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

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UNIT - V	REHABILITATION MEDICINE AND ADVOCACY	9
Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.		
Total Instructional hours : 45		

Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the basics concepts of rehabilitation engineering
CO2	Outline about assistive technology for vision & hearing.
CO3	Illustrate the fundamentals and application of motor rehabilitation
CO4	Select virtual reality tools for different aids
CO5	Summarize the legal aspects for building rehabilitation aids for the needed People

Text Books	
1.	Joseph D Bronzino, "The Biomedical Engineering Handbook". 2nd edition, CRC Press,2000.
2.	Robinson C.J, "Rehabilitation Engineering", CRC Press , 2006

Reference Books	
1.	Sashi S Kommu, "Rehabilitation Robotics", 1st edition, CRC Press, 2007. Sunder, "Textbooks of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007.
2.	Horia- Nocholai Teodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December 2000.
3.	Etienne Grandjean, Harold Oldroyd, "Fitting the task to the man", Taylor & Francis,1988.
4.	Marion A Hersh, Michael A, Johnson, "Assistive Technology for Visually impaired and blind people", Springer Publications, First edition, 2008.
5.	Warren E. Finn, Peter G. Lopressor, "Handbook of Neuroprosthetic Methods",CRC,2002
6.	Rory A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), "An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering"CRC Press, 2006.

BoS Chairman

B.E	B19BMT703 - DIAGNOSTICAND THERAPEUTIC EQUIPMENT - II	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the devices used in ICU and principles of Telemetry.
2.	To classify the types of diathermy and its uses
3.	To demonstrate applications of ultrasound in medicine
4.	To know extracorporeal devices used in critical care
5.	To study the importance of patient safety against electrical hazard

UNIT - I	PATIENT MONITORING AND BIOTELEMETRY	9

Patient monitoring systems, ICU/CCU Equipment, bed side monitors, Infusion pumps, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission.

UNIT - II	DIATHERMY	9

IR and UV lamp and its application. Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures.

UNIT - III	ULTRASONIC EQUIPMENTS	9

Diagnosis: Tissue Reaction, Basic principles of Echo technique, display techniques A, B and M mode, B Scan, Application of ultrasound as diagnostic tool – Echocardiogram, Echoencephalogram, abdomen, obstetrics and gynecology, ophthalmology.

UNIT - IV	EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES	9

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, electronic monitoring of functional parameters. Hemo Dialyser unit, Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laproscopy, Otoscopes. Thermography – Recording and clinical application.

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UNIT - V	PATIENT SAFETY	9
Physiological effects of electricity – important susceptibility parameters – Macro shock – Micro shock hazards – Patient's electrical environment – Isolated Power system – Conductive surfaces – Electrical safety codes and standards – IEC 60601-1 2005 standard, Basic Approaches to Protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Summarize the various equipment used in ICU and applications of telemetry
CO2	Explain the types of diathermy and its applications.
CO3	Identify the basics of ultrasound and its application in medicine
CO4	Make use of the various extracorporeal and special diagnostic devices used in hospitals
CO5	Outline the importance of patient safety against electrical hazard

Text Books	
1.	John G. Webster, - Medical Instrumentation Application and Design, 4th edition, Wiley India PvtLtd, New Delhi, 2015
2.	Joseph J. Carr and John M. Brown, —Introduction to Biomedical Equipment Technology, Pearson education, 2012.

Reference Books	
1.	Leslie Cromwell, - Biomedical Instrumentation and measurement, 2nd edition, Prentice hall of India, New Delhi, 2015.
2.	Richard Aston —Principles of Biomedical Instrumentation and Measurement, Merril Publishing Company, 1990.
3.	L.A Geddas and L.E.Baker —Principles of Applied Biomedical Instrumentation 2004.
4.	Myer Kutz —Standard Handbook of Biomedical Engineering & Design, McGraw-Hill Publisher, 2003. Hill, New Delhi, 2014.

BoS Chairman

Professional Elective - IV

B.E	B19BME701 – WEARABLE SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the sensors for wearable systems
2.	To learn the signal processing techniques for wearable system
3.	To explain the energy harvesting techniques for wearable devices
4.	To know the concepts of wireless health systems
5.	To summarize the application of wearable systems

UNIT - I	SENSORS	9
Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Radiant thermal sensor, Wearable motion sensors, CMOS –Based Biosensors, E-Textiles, Bio compatibility.		

UNIT - II	SIGNAL PROCESSING	9
Wear ability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, light weight signal processing, Rejection of irrelevant information, Datamining.		

UNIT - III	ENERGY HARVESTING FOR WEARABLE DEVICES	9
Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.		

UNIT - IV	WIRELESSHEALTHSYSTEMS	9
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication techniques.		

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UNIT - V	APPLICATIONS OF WEARABLE SYSTEMS	9
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Choose sensors for wearable systems.
CO2	Illustrate the signal processing techniques for wearable system.
CO3	Explain the energy requirement for a wearable system and analyze and experiment energy harvesting techniques for wearable systems.
CO4	Outline the need for BAN and the challenges involved in the design of BAN
CO5	Design basic wearable systems for medical applications

Text Books	
1.	Annalisa Bonfiglio, Danilo De Rossi, “Wearable Monitoring Systems”, Springer, 2011.
2.	Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability,” Cambridge University Press, 2013.

