INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA | Affiliated to JNTUH)
Dundigal, Hyderabad - 500 043, Telangana

OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM

MASTER OF TECHNOLOGY
EMBEDDED SYSTEMS

ACADEMIC REGULATIONS - MT23

M.Tech Regular Two Year Degree Program
(for the batches admitted from the academic year 2023 - 2024)

These rules and regulations may be altered/changed from time to time by the academic council
FAILURE TO READ AND UNDERSTAND THE RULES IS NOT AN EXCUSE

INSTITUTE VISION | MISSION | QUALITY POLICY

VISION

To bring forth professionally competent and socially sensitive engineers, capable of working across cultures meeting the global standards ethically.

MISSION

To provide students with an extensive and exceptional education that prepares them to excel in their profession, guided by dynamic intellectual community and be able to face the technically complex world with creative leadership qualities.

Further, be instrumental in emanating new knowledge through innovative research that emboldens entrepreneurship and economic development for the benefit of wide spread community.

QUALITY POLICY

Our policy is to nurture and build diligent and dedicated community of engineers providing a professional and unprejudiced environment, thus justifying the purpose of teaching and satisfying the stake holders.

A team of well qualified and experienced professionals ensure quality education with its practical application in all areas of the Institute.

DEPARTMENT VISION | MISSION

VISION

To produce professionally competent engineers, innovators and entrepreneurs capable of effectively addressing the technical challenges with social responsibility and professional ethics.

MISSION

To provide an academic environment that will ensure high quality education, training and research by keeping students abreast of latest research and innovations in science and technology aimed at promoting employability, entrepreneurship, leadership qualities with ethics and research attitude.

OR

M1: To provide an academic environment that will ensure high quality education, training and research.
M2: To keep the students abreast of latest research and innovations in science and technology.
M3: To promote employability, entrepreneurship, leadership qualities with ethics and research attitude

M.TECH - PROGRAM OUTCOMES (PO's)

A graduate of the M.Tech (Embedded Systems) Program will demonstrate:

PO - 1	:	Independently carry out research / investigation and development work to solve practical problems.
PO - 2	:	Write and present a substantial technical report / document
PO - 3	:	Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level of higher than the requirements in the appropriate bachelor program.
PO - 4	:	Apply the skills and knowledge needed to serve as a professional engineer skilful at designing embedded systems for effective use in communications, IoT, medical electronics and signal processing applications.
PO - 5	:	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team.
PO - 6	:	Recognize the need to engage in lifelong learning through continuing education and research.

CONTENTS

“Take up one idea.
Make that one idea you’re life-think of it, dream of it, and live on that idea. Let the brain muscles, nerves, every part of your body be full of that idea and just leave every other idea alone.
This is the way to success” Swami Vivekananda

PRELIMINARY DEFINITIONS AND NOMENCLATURES

Academic Council: The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Autonomy: Means freedom to an institute in all aspects of conducting its academic programs, granted by UGC for Promoting Excellence.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises two consecutive semesters i.e., Even and Odd semester.

AICTE: Means All India Council for Technical Education, New Delhi.

Autonomous Institute: Means an institute designated as autonomous by University Grants Commission (UGC), New Delhi in concurrence with affiliating University (Jawaharlal Nehru Technological University, Hyderabad) and State Government.

Backlog Course: A course is considered to be a backlog course if the student has obtained a failure grade (F) in that course.

Betterment: Betterment is a way that contributes towards improvement of the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Board of Studies (BOS): BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updation in respect of all the programs offered by a department.

Certificate course: It is a course that makes a student gain hands-on experience and skill required for holistic development in a specific area/field.

Choice Based Credit System: The credit based semester system is one which provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching along with provision of choice for the student in the course selection.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Commission: Means University Grants Commission (UGC), New Delhi.

Continuous Internal Examination: It is an examination conducted towards internal assessment.

Course: A course is a course offered by the institute for learning in a particular semester.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture hour per week.

Credit point: It is the product of grade point and number of credits for a course.

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed upto two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources and processes for evaluating the attainment of Program Educational Objectives.

Degree with Specialization: A student who fulfills all the program requirements of her/his discipline and successfully completes a specified set of professional elective courses in a specialized area is eligible to receive a degree with specialization like Aerospace Engineering, Computer Science and Engineering, Embedded Systems, Electrical Power Systems, CAD/CAM, Structural Engineering etc.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources in the process of study for a degree.

Detention in a course: Student who does not obtain minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from the Semester: A student who doesn't want to register for any semester can apply in writing in prescribed format before commencement of that semester.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective and/or Open Elective.

Evaluation: Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal assessment and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 point scale.

Institute: Means Institute of Aeronautical Engineering, Hyderabad unless indicated otherwise by the context.

Massive Open Online Course (MOOC): MOOC courses inculcate the habit of self-learning. MOOC courses would be additional choices in all the elective group courses.

Pre-requisite: A course, the knowledge of which is required for registration into higher level course.

Core: The courses that are essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

Professional Elective: A course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: Means, Master of Technology (M.Tech) degree program

Program Educational Objectives: The broad career, professional and personal goals that every student will achieve through a strategic and sequential action plan.

Project work: It is a design or research-based work to be taken up by a student during his / her second year to achieve a particular aim. It is a credit-based course and is to be planned carefully by the student.

Re-Appearing: A student can reappear only in the semester end examination for the theory component of a course, course to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester of a Program.

Regulations: The regulations, common to all M.Tech programs offered by Institute are designated as "MT23" and are binding on all the stakeholders.

Semester: It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days. The odd semester starts usually in July and even semester in December.

Semester End Examinations: It is an examination conducted for all courses offered in a semester at the end of the semester.

S/he: Means "she" and "he" both.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

University: Means the Jawaharlal Nehru Technological University Hyderabad, Hyderabad.

Withdraw from a Course: Withdrawing from a course means that a student can drop from a course within the first two weeks of the odd or even semester (deadlines are different for summer sessions). However s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

Words 'he', him', 'his', occur, they imply 'she', 'her', 'hers' also.

PREFACE

Dear Students,

The focus at IARE is to deliver value-based education with academically well qualified faculty and infrastructure. It is a matter of pride that IARE continues to be the preferred destination for students to pursue an engineering degree.

In the year 2015, IARE was granted academic autonomy status by University Grants Commission, New Delhi under Jawaharlal Nehru Technology University Hyderabad. From then onwards, our prime focus is on developing and delivering a curriculum which caters to the needs of various stakeholders. The curriculum has unique features enabling students to develop critical thinking, solve problems, analyze socially relevant issues, etc. The academic cycle designed on the basis of Outcome Based Education (OBE) strongly emphasizes continuous improvement and this has made our curriculum responsive to current requirements.

The curriculum at IARE has been developed by experts from academia and industry and it has unique features to enhance problem solving skills apart from academic enrichment. The curriculum of M.Tech program has been thoroughly revised as per AICTE / UGC / JNTUH guidelines and have incorporated unique features such as competency training / coding, industry driven elective, internship and many more. The curriculum is designed in a way so as to impart engineering education in a holistic approach towards Excellence.

I hope you will have a fruitful stay at IARE.

Dr. L V Narasimha Prasad
Principal

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)

ACADEMIC REGULATIONS

M.Tech. Regular Two Year Degree Program
(for the batches admitted from the academic year 2023 - 24)

For pursuing two year postgraduate Master Degree program of study in Engineering (M.Tech) offered by Institute of Aeronautical Engineering under Autonomous status and herein after referred to as IARE.

1. CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions (HEI's) are changing from the conventional course structure to Choose Based Credit System (CBCS) along with introduction to semester system at first year itself. The semester system helps in accelerating the teaching learning process and enables vertical and horizontal mobility in learning.

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits and adopt an interdisciplinary approach to learning.

Choice Based Credit System (CBCS) is a flexible system of learning and provides choice for students to select from the prescribed elective courses. A course defines learning objectives and learning outcomes and comprises of lectures / tutorials / laboratory work / field work / project work /mini project work with seminar/ viva / seminars / presentations / self-study etc. or a combination of some of these.

Under the CBCS, the requirement for awarding a degree is prescribed in terms of number of credits to be completed by the students.

The CBCS permits students to:

1. Choose electives from a wide range of elective courses offered by the departments of the Institute.
2. Undergo additional courses of interest.
3. Adopt an inter-disciplinary approach in learning.
4. Make the best use of expertise of the available faculty.

2. MEDIUM OF INSTRUCTION

The medium of instruction shall be **English** for all courses, examinations, seminar presentations and project work. The curriculum will comprise courses of study as given in course curriculum in accordance with the prescribed syllabi.

3. ELIGIBILITY FOR ADMISSION

The admissions for category A and B seats shall be as per the guidelines of Telangana State Council for Higher Education (TSCHE) in consonance with government reservation policy.

a) Under Category A: 70% of the seats are filled based on GATE/PGECET ranks.
b) Under Category B: 30% seats are filled on merit basis as per guidelines of TSCHE.

4. UNIQUE COURSE IDENTIFICATION CODE

Every specialization of the M.Tech program will be placed in one of the groups as listed in the Table 1.

Table 1: Group of Courses

S. No	Specialization	Offering Department	Code
1	Structural Engineering	Civil Engineering	ST
2	Electrical Power Systems	Electrical and Electronics Engineering	PS
3	CAD / CAM	Mechanical Engineering	CC
4	Embedded Systems	Electronics and Communication Engineering	ES
5	Computer Science and Engineering	Computer Science and Engineering	CS
6	Aerospace Engineering	Aeronautical Engineering	AE

5. TYPES OF COURSES

Courses in a program may be of four kinds: **Core, Elective, Open and Mandatory courses.**

5.1 Core Courses:

There may be a core course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a program in said discipline of study.

5.2 Elective Courses:

Electives provide breadth of experience in respective branch and applications areas. Elective course is a course which can be chosen from a pool of courses. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

There shall be five professional core elective groups out of which students can choose not more than two courses from each group. Overall, students can opt for four professional elective courses which suit their project work in consultation with the faculty advisor / mentor. In addition, one course from each of the two open electives has to be selected. A student may also opt for more elective courses in his/her area of interest.

5.3 Open Elective Courses:

An elective may be discipline centric focusing on those courses which add generic proficiency to the students or may be chosen from supportive / general discipline called as "Open Elective".

5.4 Mandatory Audit Courses:

The student may opt for audit courses, starting in first semester onwards. Audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Student can choose one audit course from the list. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

For mandatory non-credit Audit courses, a student has to secure 40 marks out of 100 marks (i.e. 40% of the marks allotted) in the continuous internal evaluation for passing the course/course. These marks should also be uploaded along with the internal marks of other courses.

No marks or letter grades shall be allotted for mandatory non-credit Audit courses. Its result shall be

declared with “Satisfactory” or “Not Satisfactory” performance.

6. SEMESTER STRUCTURE

The M.Tech. Programs in institute are of semester pattern, with four semesters consisting of Two academic years. Each academic year having Two Semesters: Odd and Even. Each Semester shall be of 22 weeks of duration (inclusive of Examinations), with a minimum of 90 instructional days per semester.

The two-year M.Tech. program consists of 68 credits and the student has to register for all 68 credits and earn all 68 credits for the award of M.Tech. degree. There is NO exemption of credits in any case.