Reference Books	
1.	Hang, Yuan-Ting, “Wearable medical sensors and systems”, Springer, 2013
2.	Mehmet R. Yuce, Jamil Y. Khan, “Wireless Body Area Networks Technology, Implementation and Applications”, Pan Stanford Publishing Pvt. Ltd, Singapore, 2012.
3.	Guang-Zhong Yang(Ed.), “Body Sensor Networks, “Springer, 2006.
4.	Andreas Lymberis, Danilo de Rossi,’Wearable eHealth systems for Personalized Health Management - State of the art and future challenges ‘ IOS press, The Netherlands, 2004.

BoS Chairman

B.E	B19BME702 - SOFT COMPUTING & ITS APPLICATIONS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the introduction of soft computing.
2.	To learn the optimization associated with artificial neural network.
3.	To understand the fuzzy set theory and fuzzy systems
4.	To explain genetic algorithms and hybrid systems
5.	To outline the artificial intelligence models

UNIT - I	INTRODUCTION TO SOFT COMPUTING	9

Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, applications of soft computing.

UNIT - II	FUNDAMENTALS OF ARTIFICIAL NEURAL NETWORK	9

Introduction, Model of Artificial Neuron, Architectures, Learning Methods, Deep learning, Taxonomy of ANN Systems, Single Layer ANN System, Supervised Learning Neural Networks, Perceptrons, Adaline, Backpropagation, Mutilayer Perceptrons Applications of ANN in research.

UNIT - III	FUZZY SET THEORY & FUZZY SYSTEMS	9

Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, introduction & features of membership functions, Extension Principle, Fuzzy If-Then Rules, Fuzzy Inference Systems, Sugeno Fuzzy Models, Fuzzification, Defuzzification, Applications

UNIT - IV	GENETIC ALGORITHMS & HYBRID SYSTEMS	9

Fundamentals of Genetic Algorithms, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling, Hybrid Systems: Integration of Neural Networks, Fuzzy Logic and Genetic Algorithms, Research orientation of soft computing techniques.

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UNIT - V	ARTIFICIAL INTELLIGENCE	9
AI Search algorithm-Predicate calculus rules of interface – Semantic networks-frames-objects-Hybrid models, applications.		
Total Instructional hours : 45		

Course Outcomes : At the end of the course the student will be able to	
CO1	Outline the basics of soft computing techniques
CO2	Analyse neural network architectures .
CO3	Explain neuro fuzzy control and data clustering.
CO4	Utilize the genetic algorithm and its operators.
CO5	Classify the Artificial Intelligence Algorithms.

Text Books	
1.	E – Neuro Fuzzy and Soft computing – Jang J.S.R., Sun C.T and Mizutami, Prentice hall New Jersey, 1998
2.	Fuzzy Logic Engineering Applications – Timothy J.Ross, McGraw Hill, NewYork, 1997.
3.	Fundamentals of Neural Networks – Laurene Fauseett, Prentice Hall India, New Delhi, 1994.

Reference Books	
1.	Introduction to Artificial Intelligence – E Charniak and D McDermott, Pearson Education
2.	Artificial Intelligence and Expert Systems – Dan W. Patterson, Prentice Hall of India.

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B.E	B19BME703 – PATTERN RECOGNITION AND DEEP LEARNING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the fundamentals of pattern recognition and its classification
2.	To learn the image pattern recognition and its applications
3.	To understand the basics concepts of deep learning.
4.	To know the concepts of convolutional networks
5.	To make use of RNN to model for real world applications

UNIT - I	INTRODUCTION TO PATTERN RECOGNITION	9
Component Labeling - Image Features - Textures - Boundary representations and descriptions - Regional descriptors - Feature selection and Feature dimensionality reduction. Image Classification and Recognition- Statistical Classifiers _ Clustering Algorithms - Hierarchical and Partitional clustering		

UNIT - II	IMAGE PATTERN RECOGNITION CASE STUDIES	9
Image Understanding – Case Studies in Biometrics, Video Processing, Image Fusion - Image Security - Steganography and Watermarking - Stereo vision - Visual Effects - Image compositing.		

UNIT - III	INTRODUCTON TO DEEP LEARNING	9
Introduction to Deep Learning: Basics: Biological Neuron, Idea of computational units, McCulloch– Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm		

UNIT - IV	CONVOLUTIONAL NETWORKS	9
Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet		

UNIT - V	RECURRENT NEURAL NETWORKS	9
Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks - The Long Short-Term Memory and Other Gated RNNs		
		Total Instructional hours : 45

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Course Outcomes : At the end of the course the student will be able to	
CO1	Classify patterns using statistical pattern classifier
CO2	Apply the image recognition in biomedical applications
CO3	Explain the fundamentals of deep learning.
CO4	Illustrate the various convolution algorithms.
CO5	Outlinethe various RNN.

Text Books	
1.	Duda R.O, Hart P.G, “Pattern Classification and scene analysis’’, Wiley Edition, 2000
2.	Earl Gose, Richard Johnsonbaugh Steve Jost, “Pattern Recognition and Image Analysis”, Prentice Hall of India Pvt Ltd., New Delhi,1999.
3.	Freeman J. A., and Skapura B.M, “Neural networks, algorithms, applications and programming techniques”, Addison- Wesley,2003
4.	N.D.Lewis, “Deep Learning Made Easy with R: A Gentle Introduction for Data Science”, January 2016.

Reference Books	
1.	Robert Schalkoff, “Pattern recognition, Statistical, Structural and neural approaches”, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2005.
2.	Laurene Fausett, “Fundamentals of Neural Networks- Architectures, Algorithms and Application”, Prentice Hall, 1994.
3.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
4.	Bengio, Yoshua. “Learning deep architectures for AI.” Foundations and trends in Machine Learning 2.1 (2009): 1127.

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B.E	B19BME701– NEURAL ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the structure and functions of neuron
2.	To learn the functions of brain, brain stem and spinal cord
3.	To label the neuronal diseases and disorders
4.	To know the concepts of neurophysiology and neuroradiology
5.	To explain the nerve reconstruction and rehabilitation

UNIT - I	BASICS OF NEURON STRUCTURE AND FUNCTIONS9	9
Nervous system development. Trophic factors, extra cellular matrix components in nervous system development. Neuron: structure – function – classification. Glial cells – myelination. Neurotransmitter – types and functions. Synapses - Transport of materials and impulse in neurons.		

UNIT - II	BRAIN, BRAIN STEM AND SPINAL CORD	9
Brain: structures – lobes – functional areas. Brain stem: structures – functional areas. Spinal cord: structure – functions. Concepts of nuclei – sensory and motor Tracts - Reticular formation. Blood supply to Brain and spinal cord		

UNIT - III	NEURONAL DISEASES AND DISORDERS	9
Neuro degeneration: Degenerative, Demyelinated and injury related disorders associated with nervous system. Wallerian Degeneration. Neuronal plasticity – CNS acting drugs and their pharmacokinetics. Alzheimer‘s, Parkinson‘s and Prion diseases.		

UNIT - IV	NEUROPHYSIOLOGY & NEURORADIOLOGY	9
Physiology of nerve conduction. Peripheral nerves – structure & Functions. Synaptic transmission and cellular signaling of Neurons. Electrical activity of the Brain and recording of brain waves. Evoked potentials. Visualization of nervous system. . Neuromotor-machine interface: human voluntary motor control system.		

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UNIT - V	NERVE RECONSTRUCTION AND REHABILITATION	9
Neural plasticity; Neurological dysfunctions - Regeneration of the peripheral nervous system. Neural tissue engineering; Nerve graft; Drug delivery system in CNS. Rehabilitation: Mechanisms for Neuromotor rehabilitation; Robotics and virtual reality in physical therapy; Transcranial magnetic stimulation		
Total Instructional hours : 45		

Course Outcomes : At the end of the course the student will be able to	
CO1	Outline the structure and function of neuron
CO2	Relate the function of brain, brain stem and spinal cord
CO3	Identify the neuronal diseases and disorders
CO4	Explain the concepts of neurophysiology and neuroradiology
CO5	Summarize the nerve reconstruction and rehabilitation

Text Books	
1.	Mathews G.G., “Neurobiology”, 2nd edition, Blackwell Science, UK, 2000
2.	Malcom Carpenter, “Textbooks of Neuroanatomy”, Mc. Graw hill Edition, 1996.

Reference Books	
1.	W. Mark Saltzman, “Tissue Engineering – Engineering principles for design of replacement organs and tissue’’, Oxford University Press Inc New York, 2004.
2.	Park J.B., “ACS Biomaterials Science and Engineering”, Plenum Press, 2014. Saunders, 2006.

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B.E	B19BME705 - FIBER OPTICS AND LASERS IN MEDICINE	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn the basic concepts of optical fibers and their properties.
2.	To provide adequate knowledge about the connectors, splicers and couplers.
3.	To study about the Laser systems.
4.	To explain various laser application in medical therapy
5.	To choose clinical application of fiber optic laser system

UNIT - I	INTRODUCTION TO FIBER OPTICS	9

Basic fiber link, applications, principles of light: Introduction, EM spectrum, internal & external reflections, Snell'slaw, optical fiber numerical aperture, Fresnel reflection, Optic fiber & its properties: Introduction, Basic fiber construction, propagation of light, modes of operation, refractive index profile, types of fibres, dispersion, data rate and bandwidth, attenuation, losses.

UNIT - II	CONNECTORS, SPLICERS AND COUPLERS	9

Introduction, splices: mechanical, fusion, protection of splice, connectors: SMA, STC, bionic etc,coupling: passive, Stan, TEE types. Optical sources & Photo Detectors: Introduction: creation of photons, LED, laser diode, photo, detectors: introduction, PIN photodiode, avalanche photodiode, photodiode parameters, detector noise, speed of response, SNR., Modulation scheme for fiber optics transmission: Introduction, digital modulation, analog modulation schemes, multiplexing.

UNIT - III	LASER SYSTEMS	9

Introduction, types of lasers: Solid state lasers, Gas lasers, Dye lasers, Lasers used in medical practice: Ruby laser,CO2 laser, Nd-Y AG laser and related solid state laser. Laser -Tissue Interaction: Terminology, spectral band designations, energy & power, irradiant & radiant exposure, fluence, thermal diffusion fibers & contact tips, Types of laser-tissue interactions.

UNIT - IV	LASER APPLICATION IN MEDICAL THERAPHY	9

Introduction, application in general surgery, dermatology, ophthalmology, cardiovascular &chest surgery, dentistry, neuro surgery, otolaryngology & head and neck surgery, tumor surgery, gynecologic laser, endoscopy, laproscopy, neuroendoscopy

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UNIT - V	CLINICAL APPLICATIONS OF FIBER OPTIC LASER SYSTEMS	9
Introduction, fiber optic laser system in cardiovascular disease, gastroenterology. Gynecology, neurosurgery, oncology, ophthalmology, orthopaedics, otolaryngology (ENT), urology, and flow diagram for laser angioplasty& photodynamic therapy.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Illustrate essential optical principles and fundamentals of lasers.
CO2	Compare the connectors, splicers and couplers
CO3	Explain different laser systems
CO4	Summarize about Laser application in medical therapy
CO5	Outline the concepts and applications of Lasers and Fiber optics.