UGC/AICTE specified definitions/descriptions are adopted appropriately for various terms and abbreviations used in these PG academic regulations, as listed below:

Each Semester shall have 'Continuous Internal Assessment (CIA)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) are taken as 'references' for the present set of regulations. The terms 'COURSE' and 'COURSE' imply the same meaning here and refer to 'Theory Course', or 'Lab Course', or ‘Design/Drawing Course', or 'Mini Project with Seminar', or ‘Dissertation’, as the case may be.

Before commencement of the class work, all the eligible students are required to register the courses through Samvidha (Student Management Portal) without fail.

7. PROGRAM DURATION

A student shall be declared eligible for the award of M.Tech degree, if he/she pursues a course of study and completes it successfully in not less than two academic years and not more than four academic years. A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his/her admission, shall forfeit his/her seat in M.Tech course.

a) A student will be eligible for the award of M.Tech degree on securing a minimum of 6.0/10.0 CGPA.

b) In the event of non-completion of project work and / or non-submission of the project report by the end of the fourth semester, the candidate shall re-register by paying the semester fee for the project. In such a case, the candidate will not be permitted to submit the report earlier than three months and not later than six months from the date of registration.

8. CURRICULUM AND COURSE STRUCTURE

The curriculum shall comprise Professional core courses, Professional elective courses, Audit courses, Open elective courses, Laboratory courses, Mini project with seminar, Phase-I Dissertation and Phase-II Dissertation.

Each Theory and Laboratory course carries credits based on the number of Hours / Week as follows:

- **Lecture Hours (Theory):** 1 credit per lecture hour per week.
- **Laboratory Hours (Practical):** 1 credit for 2 practical hours, 2 credits for 3 or 4 practical hours per week.
- **Dissertation Work / Project work:** 1 credit for 2 hours of project work per week.

Other student activities like study tour, guest lecture, conference/workshop participations, technical paper presentations and mandatory courses (Non-credit Audit Courses) will not carry any credits.

8.1 Credit distribution for courses offered is shown in Table 3.

Table 3: Credit distribution

S. No	Course	Hours	Credits
1	Core Courses	3	3
2	Professional Elective Courses	3	3
3	Audit Courses	2	0
4	Laboratory Courses	4	2
5	Open Elective Courses	3	3
6	Mini Project with Seminar	2	2
7	Phase - I Dissertation	20	10
8	Phase - II Dissertation	32	16

8.2 Course wise break-up for the total credits:

Total Theory Courses (12) Core Courses (04) + Professional Core Electives (05) + Open Electives (01)	04@3credits + 05 @ 3 credits + 01@3 credits	30
Total Laboratory Courses (04)	04@2credits	08
Mini Project with Seminar (01)	1@2credit	02
Research Methodology and IPR	1@2 credit	02
Phase-I Dissertation	1 @10credit	10
Phase-II Dissertation	1 @16credits	16
TOTAL CREDITS		**68**

9. EVALUATION METHODOLOGY

9.1 Theory Course:

Each theory course will be evaluated for a total of 100 marks, out of which 40 marks for Continuous Internal Assessment (CIA) and 60 marks for Semester End Examination (SEE).

9.1.1 Semester End Examination (SEE):

The SEE shall be conducted for 60 marks of 3 hours duration. The syllabus for the theory courses shall be divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern shall be as defined below. Two full questions with 'either' 'or' choice will be drawn from each unit. Each question carries 12 marks. There could be a maximum of two / three sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept
30 %	To test the analytical skill of the concept
20 %	To test the application skill of the concept

9.1.2 Continuous Internal Assessment (CIA):

For each theory course the CIA shall be conducted by the faculty / teacher handling the course. CIA is conducted for a total of 40 marks, with 30 marks for Continuous Internal Examination (CIE), 05 marks for Assignment and 05 marks for Alternative Assessment Tool (AAT). **Two CIE Tests are Compulsory** and sum of the two tests, along with the scores obtained in the assignment and AAT shall be considered for computing the final CIA of a student in a given course.

The CIE Tests/Assignment /AAT shall be conducted by the course faculty with due approval from the HOD. Advance notification for the conduction of Assignment/AAT is mandatory and the responsibility lies with the concerned course faculty.

Table 4: Outline of the Continuous Internal Assessments (CIA – 1 and CIA – 2) and SEE

Activities	CIA - 1	CIA - 2	SEE	Total Marks
Continuous Internal Examination (CIE)	10 marks	10 marks		20 marks
Assignment / Quiz	05 marks	05 marks		10 marks
Alternative Assessment Tool (AAT)	05 marks	05 marks		10 marks
Semester End Examination (SEE)			60 marks	60 marks
Total	--	--	100 marks	

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered. The valuation and verification of answer scripts of CIE exams shall be completed within a week after the conduct of the Examination.

Assignment:

To improve the writing skills in the course an assignment will be evaluated for 05 marks. Assignment has to submit either at the end of the CIE1 or CIE2 for the questions provided by each course coordinator in that semester. Assignments to be handed in as loose paper collection stapled together at the top left corner. The assignment should be presented as a professional report. It must consist of a cover sheet, content page, and should have an introduction, a body, a conclusion or recommendation, and a reference page.

Quiz: It is online proctor based online examination conducted either at the end of the CIE1 or CIE2.

The choice of conduction of Assignment / Quiz in CIE1 or CIE2 is purely choice of course handling faculty.

Alternative Assessment Tool (AAT):

In order to encourage innovative methods while delivering a course, the faculty members are encouraged to use the Alternative Assessment Tool (AAT). This AAT enables faculty to design own assessment patterns during the CIA. The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices. If properly applied, the AAT converts the classroom into an effective learning center. **The AAT may include,** Course related term paper, Technical seminar, Term paper, Case Study, Paper presentations conducted by reputed organizations relevant to the course etc.

The choice of selection of AAT is based on course handling faculty.

Note:

First mid-term examination shall be conducted on 50% of the syllabus, and the second mid-term examination shall be conducted on the remaining 50% of the syllabus.

The semester end examinations (SEE), for theory courses, will be conducted for 60 marks consisting of five questions (numbered from 1 to 5) carrying 12 marks each. Each of these questions is from each module and may contain sub-questions, for each question there will be an "either" "or" choice, which means, there will be two questions from each module, student should answer either of the two questions.

The duration of Semester End Examination is 3 hours.

9.2 Laboratory Course: For practical courses there shall be a Continuous Internal Assessment (CIA) during the semester for 40 marks and 60 marks for semester end examination. Out of the 40 marks for internal evaluation:

1. A write-up on day-to-day experiment in the laboratory (in terms of Preparation / Performance in the laboratory / Calculations and graphs / Results and error analysis / Viva-voce) which shall be evaluated for **10 marks**.
2. Viva-voce (or) tutorial (or) case study (or) application (or) poster presentation of the course concerned – **10 marks.**
3. Internal practical examination conducted by the laboratory teacher concerned shall be evaluated for **10 marks.**
4. The remaining 10 marks are for Laboratory Project, which consists of the Design (or) Software / Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.
5. The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the cluster / other colleges which will be decided by the Principal. The Semester End Examination held for 3 hours and total 60 marks are divided and allocated asshown below:

    1. 10 marks for write-up
    2. 15 for experiment/program
    3. 15 for evaluation of results
    4. 10 marks for presentation on another experiment/program in the same laboratory course
    5. 10 marks for viva-voce on concerned laboratory course

9.3 Project work

Normally, the project work should be carried out at Host Institute (Institute of Aeronautical Engineering). However, it can also be carried out in any of the recognized Educational Institutions, National Laboratories, Research Institutions, Industrial Organizations, Service Organizations or Government Organizations with the prior permission from the guide and concerned Head of the Department. A student shall submit the outcome of the project work in the form of a dissertation.

Registration of Dissertation Work: A candidate is permitted to register for the Dissertation Work after satisfying the attendance requirement in all the courses, both theory and laboratory. After satisfying the attendance requirement candidate must present in Dissertation Work Review - I, in consultation with his Supervisor, the title, objective and plan of action of his/her Dissertation work to the Project Review Committee (PRC) for approval within four weeks from the commencement of III semester. Only after obtaining the approval of the PRC can the student initiate the Dissertation work.

9.3.1 The student shall submit the project work synopsis at the end of III semester for Phase-I of project evaluation. The Phase-I Dissertation of project work shall be evaluated by Project Review

Committee (PRC) at the end of the third semester for a maximum of 100 marks. Head of the Department (HOD) shall constitute a PRC comprising of senior faculty of the specialization, Supervisor / Guide and Head of the Department.

9.3.2 The first phase of project work is to be carried out in IV semester for Phase –II of Project work. The student will be allowed to appear for final viva voce examination at the end of IV semester only if s/he has submitted s/he project work in the form of paper for presentation / publication in a conference / journal and produce the proof of acceptance of the paper from the organizers / publishers.

9.3.3 The student shall submit the project work in the form of dissertation at least four weeks ahead of the completion of the program. Head of the Department shall constitute an Internal Evaluation Committee (IEC) comprising of the Chairman BOS (PG), HOD and Supervisor/Guide. As per convenes of all meeting for open pre-submission seminar evaluation of the student. If the open pre-submission seminar by a student is not satisfactory, another seminar shall be scheduled within two weeks.

The evaluation of the project work and the marks allotted are as under:

S. No	Project Phases	Mode	Evaluation Committee	Marks
1	Phase - I	Continuous evaluation at the end of III Semester	Supervisor / Guide	40
2		Evaluation at the end of III Semester	Project Review Committee (PRC) comprising of senior faculty of the specialization, Supervisor / Guide and HOD.	60
Total (Phase – I)				**100**
3	Phase - II	An open pre-submission seminar by the student	The Internal Evaluation Committee (IEC) comprising of the Chairman, BOS (PG), HOD and Supervisor / Guide wherein the HOD convenes its meeting.	40
4		End Semester Examination (An open seminar followed by viva- voce)	The External Evaluation Committee (EEC) comprising of External Examiner, HOD and Supervisor / Guide wherein the HOD shall be the chairman of the committee.	60
Total (Phase-II)				**100**

9.3.4 As soon as a student submits project work, Principal shall appoint the external examiner among the panel of examiners recommended by the Chairman, BOS (PG).

9.3.5 The Principal shall schedule the End Semester Examination in project work soon after the completion of the study of program and a student can appear for the same provided s/he has earned successfully all the requisite credits. The student shall produce the dissertation duly certified by the guide and HOD during the Examination.

9.3.6 The project reports of M.Tech students who have not completed their course work successfully will be evaluated in that semester itself and the result sent confidentially to the Controller of Examinations. The results of the project work evaluation will be declared by the Controller of Examinations only after the successful completion of the courses by those students.

10. ATTENDANCE REQUIREMENTS AND DETENTION POLICY

The programs are offered based on a unit system with each course being considered a unit. Attendance is calculated separately for each course.

10.1 Attendance in all classes (Lectures/Laboratories) is compulsory. The minimum required attendance in each theory course (***also mandatory Audit Courses***) including the attendance of mid-term examination / Laboratory etc. is 75%. Two periods of attendance for each theory course shall

be considered, if the student appears for the mid-term examination of that course. A student shall not be permitted to appear for the Semester End Examinations (SEE), if s/he attendance is less than 75%.