Text Books	
1.	Therapeutic Lasers -Theory and practice by G. David Baxter,Churchill livingstone,2017
2.	Medical Lasers and their safe use, David H Shiney, Stephen and L. Trokel Springer-Verlag,1993

Reference Books	
1.	Laser and optical fibers in medicine by Katzer and Abraham,Academic press, 1993
2.	Elements of fiber optics by S. L. Wymer,Regents-Prentice Hall, 1993
3.	Biomedical Electronics & Instrumentation by S. K. Venkata Ram,Galgotia, 2000

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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 UAVand its types.
2.	To gain knowledge regarding the control and communications.
3.	To observe the aero dynamics per for mance 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 OFF LIGHT	9

International Rules- Regulations, Standards &Practices, Dos and Do not – Civil AviationRequirements– AIPs,NOTAM,Classification&Categorizationofdrones–TypeCertification of Drones – Registration – Sale & De-Registration of Drones – Operations ofDrones – Dos and Don'ts – Remote Pilot Licensing – Drone Insurance Fundamentals offlight–Aerodynamics–Take-off,flight,andlanding–Maneuversturnsandcircuitpattern.

UNIT - II	ATC PROCEDURES & RADIOTELEPHONY (NONFRTOL) WEATHER AND METEOROLOGY	9

Understanding AT Coperations–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 at mosphere, Measuring airpressure,Heatand temperature, Wind–Moisture, cloudformation, icing and its effects – Effect of atmosphere on RPAS operation & hazard our 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. Introduction to Mission Planning, Instrument Flying & Navigation (GCS)– Applications of fixed-wing UAVs. Pros and Cons of Fixed Wing rotorcraft. Basic droneter minology & parts, Types of drones, material used and size of drones, Drone Anatomy:Different part sofdrones, 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	HYBRIDOPERATIONS,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
Dro the 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–Typesof Image & Video Data –Analysis.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Summarize the basic operations and principles of flight
CO2	Explain about the various avionics hardware operation and ATC procedure
CO3	Apply the aero dynamic principle on the air frame configuration
CO4	Examine the operation soft he hybrid drones and maintenance of equipment
CO5	Determine the pay load distribution and safety management procedure of the UAV

Text Books	
1.	Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc,1998.
2.	Kimon P.Valavanis, “Advancesin Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer,2007.

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Reference Books	
1.	Swatton P.J., “ground studies for pilots flight planning”, Sixth edition, 2002.
2.	Ian Hey wood. “An Introduction to GIS”, Pearson Education, NewDelhi, 2001.
3.	Patel A.N & Surendra Singh, “Remotesensing principles & applications”, Scientific Publishers, Jodhpur 1992.
4.	Lille sand, T.M., and Kiefer, R.W., “Remote Sensing and Image Interpretation”,John Wiley and Sons, NewYork, 2000.
5.	Unmanned Aerial Vehicle (UAV) application for societal applications (https://www.cbinsights.com/research/drone-impact-society-uav/).

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

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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.

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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		

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	Knowing the concepts of engineering materials and steel properties
CO2	Remembering the different machining and welding process
CO3	Knowing the different tillage and sowing implements
CO4	Understanding the concepts of plant protection equipment's.
CO5	Creating 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, 2010.
4.	Michael and Ohja, "Principles of Agricultural Engineering", Jain brothers, New Delhi., 2005.

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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., “General Engineering Workshop Practice”, Asia Publishing House, Bombay, 1998.
3.	Chapman W.A.J., “Workshop Technology”, Part I, II, III, E.L.B.S. and Edward Amold Publishers Ltd, London, 1992.
4.	Kepner, R.A., et al, “Principles of farm machinery”, CBS Publishers and Distributers, Delhi, 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	19BTO701 – FUNDAMENTALS OF NANOTECHNOLOGY (COMMON TO ALL EXCEPT BT)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of nano materials and their characteristics.
2.	To gain knowledge on the relationship between nano and biosystems.
3.	To acquire information on nanobio composites.
4.	To enhance skill and knowledge on analysis of nano materials and
5.	To apply the knowledge and skills of nanotechnology in medicine and related fields.

UNIT - I	INTRODUCTION TO NANOTECHNOLOGY	9

Definition- history of nano materials- classification of nano structured materials, nanoparticles – Quantum dots, Nanowires - Ultra thin films – Multi layered materials. Properties of nano materials – concept of nanoscale engineering - size and confinement effects.

UNIT - II	SYNTHESIS AND CHARACTERIZATION OF NANOPARTICLES	9

Strategies for nano architecture, bottom-up synthesis, top-down and functional approaches; Chemical and physical synthesis of nanoparticles - characteristics of nanoparticles; Characterization of nanoscale materials using UV spectroscopy, TEM, SEM, SPM, AFM, STM, SNOM, 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 – using bacteria, fungi, yeast and plants with 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 bionano systems; 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 : Students 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 bionano materials 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 CM, and CA Mirkin, "Nanobiotechnology: Concepts, Applications and perspectives", John Wiley & Sons, 2004.

Reference Books	
1.	Nicolini C, "Nano biotechnology and Nano bio sciences", Pan Stanford Publishing Pvt. Ltd, 2009.f
2.	Goodsell S D, "Bionano technology - Lessons from Nature", Wiley-Liss, Inc9, 2004.
3.	Bhushan B, "Handbook of Nanotechnology", Springer, Heidelberg, 2006.

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B.E./ B.TECH	B19CSO701 – FUNDAMENTALS 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

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.

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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.	Ritting house, 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 Edition, 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.

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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.
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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B.E./ B.TECH	B19MEO701 – 3D PRINTING AND TOOLING (COMMON TO ALL EXCEPT MECH)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To explore the technology used in additive manufacturing.
2.	To develop CAD models for 3D printing.
3.	To acquire knowledge, techniques and skills to select relevant additive manufacturing process.
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

Overview – History – Need –classification - Additive Manufacturing Technology in product development – Materials for Additive Manufacturing.

UNIT - II	CAD AND REVERSE ENGINEERING	9

Basic concept – 3D scanning – digitization techniques – Model reconstruction – data processing for reverse engineering - Additive Manufacturing Technology: CAD model preparation – Part orientation and support generation – Model slicing – Tool path generation.

UNIT - III	LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING	9

Classification – liquid based system – stereo lithography apparatus (SLA) – principle, process, advantages and applications – solid based system – Fused Deposition Modeling – principle, process, advantages.

UNIT - IV	LASER BASED ADDITIVE MANUFACTURING SYSTEMS	9

Selective laser sintering – principles of SLS process – process, advantages and applications, 3D Printing- principle, process, advantages - Laser Engineered Net Shaping (LENS).

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UNIT - V	RAPID TOOLING AND APPLICATIONS OF ADDITIVE MANUFACTURING	9
Principles and typical process for quick batch production of plastic and metal parts through quick tooling – applications for Aerospace, defence, automobile, Bio-medical and general engineering industries		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the importance of Additive Manufacturing.
CO2	Apply technique of CAD and reverse engineering for geometry transformation in Additive Manufacturing.
CO3	Define the various process used in Additive Manufacturing.
CO4	Identify and select suitable process used in Additive Manufacturing.
CO5	Understand the basic concept of quick tooling and additive manufacturing application.

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, RapidTooling, 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.	Dougles Bryden, “CAD and Prototyping for Product Design”, 2014.
3.	CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping - Principles and Applications”, World Scientific, 2017.

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B.E.	B19BMP704 IMAGE PROCESSING LABORATORY	T	P	TU	C
		0	2	0	2

Course Objectives	
1.	To practice the basic image processing techniques
2.	To perform the operations on the image using spatial filters and frequency domain filters.
3.	To make use of transforms and analyze the characteristics of the image.
4.	To understand the concepts of image restoration and segmentation.
5.	To explore the applications of image processing techniques.

List of Experiments

Expt. No.	Description of the Experiments
1.	Image sampling and quantization
2.	Analysis of spatial and intensity resolution of images.
3.	Intensity transformation of images.
4.	DFT analysis of images
5.	Transforms (Walsh, Hadamard, DCT, Haar)
6.	Histogram Processing and Basic Thresholding functions
7.	Image Enhancement-Spatial filtering
8.	Image Enhancement- Filtering in frequency domain
9.	Image segmentation – Edge detection, line detection and point detection
10.	Region based segmentation
11.	Basic Morphological operations

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12	Analysis of images with different color models
13.	Image compression techniques
14.	Image restoration
15.	A mini project based on medical image processing
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Apply the fundamental image processing concepts on images.
CO2	Examine the performance of filters for removing the noise from an image.
CO3	Divide the images using segmentation operations.
C04	Apply the concept of image fusion.
C05	Analyze the image processing technique to solve real health care problems.

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B.E.	B19BMP702-HOSPITAL TRAINING	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To observe medical professionals at work in the wards and the roles of Allied Health Professionals.
2.	To know how to discuss with other health professionals.
3.	To learn a patient-centred inter-professional health improvement plan based upon the patient's perceived needs.
4.	To provide access to healthcare Professionals to get a better understanding of their work.
5.	To demonstrate patient-care in a hospital setting.

ASSESSMENT

Students need to complete training in any leading Multi-specialty hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course in charges during the session. Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

Departments for visit	
1.	Cardiology
2.	ENT
3.	Ophthalmology
4.	Orthopaedic and Physiotherapy
5.	ICU/CCU
6.	Operation Theatre
7.	Neurology
8.	Nephrology
9.	Radiology
10.	Nuclear Medicine

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11.	Pulmonology
12.	Urology
13.	Obstetrics and Gynaecology
14.	Emergency Medicine
15.	Biomedical Engineering Department
16.	Histo Pathology
17.	Biochemistry
18.	Paediatric/Neonatal
19.	Dental
20.	Oncology
21.	PAC
22.	Medical Records / Telemetry
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Propose a patient-centred approach in healthcare.
CO2	Discuss with other health professionals in a respectful and responsible manner.
CO3	Decide the importance of inter-professional collaboration in healthcare.
C04	Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs.
C05	Make use of the knowledge of other professions to address the healthcare needs of populations and patients served

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B.E.	B19BMP703 - PROJECT WORK PHASE - I	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To Identify a problem of current relevance to society
2.	To select the suitable solution methodology for the given complex engineering problem in Biomedical l Engineering.
3.	To demonstrate system integration, project management skill and problem solving skills
4.	To improve oral presentation and Technical report writing skill
5.	To understand the ethics and teamwork.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares 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.

Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare abstract and narrate the methodology to carry out the project work

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.