10.2 **A** student's Seminar report and presentation on Mini Project shall be eligible for evaluation, only if he ensures a minimum of 75% of his attendance in seminar presentation classes on Mini Project during that semester.

10.3 **Condoning of shortage of attendance** (between 65% and 75%) up to a maximum of 10% (considering the days of attendance in sports, games, NCC, NSS activities and medical grounds) in each course (Theory /Laboratory / Mini Project with Seminar) of a semester shall be granted by the institute academic committee on genuine reasons.

10.4 A prescribed fee per course shall be payable for condoning shortage of attendance.

10.5 Shortage of Attendance below 65% in any course shall in **no case be condoned.**

10.6 A Student, whose shortage of attendance is not condoned in any course(s) (Theory/Lab/Mini Project with Seminar) in any semester, is considered as 'Detained in that course(s), and is not eligible to write Semester End Examination(s) of such course(s), (in case of Mini Project with Seminar, s/he Mini Project with Seminar Report or Presentation are not eligible for evaluation) in that Semester; and s/he has to seek re-registration for those course(s) in subsequent semesters, and attend the same as and when offered.

10.7 A student fulfills the attendance requirement in the present semester, shall not be eligible for readmission into the same class.

10.8 **a)** A student shall put in a minimum required attendance in at least **three theory courses (excluding *mandatory (non-credit audit)* course)** in first semester for promotion to second semester.

b) A student shall put in a minimum required attendance in at least **three theory courses (excluding *mandatory (non-credit audit)* course)** in second semester for promotion to third semester.

11. CONDUCT OF SEMESTER END EXAMINATIONS AND EVALUATION

11.1 Semester end examination shall be conducted by the Controller of Examinations (COE) by inviting Question Papers from the External Examiners.

11.2 COE shall invite external examiners to evaluate all the semester end examinations answer scripts on a prescribed date(s).

11.3 Laboratory examinations are conducted by involving external examiners.

11.4 Examinations Control Office headed by COE shall consolidate the marks awarded by internal and external examiners and award grades.

12. SCHEME FOR THE AWARD OF GRADE

12.1 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each theory course, if s/he secures:

i. Not less than 40% marks (16 out of 40 marks) for each theory course in the CIA.

ii. Not less than 40% marks (24 out of 60 marks) for each theory course in the SEE.

iii. A minimum of 50% marks (50 out of 100 marks) for each theory course considering both CIA and SEE.

12.2 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each Laboratory / Mini project with Seminar / Dissertation Project, if s/he secures.

i. Not less than 40% marks (16 out of 40 marks) in the CIA.

ii. Not less than 40% marks (24 out of 60 marks) in the SEE.

iii. A minimum of 50% marks (50 out of 100 marks) considering both CIA and SEE.

If a candidate fails to secure a pass in a particular course, it is mandatory that s/he shall register and reappear for the examination in that course during the next semester when examination is conducted in that course. It is mandatory that s/he should continue to register and reappear for the examination till s/he secures a pass.

13.0 LETTER GRADES AND GRADE POINTS

13.1 Performances of students in each course are expressed in terms of marks as well as in Letter Grades based on absolute grading system. The UGC recommends a 10 point grading system with the following letter grades as given below:

% of Marks Secured in a Course / Course (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
90% and above (≥ 90%, ≤ 100%)	O (Outstanding)	10
Below 90% but not less than 80% (≥ 80%, <90%)	A+ (Excellent)	9
Below 80% but not less than 70% (≥ 70%, <80%)	A (Very Good)	8
Below 70% but not less than 60% (≥ 60%, <70%)	B+ (Good)	7
Below 60% but not less than 50% (≥ 50%, <60%)	B (above Average)	6
Below 50% (<50%)	F (Fail)	0
Absent	**AB (Absent)**	**0**

13.2 A student is deemed to have passed and acquired to correspondent credits in particular course if s/he obtains any one of the following grades: "O", "A+", "A", "B+", "B".

13.3 A student obtaining grade "F" shall be considered failed and will be required to reappear in the examination.

13.4 "SA" denotes shortage of attendance (as per item 10) and hence prevention from writing Semester End Examination.

13.5 At the end of each semester, the institute issues grade sheet indicating the SGPA and CGPA of the student. However, grade sheet will not be issued to the student if s/he has any outstanding dues.

14.0 COMPUTATION OF SGPA AND CGPA

The UGC recommends to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA). The credit points earned by a student are used for calculating the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA), both of which are important performance indices of the student. SGPA is equal to the sum of all the total points earned by the student in a given semester divided by the number of credits registered by the student in that semester. CGPA gives the sum of all the total points earned in all the previous semesters and the current semester divided by the number of credits registered in all these semesters. Thus,

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course and n represent the number of courses in which a student's is registered in the concerned semester.

$$CGPA = \sum_{j=1}^{m} \left(C_j S_j \right) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and $C_j$is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto the semester. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

15.0 ILLUSTRATION OF COMPUTATION OF SGPA AND CGPA

15.1 Illustration of calculation of SGPA

Course	Credits	Letter Grade	Grade Points	Credit Points (Credit x Grade)
Course 1	4	A	8	4 x 8 = 32
Course 2	4	O	10	4 x 10 = 40
Course 3	4	B	6	4 x 6 = 24
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B	6	3 x 6 = 18
	21			**159**

Thus, SGPA = 159 / 21 = 7.57

15.2 Illustration of calculation of CGPA

Semester	Credits	SGPA	Credits * SGPA
Semester I	24	7	24 * 7 = 168
Semester II	24	6	24 * 6 = 144
Semester III	24	6.5	24 * 6.5 = 156
Semester IV	24	6	24 * 6 = 144
	96		**612**

Thus, *CGPA = 612* / 96 = 6.37

16.0 PHOTOCOPY / REVALUATION

A student, who seeks the revaluation of the answer script, is directed to apply for the photocopy of his/her semester examination answer paper(s) in the theory course(s) within 2 working days from the declaration of results in the prescribed format to the Controller of Examinations through the Head of the Department. On receiving the photocopy, the student can consult with a competent member of faculty and seek the opinion for revaluation. Based on the recommendations, the student can register for the revaluation with prescribed fee. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses.

17.0 GRADUATION REQUIREMENTS

The following academic requirements shall be met for the award of M .Tech degree.

17.1 Student shall register and acquire minimum attendance in all courses and secure 68 credits.

17.2 A student who fails to earn 68 credits within four consecutive academic years from the year of his/her admission (with CGPA ≥ 6.0), shall forfeit his/her degree and his/her admission stands cancelled.

18.0 AWARD OF DEGREE

After a student has earned the requirements prescribed for the completion of the program and is eligible for the award of M.Tech degree, he shall be placed in one of the following three classes based on the CGPA:

Classification of degree will be as follows:

Class Awarded	CGPA
First Class with Distinction	≥ 7.75
First Class	6.75≤ CGPA < 7.75
Second Class	6.00≤ CGPA < 6.75

Note: A student with final CGPA (at the end of the M.Tech Program) < 6.00 shall not be eligible for the Award of Degree.

All the candidates who register for the semester end examination will be issued grade sheet by the Institute. Apart from the semester wise marks memos, the institute will issue the provisional certificate course to the fulfillment of all the academic requirements.

19. TERMINATION FROM THE PROGRAM

The admission of a student to the program may be terminated and the student may be asked to leave the institute in the following circumstances:

a) The student fails to satisfy the requirements of the program within the maximum period stipulated for that program.

b) The student fails to satisfy the norms of discipline specified by the institute from time to time.

20. WITH-HOLDING OF RESULTS

If the candidate has not paid any dues to the college / if any case of indiscipline / malpractice is pending against him/her, the results of the candidate will be withheld. The issue of the degree is liable to be withheld in such cases.

21. DISCIPLINE

Every student is required to observe discipline and decorum both inside and outside the institute and not to indulge in any activity which will tend to bring down the honor of the institute. If a student indulges in malpractice in any of the theory / practical examination, continuous assessment examinations he/she shall be liable for punitive action as prescribed by the Institute from time to time.

22. GRIEVANCE REDRESSAL COMMITTEE

The institute shall form a Grievance Redressal Committee for each course in each department with the Course Teacher and the HOD as the members. This Committee shall solve all grievances related to the course under consideration.

23. TRANSITORY REGULATIONS

A student who has been detained in any semester of previous regulations for not satisfying the attendance requirements shall be permitted to join in the corresponding semester of this regulation.

Semester End Examination in each course under the regulations that precede immediately these regulations shall be conducted three times after the conduct of last regular examination under those regulations. Thereafter, the failed students, if any, shall take examination in the equivalent papers of these regulations as suggested by the Chairman, BOS concerned.

24. REVISION OF REGULATIONS AND CURRICULUM

The Institute from time to time may revise, amend or change the regulations, scheme of examinations and syllabi if found necessary and on approval by the Academic Council and the Governing Body shall come into force and shall be binding on the students, faculty, staff, all authorities of the Institute and others concerned.

FAILURE TO READ AND UNDERSTAND THE REGULATIONS IS NOT AN EXCUSE

FREQUENTLY ASKED QUESTIONS AND ANSWERS ABOUT AUTONOMY

1. Who grants Autonomy? UGC, Govt., AICTE or University

In case of Colleges affiliated to a university and where statutes for grant of autonomy are ready, it is the respective University that finally grants autonomy but only after concurrence from the respective state Government as well as UGC. The State Government has its own powers to grant autonomy directly to Govt. and Govt. aided Colleges.

2. Shall IARE award its own Degrees?

No. Degree will be awarded by Jawaharlal Nehru Technological University, Hyderabad with a mention of the name IARE on the Degree Certificate.

3. What is the difference between a Deemed University and an Autonomy College?

A Deemed University is fully autonomous to the extent of awarding its own Degree. A Deemed University is usually a Non-Affiliating version of a University and has similar responsibilities like any University. An Autonomous College enjoys Academic Autonomy alone. The University to which an autonomous college is affiliated will have checks on the performance of the autonomous college.

4. How will the Foreign Universities or other stake – holders know that we are an Autonomous College?

Autonomous status, once declared, shall be accepted by all the stake holders. The Govt. of Telangana mentions autonomous status during the First Year admission procedure. Foreign Universities and Indian Industries will know our status through our website.

5. What is the change of Status for Students and Teachers if we become Autonomous?

An autonomous college carries a prestigious image. Autonomy is actually earned out of our continued past efforts on academic performances, our capability of self- governance and the kind of quality education we offer.

6. Who will check whether the academic standard is maintained / improved after Autonomy? How will it be checked?

There is a built-in mechanism in the autonomous working for this purpose. An Internal Committee called Academic Program Evaluation Committee, which will keep a watch on the academics and keep its reports and recommendations every year. In addition the highest academic council also supervises the academic matters. The standards of our question papers, the regularity of academic calendar, attendance of students, speed and transparency of result declaration and such other parameters are involved in this process.

7. Will the students of IARE as an Autonomous College qualify for University Medals and Prizes for academic excellence?

No. IARE has introduced its own awards, medals, etc. for the academic performance of the students. However for all other events like sports, cultural on co-curricular organized by the University the students shall qualify.

8. Can IARE have its own Convocation?

No. Since the University awards the Degree the Convocation will be that of the University, but there will be Graduation Day at IARE.

9. Can IARE give a provisional degree certificate?

Since the examinations are conducted by IARE and the results are also declared by IARE, the college sends a list of successful candidates with their final Grades and Grade Point Averages including CGPA to the University. Therefore, with the prior permission of the University the college will be entitled to give the provisional certificate.

10. Will Academic Autonomy make a positive impact on the Placements or Employability? Certainly. The number of students qualifying for placement interviews is expected to improve, due to rigorous and repetitive classroom teaching and continuous assessment. Also the autonomous status is more responsive to the needs of the industry. As a result therefore, there will be a lot of scope for industry oriented skill development built-in into the system. The graduates from an autonomous college will therefore represent better employability.

11. What is the proportion of Internal and External Assessment as an Autonomous College?
Presently, it is 70 % external and 30% internal. As the autonomy matures the internal assessment component shall be increased at the cost of external assessment.

12. Is it possible to have complete Internal Assessment for Theory or Practicals?
Yes indeed. We define our own system. We have the freedom to keep the proportion of external and internal assessment component to choose.

13. Why Credit based Grade System?
The credit based grade system is an accepted standard of academic performance the world over in all Universities. The acceptability of our graduates in the world market shall improve.

14. What exactly is a Credit based Grade System?
The credit based grade system defines a much better statistical way of judging the academic performance. One Lecture Hour per week of Teaching Learning process is assigned One Credit. One hour of laboratory work is assigned half credit. Letter Grades like A, B, C, D, etc. are assigned for a Range of Marks. (e.g. 91% and above is A+, 80 to 90 % could be A etc.) in Absolute Grading System while grades are awarded by statistical analysis in relative grading system. We thus dispense with sharp numerical boundaries. Secondly, the grades are associated with defined Grade Points in the scale of 1 to 10. Weighted Average of Grade Points is also defined Grade Points are weighted by Credits and averaged over total credits in a Semester. This process is repeated for all Semesters and a CGPA defines the Final Academic Performance

15. What are the norms for the number of Credits per Semester and total number of Credits for UG/PG program?
These norms are usually defined by UGC or AICTE. Usually around 25 Credits per semester is the accepted norm.

16. What is a Semester Grade Point Average (SGPA)?
The performance of a student in a semester is indicated by a number called SGPA. The SGPA is the weighted average of the grade points obtained in all the courses registered by the student during the semester.

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and $G_i$is the grade point scored by the student in the i^{th} course and $i$represent the number of courses in which a student registered in the concerned semester. SGPA is rounded to two decimal places.

17. What is a Cumulative Grade Point Average (CGPA)?

An up-to-date assessment of overall performance of a student from the time of his first registration is obtained by calculating a number called CGPA, which is weighted average of the grade points obtained in all the courses registered by the students since he entered the Institute.

$$CGPA = \sum_{j=1}^{n} (C_i S_i) / \sum_{j=1}^{n} C_i$$

Where, S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester and j represent the number of courses in which a student's is registered upto the semester. CGPA is rounded to two decimal places.

18. Is there any Software available for calculating Grade point averages and converting the same into Grades?

Yes, The institute has its own MIS software for calculation of SGPA, CGPA, etc.

19. Will the teacher be required to do the job of calculating SGPAs etc. and convert the same into Grades?

No. The teacher has to give marks obtained out of whatever maximum marks as it is. Rest is all done by the computer.

20. Will there be any Revaluation or Re-Examination System?

No. There will double valuation of answer scripts. There will be a make up Examination after a reasonable preparation time after the End Semester Examination for specific cases mentioned in the Rules and Regulations. In addition to this, there shall be a 'summer term' (compressed term) followed by the End Semester Exam, to save the precious time of students.

21. How fast syllabi can be and should be changed?

Autonomy allows us the freedom to change the syllabi as often as we need.

22. Will the Degree be awarded on the basis of only final year performance?

No. The CGPA will reflect the average performance of all the semester taken together.

23. What are Statutory Academic Bodies?

Governing Body, Academic Council, Examination Committee and Board of Studies are the different statutory bodies. The participation of external members in everybody is compulsory. The institute has nominated professors from IIT, NIT, University (the officers of the rank of Pro-vice Chancellor, Deans and Controller of Examinations) and also the reputed industrialist and industry experts on these bodies.

24. Who takes Decisions on Academic matters?

The Governing Body of institute is the top academic body and is responsible for all the academic decisions. Many decisions are also taken at the lower level like Boards of Studies. Decisions taken at the Board of Studies level are to be ratified at the Academic Council and Governing Body.

25. What is the role of Examination committee?

The Examinations Committee is responsible for the smooth conduct of internal, End Semester and make up Examinations. All matters involving the conduct of examinations, spot valuations, tabulations and preparation of Grade Cards etc., fall within the duties of the Examination Committee.

26. Is there any mechanism for Grievance Redressal?
The institute has grievance redressal committee, headed by Dean - Student affairs and Dean - IQAC.

27. How many attempts are permitted for obtaining a Degree?
All such matters are defined in Rules & Regulation

28. Who declares the result?
The result declaration process is also defined. After tabulation work wherein the SGPA, CGPA and final Grades are ready, the entire result is reviewed by the Moderation Committee. Any unusual deviations or gross level discrepancies are deliberated and removed. The entire result is discussed in the Examinations and Result Committee for its approval. The result is then declared on the institute notice boards as well put on the web site and Students Corner. It is eventually sent to the University.

29. Who will keep the Student Academic Records, University or IARE?
It is the responsibility of the Dean of Academics of the Autonomous College to keep and preserve all the records.

30. What is our relationship with the JNT University?
We remain an affiliated college of the JNT University. The University has the right to nominate its members on the academic bodies of the college.

31. Shall we require University approval if we want to start any New Courses?
Yes, It is expected that approvals or such other matters from an autonomous college will receive priority.

32. Shall we get autonomy for PG and Doctoral Programs also?
Yes, presently our PG programs also enjoying autonomous status.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

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

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is course to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course.
6.	Refuses to obey the orders of the Controller of Examinations /Additional Controller of Examinations/any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the COE or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the COE or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the Institute premises or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is course to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat.

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

INSTITUTE OF AERONAUTICALENGINEERING

(Autonomous)

COURSE CATALOGUE

REGULATIONS: MT-23

EMBEDDED SYSTEMS

I SEMESTER

Course Code	Course Name	Course Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BESD01	Embedded System Programming	PCC	Core	3	0	0	3	40	60	100
BESD02	Microcontrollers and Programmable Digital Signal Processing	PCC	Core	3	0	0	3	40	60	100
	Professional Elective - I	PEC	Elective	3	0	0	3	40	60	100
	Professional Elective - II	PEC	Elective	3	0	0	3	40	60	100
BHSD01	Research Methodology & IPR	--	--	2	0	0	2	40	60	100
	Audit Course - I	Audit - I	Audit	2	0	0	0	--	--	--
PRACTICAL										
BESD11	Embedded System Programming Laboratory	PCC	Core	0	0	4	2	40	60	100
BESD12	Microcontrollers and Programmable Digital Signal Processors Laboratory	PCC	Core	0	0	4	2	40	60	100
TOTAL				**16**	**00**	**08**	**18**	**280**	**420**	**700**

***Professional Elective- I and Professional Elective- I Lab must be of same course.**

II SEMESTER

Course Code	Course Name	Course Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BESD13	Internet of things (IOT) and Applications	PCC	Core	3	0	0	3	40	60	100
BESD14	ARM Cortex Architecture and Programming	PCC	Core	3	0	0	3	40	60	100
	Professional Elective-III	PEC	Elective	3	0	0	3	40	60	100
	Professional Elective-IV	PEC	Elective	3	0	0	3	40	60	100
	Audit Course - II	Audit - II	Audit	2	0	0	0	--	--	--
PRACTICAL										
BESD23	Internet of Things (IoT) Applications Laboratory	PCC	Core	0	0	4	2	40	60	100
BESD24	ARM Cortex Architecture and Programming Laboratory	PCC	Core	0	0	4	2	40	60	100
BESD25	Mini Project with Seminar	PCC	Core	0	0	4	2	40	60	100
TOTAL				**14**	**00**	**12**	**18**	**280**	**420**	**700**

*** Professional Elective- III and Professional Elective- III Lab must be of same course.**

III SEMESTER

Course Code	Course Name	Course Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
	Professional Elective – V	PEC	Elective	3	0	0	3	40	60	100
	Open Elective	OEC	Elective	3	0	0	3	40	60	100
PROJECT										
BESD34	Phase-I Dissertation	Major Project	Core	0	0	12	6	40	60	100
TOTAL				**06**	**00**	**12**	**12**	**120**	**180**	**300**

IV SEMESTER

Course Code	Course Name	Course Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
BESD35	Dissertation Work Review - III	Major Project	Core	0	0	12	6	40	60	100
BESD36	Dissertation Viva-Voce	--	Core	0	0	28	14	40	60	100
TOTAL				**00**	**00**	**40**	**20**	**80**	**120**	**200**

ELECTIVE COURSES

PROGRAM CORE ELECTIVES (PCE)

Course Code	Course Name	Professional Electives
BESD03	Embedded System Design	I
BESD04	Real Time Operating Systems	I
BESD05	Hardware and Software Co-Design	I
BESD06	Communications Buses & Interfaces	I
BESD07	CPLD and FPGA Architectures and Applications	II
BESD08	Advanced Computer Architecture	II
BESD09	Design for Testability	II
BESD10	System on Chip Design	II
BESD15	Embedded Systems for Machine learning	III
BESD16	System Design with Embedded Linux	III
BESD17	Embedded Systems in Robotics	III
BESD18	Embedded Systems in Biomedical Applications	III
BESD19	Advanced Mobile and Wireless Networks	IV
BESD20	Wireless Sensor Networks	IV
BESD21	Cryptography and Network Security	IV
BESD22	Sensors and Actuators	IV
BESD26	Embedded Systems for Automotive Applications	V
BESD27	FPGA Based System Design	V
BESD28	Discrete Time Signal Processing	V
BESD29	Sensor Technologies and MEMS	V

OPEN ELECTIVE COURSES FOR OTHER DEPARTMENTS

S.No	Course Code	Course Name
1	BESD30	Embedded System Design
2	BESD31	Principles of Distributed Embedded Systems
3	BESD32	Advanced Digital System Design
4	BESD33	Digital Image and Video Processing

AUDIT COURSES – I AND II

S.No	Course Code	Course Title
1	BHSD02	English for Research Paper Writing
2	BHSD03	Disaster Management
3	BHSD04	Sanskrit for Technical Knowledge
4	BHSD05	Value Education
5	BHSD06	Constitution of India
6	BHSD07	Pedagogy Studies
7	BHSD08	Stress Management by Yoga
8	BHSD09	Personality Development through Life Enlightenment Skills

COURSE CONTENT

EMBEDDED SYSTEM PROGRAMMING								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD01	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

An embedded system programming course typically covers designing, programming, working with embedded systems. embedded C is an extension to the standard C Programming Language. It focuses on the knowledge and skills required to define the functionality of the embedded systems.