Total Instructional hours : 45

Course Outcomes : At the end of the Course, students will be able to	
CO1	Apply a sound technical knowledge of their selected project topic.
CO2	Identify problem identification, formulation and solution.
CO3	Design engineering solutions to complex problems utilising a systems approach.
C04	Discuss with engineers and the community at large in written an oral forms.
C05	Develop the knowledge, leadership skills and attitudes of a professional Engineer

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Semester - VIII

Professional Elective - V

B.E	B19BME801 - FOUNDATIONS FOR NANO ELECTRONICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the concept of quantum mechanics
2.	To learn the simple harmonic oscillators and approximations
3.	To explain the nanosystems with two and many degrees of freedom
4.	To know the statistical mechanics for understanding nano systems
5.	To outline the applications of nanoelectronics.

UNIT - I	INTRODUCTION TO QUANTUM MECHANICS	9
Particles, waves, probability amplitudes, Schrodinger equation, wave packets solutions,Operators, expectation values, eigen funtions, piecewise constant potentials.		

UNIT - II	SIMPLE HARMONIC OSCILLATORS AND APPROXIMATIONS	9
SHM Operators, SHM wave packet solutions, Quantum LC circuit, WKB approximations, variational methods.		

UNIT - III	SYSTEMS WITH TWO AND MANY DEGREES OF FREEDOM	9
Two level systems with static and dynamic coupling, problems in more than one dimensions, electromagnetic field quantization, density of states.		

UNIT - IV	STATISTICAL MECHANICS	9
Basic concepts, microscopic, quantum systems in equilibrium, statistical models applied to metals and semiconductors		

UNIT - V	APPLICATIONS	9
Hydrogen and Helium atoms, electronic states, atomic force microscope, Nuclear Magnetic Resonance, carbon nanotube properties and applications		
Total Instructional hours : 45		

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Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the concept of quantum mechanics
CO2	Identify the simple harmonic oscillators and approximations
CO3	Illustrate the nanosystems with two and many degrees of freedom
CO4	Apply statistical mechanics for understanding nano systems
CO5	Outline the applications of nanoelectronics.

Text Books	
1.	Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando, "Introduction to Applied Quantum and Statistical Physics",, New York, NY: Wiley, 2004.
2.	Rainer Waser, "Nanoelectronics and Information Technology", Wiley, 3rd Edition, 2012.

Reference Books	
1.	Neil Gershenfeld, "The Physics of Information Technology", Cambridge University Press, 2000.
2.	Adrian Ionesu and Kaustav Banerjee eds. "Emerging Nanoelectronics Life with and after CMOS", Vol I, II, and III, Kluwer Academic, 2005.

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B.E	B19BME802 – EMBEDDED SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn the concepts of embedded system and perform case studies of embedded system.
2.	To explore the knowledge in embedded networking.
3.	To integrate hardware and software for embedded firmware development.
4.	To understand the concepts of real time operating system
5.	To know the application of Embedded systems

UNIT - I	INTRODUCTION TO EMBEDDED SYSTEMS	9
Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.		

UNIT - II	EMBEDDED NETWORKING	9
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols - RS232 standard – RS422 – RS485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers		

UNIT - III	EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT	9
Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.		

UNIT - IV	RTOS BASED EMBEDDED SYSTEM DESIGN	9
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: Vx Works, μC/OS-II, RTLinux.		

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UNIT - V	CASE STUDIES OF EMBEDDED SYSTEMS	9
Case study of embedded system like Automatic Chocolate Vending Machine, Mobile Phone, Digital camera, washing machine, smart card, ECG recorder. Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE. - Distributed embedded systems – MPSoCs and shared memory multiprocessors. – Design Example - Audio player, Engine control unit – Video accelerator.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Summarize the basic building blocks of embedded systems
CO2	Explain the embedded networking
CO3	Infer the hardware – software co design issues
CO4	Identify the real time operating systems concepts
CO5	Design real-time applications using embedded-system

Text Books	
1.	Rajkamal, ‘Embedded System-Architecture, Programming, Design’, McGraw Hill, 2013.
2.	Peckol, “Embedded system Design”, John Wiley & Sons, 2010
3.	Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013

Reference Books	
1.	Shibu. K.V, “Introduction to Embedded Systems”, Tata Mcgraw Hill, 2009.
2.	Elicia White,” Making Embedded Systems”, O’ Reilly Series, SPD, 2011.
3.	Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.

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B.E	B19BME803 – MEDICAL INFORMATICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of medical informatics
2.	To know the medical standards and functions of hospital information system
3.	To learn the medical data formats
4.	To study about health informatics
5.	To outline the recent trends in medical informatics.

UNIT - I	MEDICAL INFORMATICS9	9

Introduction - Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics –Functional capabilities of Hospital Information System - On-line services and off – line services - History taken by computer, Dialogue with the computer.

UNIT - II	MEDICAL STANDARDS	9

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA –Electronics Patient Records –Healthcare Standard Organizations – JCAHO (Join Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

UNIT - III	MEDICAL DATA ACQUISITION AND STORAGE	9

Plug-in Data Acquisition and Control Boards – Data Acquisition using Serial Interface – Medical Data formats – Signal, Image and Video Formats – Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System - PACS , Data mining.

UNIT - IV	HEALTH INFORMATICS	9

Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics,
Genome projects, Clinical informatics, Nursing informatics, Public health informatics -Education and Training.