II. COURSES OBJECTIVES:

The students will try to learn

I. The importance of embedded C and microcontrollers to design real time timers with various constraints
II. Writing, compiling, and debugging code for embedded systems.
III. Techniques for debugging and testing both software and hardware components of embedded systems.
IV. To interface with input and output devices, as well as communication interfaces commonly used in embedded systems.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Summarize the concepts of embedded C and develop the embedded C programming examples with Keil IDE and interfacing modules.
CO2 Choose serial or parallel communication for transmitting the data between microcontroller and peripherals.
CO3 Develop Embedded C language programs for, blinking the LED and interfacing of switch, LCD display, buzzer and temperature sensors to the microcontrollers.
CO4 Build an interface between micro controller and peripherals to provide solutions to the real world problems.
CO5 Make use of debugging techniques in embedded software to know step- by-step software execution process.
CO6 Develop embedded system programming for different peripherals to increase the code density.

IV. COURSE CONTENT:

MODULE - I: EMBEDDED C PROGRAMMING (10)

Introduction to 'C' programming, Difference between C & Embedded C, storage Classes, Data Types Controlling program flow, Arrays, Functions, Memory Management, Pointers, Arrays and Pointers, Pointer to Functions and advanced topics on Pointers, Structures and Unions, Data Structures, Linked List, Stacks, Queues Conditional Compilation, Pre-processor directives, File operations, Bitwise operations, Typecasting.

MODULE –II: TIMERS & COUNTERS AND SERIAL COMMUNICATION PROGRAMMING (09)

Introduction to Timers & Counters, Difference between Timer and Counter, Description of SFR associated with Timers & Counters, Programming of Timers & Counters. Introduction to Serial Communication, Types of Serial Communication, Description of SFR associated with Serial Communication, Programming of UART

MODULE –III: PROGRAMMING FOR EXTERNAL INTERFACES (10)
Interfacing Circuit Description of LED's, Programming of LED's Interfacing, Interfacing of Seven Segment Display, Programming of 7 Segment Display Interfacing, Interfacing Circuit Description of 16 x 2 LCD, Programming of 16 x 2 LCD.

Interfacing Circuit of Switches & Keyboard Matrix, Programming of Keyboard Matrix & Switches, Programming & Controlling of motors in Embedded System.

MODULE –IV: EMBEDDED SYSTEM DEVELOPMENT (09)
The integrated development environment, Types of files generated on cross compilation, Simulators. emulators and debugging, Target hardware debugging, Boundary Scan, Embedded software development and tools. testing on host machine.

MODULE –V: CASE STUDIES (10)
Design of Embedded Systems using Microcontrollers for applications in the area of communication and automotive. (GSM/GPRS, CAN, ZigBee).

V. TEXT BOOKS:

1. Michael J. Pont, "Embedded C", A Pearson Education, 2nd edition, 2009.
2. RajKamal, "Embedded Systems, Architecture Programming and Design", Tata McGraw Hill, 2nd edition, 2008.

VI. REFERENCE BOOKS:

1. Jonathan W. Valvano – Brookes / Cole, "Embedded Microcomputer Systems, Real Time Interfacing", Thomas Learning, 1st Edition, 1998.

VII. WEB REFERENCES:

1. http://www.nptelvideos.in/2012/11/embedded-systems.html
2. http://nptel.iitg.ernet.in/courses/Elec_Engg/IIT%20Delhi/Embedded%20Systems%20(Video).html
3. http://www.sciencedirect.com/science/book/9780750677929
4. https://books.google.co.in/books/about/Embedded_systems.html?id=tgLm2g8KnH0C

VIII. MATERIALS ONLINE:

1. Course Template
2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes
7. Power point presentation

COURSE CONTENT

MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSING								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD02	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

This course is intended to provide fundamentals of ARM Cortex-M3 Processor and LPC17XXMicrocontroller architectures and their features. It includes the architectures of the Cortex-M3, instruction set summary, Programmable DSP processor. It is used in the applications of microcontrollers programming models and programmable digital signal processors

II. COURSES OBJECTIVES:

The students will try to learn

I. The programming models of ARM processors core-based System on Chip with several features / peripherals based on requirements of embedded applications.
II. Identify and characterize architecture of Programmable DSP Processors.
III. Design and develop small applications by utilizing the ARM processor core and DSP processor-based platform.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Illustrate the Internal architecture and memory operations of ARM Cortex M3 processor for interfacing microprocessor applications.
CO2 Analyze Exceptions handler mechanism to minimize interrupt latency using Nested Vectored Interrupt Controller.
CO3 Construct the high level of integration in embedded applications using LPC 17XX Microcontroller
CO4 Demonstrate various computational building blocks of programmable DSP architectures using interfacing of memory and I/O peripherals.
CO5 Identify the CPU architecture, peripherals, and development tools for the TMS320C6000 digital signal processors.
CO6 Develop the application for digital signal processing using code composer studio tool.

IV. COURSE CONTENT:

MODULE - I: ARM CORTEX-M3 PROCESSOR (09)

ARM Cortex-M3 processor: Applications, Programming model – Registers, Operation modes, Exceptions and Interrupts, Reset Sequence Instruction Set, Unified Assembler Language, Memory Maps, Memory Access Attributes, Permissions, Bit-Band Operations, Unaligned and Exclusive Transfers, Pipeline, Bus Interfaces

MODULE –II: EXCEPTIONS AND INTERRUPT (10)

Exceptions, Types, Priority, Vector Tables, Interrupt Inputs and Pending behavior, Fault Exceptions, Supervisor and Pendable Service Call, Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency

MODULE –III: LPC 17XX MICROCONTROLLER (10)
LPC 17xx microcontroller- Internal memory, GPIOs, Timers, ADC.

UART and other serial interfaces, PWM, RTC, WDT.

MODULE –IV: PROGRAMMABLE DSP (P-DSP) PROCESSORS (09)
Programmable DSP (P-DSP) Processors: Harvard architecture, Multiport memory, architectural structure of P-DSP-MAC unit, Barrel shifters, Introduction to TI DSP processor family.

MODULE –V: VLIW ARCHITECTURE (10)
VLIW architecture and TMS320C6000 series, architecture study, data paths, cross paths, Introduction to Instruction level architecture of C6000 family, Assembly Instructions memory addressing, for arithmetic, logical operations code composer Studio for application development for digital signal processing, on chip peripherals, processor benchmarking.

V. TEXT BOOKS:

1. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3", Elsevier, 3rd edition, 2014.
2. Venkatraman B, Bhaskar M, "Digital Signal Processors: Architecture, Programming and Applications, TMH, 2nd edition, 2011.

VI. REFERENCE BOOKS:

1. Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing and Optimizing", Morgan Kaufman Publications,
2. Steve furber, "ARM System-on-Chip Architecture", Pearson Education.
3. Frank Vahid and Tony Givargis, "Embedded System Design", Wiley Publications.

VII. WEB REFERENCES:

1. http://nptel.ac.in/courses/106105036/
2. https://www.youtube.com/watch?v=rpdygqOI9mM
3. https://www.youtube.com/watch?v=hELr9-7aAG8

VIII. E-TEXT BOOKS:

1. https://university.ti.com
2. http://www.everythingvtu.wordpress.com

COURSE CONTENT

EMBEDDED SYSTEMS DESIGN								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD03	**ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

This course aims to provide students with a solid foundation in embedded system design, covering both theoretical concepts and practical implementation. Students will learn about the design, development, and testing of embedded systems, as well as the key components involved in creating
efficient and reliable embedded solutions.

II. COURSES OBJECTIVES:

The students will try to learn

I. The difference between embedded systems and general purpose systems.
II. Develop an understanding of hardware/software co-design and its significance.
III. Implement basic networking and communication capabilities in embedded systems

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Describe the characteristics, challenges, and constraints of embedded systems
CO 2 Apply the suitable memory technology and other components for different applications to meet the ever-growing needs of the embedded applications.
CO 3 Choose the fundamental components that make up an embedded board to implement an Instruction Set Architecture ‘s features in a processor
CO 4 Categorize the embedded firmware design approaches and development languages used for programming embedded devices.
CO 5 Make use of the memory hierarchy to minimize the access time in embedded architecture design.
CO 6 Identify the hardware software co- design issues pertaining to design of an embedded system using low power microcontrollers.

IV. COURSE CONTENT:

MODULE - I: NTRODUCTION TO EMBEDDED SYSTEMS (09)

Overview of microcontrollers and microprocessors Architecture, memory organization, and I/O operations, Selection criteria for choosing microcontrollers, Definition and characteristics of embedded systems, Embedded system applications and real-world examples, Challenges and constraints in embedded system design.

MODULE –II: TYPICAL EMBEDDED SYSTEM (09)

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication
Interfaces.

MODULE –III: EMBEDDED SYSTEM SOFTWARE (10)
Embedded software development process, Embedded programming languages (C, Assembly), Real-time operating systems (RTOS) and scheduling.

Hardware/Software Co-design: Hardware-software partitioning, Communication between hardware and software components, Trade-offs and optimization techniques.

MODULE –IV: RTOS BASED EMBEDDED SYSTEM DESIGN (10)
Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

MODULE –V: EMBEDDED NETWORKING AND COMMUNICATION (10)
Network protocols (TCP/IP, MQTT, etc.), Wireless communication (Wi-Fi, Bluetooth, etc.), IoT (Internet of Things) concepts

V. TEXT BOOKS:

1. Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley Publications, 3rd Edition, 2006.

VI. REFERENCE BOOKS:

1. Raj Kamal, “Embedded Systems”, TMH, 2nd Edition, 2008.
2. Shibu K.V, “Introduction to Embedded Systems, McGraw Hill, 3rd Edition, 2012.
3. Lyla, “Embedded Systems”, Pearson Education, 2nd Edition, 2013.

COURSE CONTENT

REAL TIME OPERATING SYSTEMS								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD04	**ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

This course is to introduce students with the basic concepts and approaches in the design and analysis of real-time operating systems. It covers design considerations of real time operating systems, task scheduling, threads, multitasking, task communication and synchronization. Applications of the course include real time operating systems in image processing, fault tolerant applications and control systems.

II. COURSES OBJECTIVES:

The students will try to learn

I. The concepts of operating systems and principles of real time operating system, implementation aspects of real time concepts in embedded systems.
II. The design of real time operating system by using the concepts of Timers, I/O subsystem and Memory management units.
III. Software development process and tools like Vxworks and mu COS for real time operating system applications.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Recall real time operating system to provide resource management and synchronization for communication systems.
CO2 Compare soft real-time operating system and hard real-time operating systems for the priority-based task scheduling.
CO3 Outline the components of real time operating systems for the design of reliable embedded system.
CO4 Analyze finite state machine for the task scheduling and execution in kernel models.
CO5 Develop a semaphore token for the execution of one or more threads in mutual exclusion.
CO6 Interpret message queue in asynchronous communications protocol for send and receive messages simultaneously.

IV. COURSE CONTENT:

MODULE - I: REAL TIME OPERATING SYSTEM PRINCIPLES (10)

History of operating systems, defining RTOS, classification of real-time systems, The scheduler, objects, services and key characteristics of RTOS, Tasks: Defining a task, task states and scheduling, typical task operations, typical task structure.

MODULE –II: REAL TIME KERNEL OBJECTS (09)

Semaphores: Defining semaphores, typical semaphore operations, typical semaphore use; Message Queues: Defining message queues, message queue states, message queue content, message queue storage, typical message queue

operations; Typical message queue use other kernel objects: Pipes, event registers, signals, condition variables.