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UNIT - V	RECENT TRENDS IN MEDICAL INFORMATICS	9
Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment – Surgical simulation - Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine		
		Total Instructional hours : 45

Course Outcomes : At the end of the course the student will be able to	
CO1	Illustrate the health informatics in medicine.
CO2	Adopt and appreciate the medical standards.
CO3	Explain the function of Hospital Information Systems.
CO4	Outline the knowledge about health informatics.
CO5	Summarize recent trends in medical informatics

Text Books	
1.	Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Computers Ltd, New Delhi, 2003.

Reference Books	
1.	R.D.Lele, “Computers in Medicine: Progress in Medical Informatics’’, Tata McGraw Hill Publishing computers Ltd, New Delhi, 2005.
2.	N.Mathivanan, “PC-Based Instrumentation’’, Prentice Hall of India Pvt Ltd – New Delhi, 2007.
3.	Yi – Ping Phoebe Chen, “Bioinformatics Technologies’’, Springer International Edition, New Delhi, 2007

BoS Chairman

B.E	B19BME701– VIRTUAL REALITY IN MEDICINE	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of virtual reality
2.	To learn the process of VR development
3.	To study the content creation considerations for VR
4.	To know the concepts of VR on the WEB and mobile
5.	To explain the application of virtual reality

UNIT - I	INTRODUCTION	9
The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback		

UNIT - II	MODELING	9
Geometric modeling - kinematics modeling- physical modeling - behaviour modeling – model Management.		

UNIT - III	HUMAN FACTORS	9
Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment		

UNIT - IV	VR PROGRAMMING	9
Introducing Java 3D-loading and manipulating external models-using a lathe to make shapes. 3D Sprites- animated 3D sprites-particle systems.		

UNIT - V	APPLICATIONS	9
Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy		
Total Instructional hours : 45		

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Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the basic concepts of Virtual reality.
CO2	Design of various modeling concepts.
CO3	Identify the virtual reality system in Health and safety issues
CO4	Make use of Virtual Reality Programming with toolkits
CO5	Develop the Virtual Reality applications in different areas

Text Books	
1.	C. Burdea & Philippe Coiffet, —Virtual Reality Technology, Second Edition, Gregory, John Wiley &Sons, Inc.,2008
2.	Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.

Reference Books	
1.	Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575Mehmet R. Yuce, Jamil Y. Khan, “Wireless Body Area Networks Technology, Implementation and Applications”, Pan Stanford Publishing Pvt. Ltd, Singapore,2012.
2.	Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability),Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016
3.	The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Robert Scoble & Shel Israel, Patrick Brewster Press; 1 edition, 2016.
4.	Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O‘Reilly Media; 1 edition, 2015.
5.	Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages, Tony Parisi, O’Reilly Media; 1 edition, 2014.
6.	Learning Three.js: The JavaScript 3D Library for WebGL - Second Edition, Jos Dirksen, Packt Publishing - ebooks Account; 2nd Revised ed. Edition 2015.

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B.E	B19BME805 - BIOMETRIC SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the technologies of fingerprint, iris, face, and speech recognition.
2.	To learn fingerprint identification technology
3.	To know face recognition models
4.	To study the technologies of fingerprint, iris, face and speech recognition.
5.	To study of evaluation of biometrics systems.

UNIT - I	INTRODUCTION TO BIOMETRICS	9
Introduction and back ground – biometric technologies – passive biometrics – active biometrics - Biometrics Vs traditional techniques – Benefits of biometrics - Operation of a biometric system– Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems: FAR, FRR, FTE rate, FTA rate and rate- Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications.		

UNIT - II	FINGERPRINT IDENTIFICATION TECHNOLOGY	9
Geometric modeling - kinematics modeling- physical modeling - behaviour modeling – model Management.		

UNIT - III	FACE RECOGNITION AND HAND GEOMETRY	9
Introduction to face recognition, face recognition using PCA, LDA, face recognition using shape and texture, face detection in color images, 3D model based face recognition in video images,Neural networks for face recognition, Hand geometry – scanning – Feature Extraction –classification.		

UNIT - IV	IRIS RECOGNITION	9
Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wilde‘s approach, Iris matching, Iris scan strengths and Weaknesses,System performance, future directions.		

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UNIT - V	VOICE SCAN AND MULTIMODAL BIOMETRICS	9
Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system – Integration strategies – Architecture –level of fusion – combination strategy, examples of multimodal biometric systems, Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC).		
Total Instructional hours : 45		

Course Outcomes : At the end of the course the student will be able to	
CO1	Explain the principles of biometric systems.
CO2	Develop fingerprint recognition technique.
CO3	Design face recognition and hand geometry system
CO4	Design iris recognition system.
CO5	Develop speech recognition and multimodal biometric systems

Text Books	
1.	James Wayman & Anil Jain, “Biometric Systems- Technology Design and Performance Evaluation”, SPRINGER (SIE), 1st Edition, 2011.
2.	Paul Reid, “Biometrics for Network Security”, Pearson Education, 2004.

Reference Books	
1.	Nalini K Ratha, Ruud Bolle, “Automatic fingerprint recognition system’’, Springer, 2003.
2.	L C Jain, I Hayashi, S B Lee, U Halici, “Intelligent Biometric Techniques in Fingerprint and Face Recognition”, CRC Press, 1st Edition, 1999.
3.	S.Y. Kung, S.H. Lin, M.W., “Biometric Authentication: A Machine Learning Approach”, Prentice Hall, 2004.
4.	John Chirillo, Scott Blaul, “Implementing Biometric Security”, John Wiley & Sons, 2003.