MODULE –III: RTOS DESIGN CONSIDERATIONS (10)
Timer and Timer Services: Real-time clocks and system clocks, programmable interval timers, timer interrupt service routines, model for implementing the soft-timer handling facility, timing wheels.

I/O sub system: Basic I/O concepts, the I/O sub system; Memory management: Dynamic memory allocation, fixed-size memory management, blocking vs. Non-blocking memory functions, hardware memory management units.

MODULE –IV: TASKS COMMUNICATION AND SYNCHRONIZATION (10)
Synchronization and Communication: Synchronization, communication, resource synchronization methods, common practical design patterns; common design problems: Resource classification, deadlocks, priority inversion.

MODULE –V: RTOS APPLICATION DOMAINS (09)
Comparison and study of RTOS: Vx works and COS, Case studies: RTOS for image processing, embedded RTOS for voice over IP, RTOS for fault tolerant applications, RTOS for control systems.

V. TEXT BOOKS:

1. Andrew Troelsen,"Pro C and the .NET 4 Platform, Springer (India) Private Limited, New Delhi, India, 5th edition,2010.
2. David Chappell, "Understanding .NET – A Tutorial and Analysis", Addison Wesley, 2nd Edition, 2002.
3. Thamarai Selvi, R. Murugesan, A Textbook on C, Pearson Education, 1st Edition, 2003.

VI. REFERENCE BOOKS:

1. Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI, 1st edition, 1999.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Kindle Publishers, 2nd edition, 2005.
3. Tanenbaum, "Modern Operating Systems", Pearson Edition, 3rd edition, 2007.

VII. WEB REFERENCES:

1. https://www.jntumaterials.co.in
2. http://www.inf.ed.ac.uk/teaching/courses/es/PDFs/RTOS.pdf
3. https://nptel.ac.in/courses/106108101/pdf/Lecture_Notes/Mod%208_LN.pdf
4. http://wwww.iare.ac.in

VIII. E-TEXT BOOKS:

1. http://www.bookzz.org/
2. http://www.jntubook.com
3. http://www.4shared.com/web/preview/pdf/BhrrT3m0
4. http://www.archive.org

COURSE CONTENT

HARDWARE SOFTWARE CODESIGN								
I Semester: M.TECH - ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD05	**ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Basic principles of physics								

I. COURSE OVERVIEW:

This course intended to provide combined effort of hardware and software concurrent design in order to meet embedded system level objectives. It focuses on the hardware architectures, languages for systems design, system partitioning and design challenges. It gives the platform for designing applications in the area of aircraft, industrial automation, robotics, wireless communication and automobiles.

II. COURSES OBJECTIVES:

The students will try to learn

I. Providing adequate knowledge in the modeling of heterogeneous embedded systems based on design constraint and provide alternate solution exploring trade-off. Explore the various wireless communication technologies that enable IoT devices to connect and communicate, such as Wi-Fi, Bluetooth, Zigbee, LoRa WAN, and cellular networks.
II. Introducing the importance of estimating the cost analysis in terms of hardware and software parameters.
III. Introducing various co-synthesis and co-simulation tools for the effective design of embedded systems with better communication between different modules.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Demonstrate the principles and strategies involved in mapping software components onto hardware platforms in embedded systems.
CO2 Identify and differentiate between various types of partitioning techniques used in embedded systems, such as hardware/software partitioning and task/data partitioning, and recognize when to apply each type.
CO3 Identify the principles of hardware synthesis, which involve the automatic generation of hardware components from high-level design descriptions, and how it contributes to the integration of hardware and software in embedded systems.
CO4 Examine the importance of interface synthesis in creating efficient communication and interaction between hardware and software components within embedded systems, and learn to design and implement effective interfaces.
CO5 Analyze the execution timing and power consumption of hardware components within embedded systems, with the ability to optimize timing and power efficiency for specific applications.
CO6 Interpret the concept of virtual prototyping and how co-simulation plays a crucial role in creating virtual prototypes for embedded systems, allowing for early system evaluation and validation

IV. COURSE CONTENT:

MODULE – I: HW/SW PARTITIONING CONSTRAINTS & TRADEOFFS (10)
Cost modeling, Principle of hardware/software mapping – Real time scheduling – design specification & constraints on Embedded systems – Tradeoffs

MODULE –II: HW/SW PARTITIONING METHODOLOGIES (10)
Partitioning-Types of partitioning-Partitioning granularity - Kernigan-Lin Algorithm –Extended Partitioning – Binary Partitioning: GCLP Algorithm

MODULE –III: CO-SYNTHESIS (10)
Software synthesis – Hardware Synthesis – Interface Synthesis – Co-synthesis Approaches: Vulcan, Cosyma, Cosmos, Polis and COOL.

MODULE –IV: ESTIMATION: HARDWARE & SOFTWARE (09)
Hardware area, execution timing and power, Software memory and execution timing, Worst Case Execution Time, Case studies.

MODULE –V: CO-SIMULATION & CO-VERIFICATION (09)
Principles of Co-simulation – Abstract Level; Detailed Level – Co-simulation as Partitioning support – Co-simulation using Ptolemy approach, Virtual Prototyping, Rapid Prototyping.

V. TEXT BOOKS:

1. Soonhoi Ha, Jürgen Teich, “Handbook of Hardware/Software Codesign”, Springer, 2017. ,2014

VI. REFERENCE BOOKS:

1. Schaumont, Patrick, A,” A Practical Introduction to Hardware/Software Codesign”, 2013, reprint, Springer, India.N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.
2. Felice Balarin, Massimiliano Chiodo, Paolo Giusto, Harry Hsieh, Attila Jurecska, Luciano Lavagno, Claudio Passerone, Alberto Sangiovanni-Vincentelli, Ellen Sentovich, Kei Suzuki, Bassam Tabbara, “Hardware-Software Co-Design of Embedded Systems: The POLIS Approach”, Springer, 2012.

COURSE CONTENT

COMMUNICATION BUSES & INTERFACES								
I Semester: M.TECH – ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD06	**ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

This Course deals with a variety of applications including converters that translate between RS-232, RS-485, and 3V/5V logic. Designs with fail-safe features, high noise immunity, and low power consumption are included. USB is the most successful personal-computer interface ever. PCs, tablets, phones, and other devices have USB ports that can connect to everything from keyboards, mice, and game controllers to cameras, printers, drives, audio and video devices, and more.

II. COURSES OBJECTIVES:

The students will try to learn

I. Using wireless technologies to transmit serial by select the suitable Buses for different applications.
II. Familiar USB peripherals include mice, keyboards, drives, printers, speakers, and cameras for data-acquisition.
III. Implementation of multicast-based communication protocol like Controller Area Network Overview and covering all the basics of Peripheral Component Interface architecture at a high level.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Select Low speed Serial buses for various applications
CO 2 Choose Low speed serial buses configuration for asynchronous serial communications
CO 3 Analyze the communication systems based on the Controller Area Network (CAN) standard
CO 4 Compare architectural perspective of the PCI Express Technology with PCI bus.
CO 5 Organize the transfers like control, bulk and interrupt in USB descriptors
CO 6 Understand the basic concepts of communication buses and interfaces

IV. COURSE CONTENT:

MODULE – I: SERIAL BUS ARCHITECTURE (09)

Serial Buses – Physical interface, Data and Control signals, features, limitations and applications of RS232, RS485, I2C, SPI Features, Frame structure, Control signals, Limitations

MODULE –II: SERIAL BUS PHYSICAL INTERFACE (09)

Serial Buses RS232, RS485, I2C, SPI, Physical Interface, Configuration and applications

MODULE –III: CONTROLLER AREA NETWORK (CAN) STANDARD (10)

The CAN 2.0b Standard: Physical Layer, Message Frame Formats, Bus Arbitration, Message Reception and Filtering,

Reference Architecture of a CAN-Based System: CAN Controller and Bus Adapter, CAN Device Drivers and Interaction Layer. CAN Tools.

MODULE –IV: PCI EXPRESS TECHNOLOGY (10)

PCI Basics, Bus architecture, PCIe architecture overview, configuration overview, Address space and Transaction routing: Base address registers, Base and limit registers, TLP elements: General, Motivation and Details.

MODULE –V: UNIVERSAL SERIAL BUS (USB) (10)

USB Basics, Inside USB Transfers, A Transfer Type for Every Purpose, Enumeration: How the Host Learns about Devices, Control Transfers: Structured Requests for Critical Data, Chip Choices, Device Classes, Matching a Driver to a Device and Detecting Devices

V. TEXT BOOKS:

1. Axelson, J. Serial Port Complete: COM Ports, USB Virtual COM Ports, and Ports for Embedded Systems, ser, 2nd Edition, Complete Guides Series. Lakeview Research 2007.
2. Axelson, Jan. USB complete . Lakeview Research, 2015.
3. Mike Jackson, Ravi Budruk, “PCI Express Technology”, Mindshare Press
4. Marco Di Natale, Haibo Zeng, Understanding and Using the
5. Controller Area Network Communication Protocol, 2012.

VI. REFERENCE BOOKS:

1. Serial Front Panel Draft Standard VITA 17.1 – 200x
2. Technical references on www.can-cia.org, www.pcisig.com, www.usb.org

COURSE CONTENT

CPLD AND FPGA ARCHITECTURES AND APPLICATIONS								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD07	**ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

Programmable logic has become more and more common as a core technology used to build electronic systems. By integrating soft-core or hardcore processors, these devices have become complete systems on a chip, steadily displacing general purpose processors and ASICs. This course will give you the foundation for FPGA design in embedded systems along with practical design skills.

II. COURSES OBJECTIVES:

The students will try to learn

I. The operational principles, characteristics of semiconductor devices and circuits.
II. The principles of operating semiconductor devices for rectification, amplification, conditioning and voltage regularization of signals.
III. The analytical skills needed to model analog and digital integrated circuits (IC) at discrete and micro circuit level
IV. The foundations of basic electronic circuits necessary for building complex electronic hardware.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Understand the features and architectures of industrial CPLDs with different families.

CO2 Understand the features and architectures of industrial FPGAs with different families.

CO3 Make use of the programming techniques used in FPGA design methodology.

CO4 Design and implement complex real time digital circuits.

CO5 Analyze system level design and their application for combinational and sequential Circuits.

CO6 Explore the types of programmable logic, SPLDs and CPLDs, their basic structure.

IV. COURSE CONTENT:

MODULE – I: INTRODUCTION TO PROGRAMMABLE LOGIC DEVICES: (10)

Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices / Generic Array Logic; Complex Programmable Logic Devices – Architecture of Xilinx Cool Runner XCR3064XL CPLD, CPLD Implementation of a Parallel Adder with Accumulation.

MODULE –II: FELID PROGRAMMABLE GATE ARRAYS: (10)

Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated Specialized Components of

FPGAs, and Applications of FPGAs.

MODULE –III: SRAM PROGRAMMABLE FPGAS: (09)
Introduction, Programming Technology, Device Architecture,

The Xilinx XC2000, XC3000 and XC4000 Architectures.

MODULE –IV: ANTI-FUGE PROGRAMMED FPGAs: (10)
Introduction, Programming Technology, Device Architecture the Actel ACT1, ACT2 and ACT3 Architectures.