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UNIT - V	SUPPORT TO ENTREPRENEURS	9
Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Classify and compare the entrepreneurship in society.
CO2	Identify the interpersonal attributes needed to become entrepreneur.
CO3	Demonstrate the various facets of business.
CO4	Summarize the components of finance and accounting.
CO5	Outline the comprehensive business entities.

Text Books	
1.	Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9th Edition, Cengage Learning, 2014.
2.	Khanka. S.S., "Entrepreneurial Development" S. Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.

Reference Books	
1.	Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2.	Rajeev Roy, "Entrepreneurship" 2ndEdition, Oxford University Press, 2011.

BoS Chairman

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
CO2	Make use of sketching concept like tape drawing and clay modelling to reduce the aerodynamics drag on vehicle body
CO3	Analyze the various automotive noise sources and its control techniques)
CO4	Evaluate the vehicle crash worthiness requirements for improving passengers and comfort
CO5	List the different control system and sensors used in controlling the vehicle

Text Books	
1.	Julian Happian-Smith, “An Introduction to Modern Vehicle Design”, Butterworth-Heinemann Ltd., 2002.

Reference Books	
1.	Wolf-Heinrich Hucho (Eds.), “Aerodynamics of Road Vehicles: From Fluid Mechanics to Vehicle Engineering”, Butterworth-Heinemann Ltd., 1987.
2.	Ian R Sinclair, Sensors and Transducers, Butterworth - Heinemann Ltd., 2001.
3.	T.K. Garrett, K. Newton & W. Steeds, “the Motor Vehicle”, Butterworth- Heinemann Ltd.,

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B.E./ B.TECH	B19AGO801 – AGRICULTURE FINANCE, BANKING AND CO-OPERATIVES (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	Acquiring the knowledge on sources of Agricultural Micro-Macro financing and credit systems.
CO2	Understanding the history of financing agriculture in India.
CO3	Learning the significance and limitations of crop insurance.
CO4	Developing the knowledge on cooperative systems.
CO5	Creating the knowledge on insurance policies and financial system.

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Text Books	
1.	Muniraj, R., “Farm Finance for Development”, Oxford & IBH, New Delhi, 1987.
2.	Subba Reddy S. and P. Raghu Ram, “Agricultural Finance and Management”, Oxford & IBH, New Delhi, 2011.
3.	Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray, “Agricultural Finance”, Kalyani Publishers, New Delhi, 1998.
4.	Mammoria, C.B. and R.D. Saxena, “Cooperation in India”, Kitab Mahal, Allahabad, 1973.
5.	Patnaik, V.E. and A.K. Roy, “Cooperation and Cooperative Management”, Kalyani Publishers, Ludhiana, 1988.

Reference Books	
1.	Ghosal, S N., “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/

EXCELLENCE BEYOND EXPECTATION KIT COIMBATORE

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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.
5.	To create knowledge on various control systems

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 : Students will 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 W W, “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 R M, IL Pepper and CP Gerba, “Environmental Microbiology”, Academic Press. 2000.
6.	Pelczar M J, ECS Chan and N R Kreig, “Microbiology”, 5th Ed., Tata McGraw-Hill, New Delhi, 2002.

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B.E./ B.TECH	B19CSO801 – FUNDAMENTALS 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

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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

R. Gowri

BoS Chairman

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”, 4th Edition, Tata McGraw-Hill, 2009.
2.	Behrou A. Forouan, “Data Communication and Networking”, 5th Edition, Tata McGraw Hill, 2013.
3.	Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014.
4.	AfifOsseiran, Jose.F.Monserrat and Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016.
5.	Kasun Maduranga 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, 2nd Edition, 2012.
7.	M. Richharia, “Satellite Systems for Personal Applications”, John Wiley, 2010.
8.	Balanis. A, “Antenna Theory Analysis and Design”, 3rd Edition, John Wiley and sons, New York, 1982.
9.	William Stallings, “Cryptography & Network Security - Principles and Practices”, Pearson Education, 4th Edition, 2006.

BoS Chairman

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

BoS Chairman

B.E./ B.TECH	B19MEO801 – LEAN SIX SIGMA (Common to all Except MECH)	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.

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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

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, "Simplified Lean Manufacture", PHI, 2010.

Reference Books	
1.	Devadasan S. R., Mohan Sivakumar V., Murugesh R. and Shalij P. R., "Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities", Prentice Hall of India Learning Limited, New Delhi, 2012.
2.	Gopalakrishnan N., "Simplified Lean Manufacture: Elements, Rules, Tools and implementation", Prentice Hall of India Learning Private Limited, India, 2010.
3.	Bill Carr ira, "Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Wastes and Maximizing Profits", Prentice Hall of India Learning Private Limited, India, 2009.
4.	Don Tapping, Tom Lu ster 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.	B19BMP801 - PROJECT WORK PHASE - II	T	P	TU	C
		0	16	0	8

Course Objectives	
1.	To Identify a problem of current relevance to society
2.	To select the suitable solution methodology for the given complex engineering problem
3.	To troubleshoot problems developed for the given applications.
4.	To demonstrate system integration, project management skill and problem-solving skills
5.	To learn software tool for analyzing complex problems
6.	To improve oral presentation and technical report writing skill

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares 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.

The Project Work Phase-II is the continuation work of Project Phase-I .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.

Total Instructional hours : 45

Course Outcomes : At the end of the Course, students will be able to	
CO1	Identify a problem of current relevance to society
CO2	Select the suitable solution methodology for the given complex engineering Problem

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