MODULE –V: DESIGN APPLICATIONS: (09)
General Design Issues, Counter Examples, A Fast Video Controller, and A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices, Designing Adders and Accumulators with the ACT Architecture.

V. TEXT BOOKS:

1. Stephen M. Trim Berger, "Field Programmable Gate Array Technology," Springer International Edition.
2. Charles H. Roth Jr, Lizy Kurian John, "Digital Systems Design," Cengage Learning.

VII. REFERENCE BOOKS:

1. John V. Oldfield, Richard C. Dorf, "Field Programmable Gate Arrays," Wiley India.
2. Pak K. Chan/Samiha Mourad, "Digital Design Using Field Programmable Gate Arrays," Pearson Low Price Edition.
3. Ian Grout, "Digital Systems Design with FPGAs and CPLDs", Elsevier, Newnes.
4. Wayne Wolf, "FPGA based System Design", Prentice Hall Modern Semiconductor Design Series.

VII. E-TEXT BOOKS:

1. https://www.gacbe.ac.in/images/E%20books/Grout%20%20Digital%20(Elsevier,%202008).pdf
2. http://www.ee.ic.ac.uk/pcheung/teaching/ee2_digital/fpga%20&%20cpld%20tutorial.pdf

COURSE CONTENT

ADVANCED COMPUTER ARCHITECTURE								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD08	**ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

This course intended to provide the structure, internal working and implementation of a computer system. The fundamentals of various functional units of computer, computer instructions, addressing modes, computer arithmetic and logic unit, registers, data transfer, memory and input output system. It focuses on analysis of computer performance and functioning in modern computers.

II. COURSES OBJECTIVES:

The students will try to learn

I. Understand the concept of micro-architectural design of processors.
II. Analyze performance improvement and power savings in current processors.
III. Study the different multiprocessor architectures and related issues.
IV. Improve the knowledge on performance issues of memory and I/O systems.

III.COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Explain the structure, characteristics of computer systems and the various functional units for understanding the components of computers.
CO2 Demonstrate the computer languages, machine, symbolic and assembly levels for understanding execution of program.
CO3 Recall the number system their representations and conversion for the usage of instructions in digital computers.
CO4 Demonstrate the register transfer language, represent memory and Arithmetic/ Logic/ Shift operations for implementation of micro-operations.
CO5 Illustrate the basics of hardwired and micro-programmed control of the CPU which generates the control signals to fetch and execute instructions
CO6 Compare different types of addressing modes for specifying the location of an operand.

IV.COURSE CONTENT:

MODULE – I: FUNDAMENTALSOFCOMPUTERDESIGN (10)

Fundamentals of computer design: Defining computer architecture, trends in technology, power in integrated circuits and cost, measuring and reporting performance, quantitative principles of computer design; Instruction set principles: Classifying ISA, design issues.

MODULE –II: INSTRUCTION-LEVELPARALLELISM (09)

ILPconcepts: Pipelining over view, compiler techniques for exposing ILP; Dynamic branch prediction;
Dynamic scheduling; Multiple instructions issue; Hardware based speculation; Static scheduling; Limitations of ILP;

Case studies of contemporary microprocessors.

MODULE –III: DATA-LEVELPARALLELISM (10)

ILP software approach: Compiler techniques, static branch protection, VLIW approach, hardware support for more ILP at compile time, hardware verses software solutions.

Multi vector and SIMD computers: Vector processing principles, multi svector multiprocessors, compound vector processing, SIMD computer organizations, the connection machine CM-5; Loop level parallelism.

MODULE –IV: MEMORYANDI/O (10)

Introduction; cache performance: Reducing cache miss penalty and miss rate, Reducing hit time, Main memory and performance, Memory technology; Types of storage devices: Buses, RAID, Reliability,
Availability and depend ability; Virtual memory; I/O performance measures: Designing an I/O system.

MODULE –V: MULTIPROCESSORSANDTHREAD-LEVELPARALLELISM (10)

Introduction; Symmetric shared-memory architectures; Performance of Symmetric shared-memory architectures; Distributed shared memory and directory-based coherence; Basics of synchronization; Models of memory consistency; Multithreading.

V. TEXT BOOKS:

1. John L Hennessey and David A Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann/ Elsevier, 5th Edition, 2013.
2. John L Hennessey and David A Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann/ Elsevier, 6th Edition, 2017.

VI. REFERENCE BOOKS:

1. Kai Hwang, Faye Briggs, "Computer Architecture and Parallel Processing", McGraw-Hill International Edition, 2000.
2. Sima D, Fountain T. Kacsuk P, "Advanced Computer Architectures: A Design Spaces Approach‖, Addison Wesley, 2000.
3. David E. Culler, Jaswinder Pal Singh, Anoop Gupta, "Parallel Computer Architecture, A Hardware / Software Approach", Elsevier.

VII. WEB RESOURCES:

1. http://uni-site.ir/khuelec/wp-content/uploads/Computer-Architecture-A-Quantitative-Approach.pdf
2. https://doc.lagout.org/Computer%20Architechture.pdf
3. http://lecturesppt.blogspot.in/2010/03/advanced-computer-architecture.html

VIII. E-TEXT BOOKS:

1. http://www.freebookcentre.net/ComputerScience-Books-Download/Advanced-ComputerArchitecture- (PDF-76P).html
2. http://www.freebookcentre.net/CompuScience/Free-Computer-Architecture-Books-Download.html

COURSE CONTENT

DESIGN FOR TESTABILITY								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD09	**ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

This course is intended to give fundamental knowledge on different types of testing. Understand different types of faults associated with logic circuits and types of testing by employing fault models to the logic circuits. This course covers complete knowledge about different methods of simulation and algorithms associated with testing. These courses also covers advanced testing built in self test and boundary scan testing.

II. COURSES OBJECTIVES:

The students will try to learn

I. The different techniques available for VLSI testing and fault models to the logic circuits.
II. The high level testability measures and various scan based testing.
III. Various test Pattern generation techniques for BIST and Boundary scan standard.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Acquire verification knowledge and Fault modeling to test analog and digital circuits
CO 2 Design for testability rules and techniques.
CO 3 Learn the algorithms for fault simulation
CO 4 Utilize the scan architectures for different digital circuits.
CO 5 Acquire the knowledge of design of built-in-self test.
CO 6 Acquire the knowledge of language for boundary scan test

IV. COURSE CONTENT:

MODULE – I: INTRODUCTION TO TESTING (09)

Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

MODULE –II: LOGIC AND FAULT SIMULATION (10)

Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation.

MODULE –III: TESTABILITY MEASURES (10)

SCOAP Controllability and Observability, High Level Testability Measures, Digital DFT and Scan Design:

Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.

MODULE –IV: BUILT-IN SELF-TEST (09)
The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per-Scan BIST Systems, Circular Self Test Path System, Memory BIST, Delay Fault BIST.

MODULE –V: BOUNDARY SCAN STANDARD (10)
Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions

V. TEXT BOOKS:

1. M.L. Bushnell, V. D. Agrawal, "Essential of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits", Kluwer Academic Publishers C.A. Balanis, "Antenna Theory", John Wiley and Sons, 2nd Edition, 2001

VI. REFERENCE BOOKS:

1. M. Abramovici, M. A. Breuer and A.D Friedman, Digital Systems and Testable Design", Jaico Publishing House.
2. P. K. Lala, "Digital Circuits Testing and Testability", Academic Press

COURSE CONTENT

SYSTEM ON CHIP DESIGN								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD10	**ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

This course provides the basic knowledge on design, programming of system and processor architecture. It includes memory designing, interconnect customization and configuration, SOC Design approach, AES algorithms, image compression. It provides skills for embedded systems and mobile computing applications, on-chip memories and communication networks, I/O interfacing, RTL design of accelerators

II. COURSES OBJECTIVES:

The students will try to learn

I. The system on chip fundamentals and their applications.
II. The various computation models of SOCs and basic concepts of processor architecture and instructions.
III. The SOC customization and reconfiguration technologies and external, internal memory of SOC.
IV. The SOC Design approach for design and evaluation of Image compression.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Recall the knowledge of all the components required for SOC Design and System Architecture.
CO2	Interpret the basic elements and architectures required for different types of processors.
CO3	Design SOC internal and external memory for interpreting different memory architectures.
CO4	Develop the analytical skill for deciding the type of processor required to design the desired application SoC.
CO5	Classify the types and applications of different memory devices using SOC design concept.
CO6	Analyze different types of interconnect buses required for different applications.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION TO THE SYSTEM APPROACH (10)

System Architecture, Components of the system, SoC definition, benefits, challenges, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

MODULE – II: PROCESSORS (9)

Introduction, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Processing (CPU, Accelerators, IPs), Memory and peripherals On-chip interconnect Processor Selection for SOC, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

MODULE – III: MEMORY DESIGN FOR SOC (10)

Overview of SOC external memory, FPGA overview and System on FPGA with Xilinx/Intel, VLSI design overview, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization Cache data, Write Policies, Strategies

for line replacement at miss time.
Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation, SOC Memory System, Models of Simple Processor – memory interaction.

MODULE – IV: INTERCONNECT CUSTOMIZATION AND CONFIGURATION (10)
Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Linux installation and configuration on a FPGA SoC, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism.

MODULE – V: APPLICATION STUDIES / CASE STUDIES (9)
SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

V. TEXT BOOKS:

1. Michael J. Flynn and Wayne Luk, "Computer System Design System-on-Chip", Wiley India Pvt. Ltd.
2. Steve Furber, "ARM System on Chip Architecture ", 2nd Edition, 2000, Addison Wesley Professional

VI. REFERENCE BOOKS:

1. Ricardo Reis, "Design of System on a Chip: Devices and Components", 1st Edition, 2004, Springer
2. Jason Andrews, "Co-Verification of Hardware and Software for ARM System on Chip Design Embedded Technology)", Newnes, BK and CDROM.
3. Prakash Rashinkar, Peter Paterson and Leena Singh L, "System on Chip Verification – Methodologies and Techniques", 2001, Kluwer Academic Publishers.

VII. WEB RESOURCES:

1. www.edufind.com

VIII. E-TEXT BOOKS:

1. https://www.ele.uva.es/~jesman/BigSeti/ftp/Microcontroladores/ARM/Arm%20System-OnChip%20Architecture. pdf
2. https://www.intechopen.com/chapters/53952.

COURSE CONTENT

EMBEDDED SYSTEMS PROGRAMMING LABORATORY								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD11	**CORE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite:								

I. COURSE OVERVIEW:

This course outlines the design and implementation of embedded systems using suitable hardware and Keil Embedded C software tools. The instruction set, Embedded C programming for I/O and memory interfacing techniques are covered. The hands-on experience acquired by the student's during the course makes them to carry out processor/controller-based projects and extend their knowledge on the latest trends and technologies in the field of embedded system.

II. COURSES OBJECTIVES:

The students will try to learn

I. Use embedded C for reading data from port pins.
II. The interfacing of data I/O devices with microcontroller.
III. The serial communication and port RTOS on microcontroller

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Make use of emulators and cross compilers for writing, compiling and running an embedded C language programs on training boards.
CO2	Develop Embedded C language programs for accomplishing code to reading the data from ports, blinking the LED and interfacing of switch and buzzer and temperature sensors to the microcontrollers.
CO3	Select suitable RTOS of microcontroller and write Embedded C language program to run 2 to3 task simultaneously.
CO4	Choose serial or parallel communication for transmitting the data between microcontroller and peripherals.
CO5	Utilize the Analog to Digital and Digital to Analog converters with micro-controller for data conversion.
CO6	Build an interface between microcontroller and peripheral stop provide solutions to the real world problems.

IV. LIST OF EXPERIMENTS:

Week-1: LED BLINKING
Program to toggle all the bits of port P1continuouslywith250msdelay.

Week-2: INTERFACING OF SWITCH AND BUZZER
Program to interface a switch and a buzzer to two different pins of a port such that the buzzer should sound as long as the switch is pressed.

Week-3: INTERFACING OF LCD
Program to interface LCD data pins to port P1 and display a message on it.

Week-4: INTERFACING SEVEN SEGMENT DISPLAY
Program to interface seven segment display.

Week-5: INTERFACING OF KEYPAD
Program to interface keypad. Whenever a key is pressed, it should be displayed on LCD.

Week-6: SERIAL COMMUNICATION
Program to transmit message from microcontroller to PC serially using RS232. Program to receive a message from PC to microcontroller serially using RS232

Week-7: INTERFACING OF STEPPER MOTOR
Program to interface Stepper Motor to rotate the motor in clockwise and anti-clock wise directions program to toggle all the bits of port P1continuouslywith250msdelay.

Week-8: INTERFACING TEMPERATURE SENSOR
Program to read data from temperature sensor and display the temperature value.

Week-9: PORTING OF RTOS
Port RTOS on to 89V51 Microcontroller and verify. Run 2 to 3 tasks simultaneously on 89V51 SDK. Use LCD interface, LED interface, Serial communication.

Week-10: INTERFACING OF ADC
Program to convert analog signal into digital (ADC).

Week-11: INTERFACING OF DAC
Program to convert Digital into Analog (DAC).

Week-12: INTERFACING OF ELEVATOR
Program to interface Elevator.

Week-13: INTERFACING OF SERVO MOTOR
Program to interfacing of servo motor

Week-14: INTERFACING OF LCD DISPLAY
Program to interfacing of LCD displays

V. Reference Books:

1. Michael J. Pont, “Embedded C”, Pearson Education, 2nd Edition, 2008.
2. Nigel Gardner, “The Microchip PIC in CCS C”. Ccs Inc, 2nd Revision Edition, 2002.

COURSE CONTENT

MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS LABORATORY								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD12	**CORE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite:								

I. COURSE OVERVIEW:

This course provides knowledge of basics of DSP processors and embedded C programming language. It covers the concepts like blinking an LED with software delay, system clock real time alteration using the PLL modules and controlling an LED using switch by polling method. Through laboratory experiments, students are provided learning experiences that enable them to provide in depth knowledge about embedded and DSP processors.

II. COURSES OBJECTIVES:

The students will try to learn

I. Demonstrate Keil IDE tool for development of Embedded system.
II. The Program the interfacing of various devices with ARM using Embedded C.
III. Implementation of digital signal processing algorithms in MATLAB and C.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Make use of Cortex-M3 development board write a assembly language program for LED display in various applications
CO2 Analyze the various sleep modes by putting core in sleep and deep sleep modes using GNU tool chain
CO3 Develop an embedded C program for Temperature indication on an RGBLED and Verify the output in the Cortex-M3 kit
CO4 Build an assembly code and C code to compute Euclidian distance between any two Points
CO5 Examine various filters in C to enhance the features of given input sequence or signal
CO6 Design an assembly and C code for convolution Operation using code composer studio (CCS).

IV. LIST OF EXPERIMENTS:

Part A) Experiments to be carried out on Cortex-M3 development boards using GNU tool chain.

Week-1: Blink an LED with software delay, delay generated using the Sys Tick timer.

Week-2: System clock real time alteration using the PLL modules.

Week-3: Control intensity of an LED using PWM implemented in software and hardware

Week-4: Control an LED using switch by polling method, by interrupt method and flash the LED once.

Week-5: UART Echo Test.

Week-6: Take analog readings on rotation of rotary potentiometer connected to an ADC channel.

Week-7: Temperature indication on an RGB LED.

Week-8: Mimic light intensity sensed by the light sensor by varying the blinking rate of an LED.

Week-9: Evaluate the various sleep modes by putting core in sleep and deep sleep modes.

Week-10: Sample sound using a microphone and display sound levels on LEDs.

Part B) Experiments to be carried out on DSP C6713 evaluation kits and using Code ComposerStudio (CCS).

Week-11: To develop an assembly code and C code to compute Euclidian distance between any two points.

Week-12: To develop assembly code and study the impact of parallel, serial and mixed execution.

Week-13: To develop assembly and C code for implementation of convolution operation.

Week-14: To design and implement filters in C to enhance the features of given input sequence/signal

V. REFERENCE BOOKS:

1. Michael J. Pont, "Embedded C", Pearson Education, 2nd edition, 2008.
2. Nigel Gardner, "The Microchip PIC in CCS C". Ccs Inc, 2nd Revision edition, 2002.

COURSE CONTENT

INTERNET OF THINGS AND APPLICATIONS								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD13	**Core**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Embedded systems								

I. COURSE OVERVIEW:

This course will explore the fascinating world of IoT and delve into its various applications that are shaping the future of technology and connectivity. The course is designed to provide a solid foundation in both the theoretical and practical aspects of IoT, equipping you with the knowledge and skills to understand, design, and implement IoT solutions across diverse industries.

II. COURSES OBJECTIVES:

The students will try learn:

I. Build IoT Prototypes, design sensor networks, and work with IoT platforms to gain practical experience.
II. Explore the various wireless communication technologies that enable IoT devices to connect and communicate, such as Wi-Fi, Bluetooth, Zigbee, LoRa WAN, and cellular networks.
III. Delve into different types of sensors used in IoT applications, including environmental sensors, motion sensors, proximity sensors, and more.
IV. Engage in hands-on projects that allow to apply knowledge in real-world scenarios.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Relate different types of sensors used in IoT applications, including their working principles and real-world use cases.
CO 2 Analyze advanced generation sensors, including their features, improvements over earlier technologies, and the role they play in enhancing data accuracy and precision in industrial applications.
CO 3 Demonstrate the components and architecture of wireless sensor systems, including their fundamental structure and the interplay of various modules in achieving wireless sensing capabilities.
CO 4 Identify the role and characteristics of energy storage modules in wireless sensor systems, and how they enable reliable and continuous sensor operation by storing and managing energy from various sources.
CO 5 Explain the NEST sensor ecosystem, including its characteristics, functionalities, and its contribution to creating smart and energy-efficient homes.
CO 6 Develop the ability to interact with hardware components using the chosen platform, including communication protocols, wiring, and programming.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION TO INTERNET OF THINGS (10)

Internet of things promises, definition. scope, sensors for IoT applications, structure of IoT, IoT map device.

MODULE –II: IOT SENSORS (09)

Industrial sensors, description & characteristics, first generation, description &characteristics, advanced generation, description & characteristics, integrated IoT sensors, description & characteristics, polytonic systems, description & characteristics, sensors' swarm, description & characteristics, printed electronics, description & characteristics, IoT generation-roadmap.

MODULE –III: IOT ANALYSIS (10)

Wireless Sensor Structure, processor, radio interface, ADC, Energy Storage Module, energy usage and storage, Power Management Module, power requirements.

Optimizing power consumption, lower power modes, monitoring power usage, testing and verifying performance, RF Module, basic components, modulation techniques, communication protocols

MODULE –IV: IOT DEVELOPMENT EXAMPLES (10)

ACOEM Eagle – EnOcean Push Button – NEST Sensor – Ninja Blocks -Focus on Wearable Electronics, Tesla IOT car, Hitachi, PTC Thing Worx, Caterpillar, Tom farms.

MODULE –V: IOT APPLICATIONS (09)

Creating the sensor project, preparing raspberry Pi/ ARM cortex, clyster libraries, hardware, interacting with the hardware, interfacing the hardware, internal representation of sensor values, persisting data, external representation of sensor values, exporting sensor data, creating the actuator project, hardware, interfacing the hardware, creating a controller, representing sensor values, parsing sensor data, calculating control states, creating a camera, hardware accessing the serial port on raspberry Pi/ ARM Cortex, interfacing the hardware, creating persistent default settings, adding configurable properties, persisting the settings, working with the current settings, initializing the camera.

V. TEXT BOOKS:

1. Dr. Guillaume Girardin, Antoine Bondable, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024', Yole Development Copyrights, 2014.
2. Peter Washer, 'Learning Internet of Things', Packet Publishing, 2015.

VI. REFERENCE BOOKS:

1. Editors Ovidiu Vermes a Peter Friess, 'Internet of Things – From Research and Innovation to Market, 2014.
2. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

VII. ELECTRONIC RESOURCES:

1. https://nptel.ac.in/courses/1081061
2. https://nptel.ac.in/courses/108108123

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

ARM CORTEX ARCHITECTURE AND PROGRAMMING								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD14	**Core**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Embedded system Design								

I. COURSE OVERVIEW:

This course focuses on the fundamental concepts and practical aspects of ARM Cortex-M-based microprocessor, incorporates architecture, programming and interfacing aspects. ARM Cortex-M processor-based microcontroller, TM4C123, Cortex-M programming, the basics of Cortex-M assembly programming, interfacing different real- life hardware devices to the ARM Cortex-M controller. the workings of general-purpose input-output (GPIO) pins, their features, possible alternate functionalities, and interfacing of Output (LED, LCD displays) as well as input (switches and keypads) devices.

II. COURSES OBJECTIVES:

The students will try to learn

I. Architectural features of ARM cortex-M Processor.
II. Programming of ARM using assembly language.
III. TM4C123 Microcontroller architecture and interfacing.
IV. Configuration of TM4C123 microcontroller communication interfaces.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Describe the features of ARM Cortex-M processors for signal description and architecture.

CO 2 Illustrate the programmer ‘s model of ARM processor and test.

CO 3 programming model using high level and low-level languages.

CO 4 Demonstrate the internal architecture and TM4C123 Microcontroller various modes of operation of the devices used for interfacing memory and I/O devices with ARM processor.

CO 5 Apply the memory management architecture for allocating the MMU.

CO 6 Analyze floating point processor architecture and its architectural.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION TO EMBEDDED SYSTEMS (10)

Overview of microcontrollers and microprocessors architecture, memory organization, and I/O operations, selection criteria for choosing microcontrollers, definition and characteristics of embedded systems, embedded system applications and real- world examples, challenges and constraints in embedded system design.

MODULE –II: TYPICAL EMBEDDED SYSTEM (09)

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-

The-Shelf Components (COTS), memory: ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems, sensors and actuators, communication interface: Onboard and external communication Interfaces.

MODULE –III: EMBEDDED SYSTEM SOFTWARE (10)

Embedded software development process, embedded programming languages (C, Assembly), real-time operating systems (RTOS) and scheduling.

Hardware/Software Co-design: Hardware-software partitioning, communication between hardware and software components, trade-offs and optimization techniques.

MODULE –IV: RTOS BASED EMBEDDED SYSTEM DESIGN (09)

Operating System Basics, types of Operating Systems, Tasks, process and Threads, multiprocessing and Multitasking, task scheduling.

MODULE –V: EMBEDDED NETWORKING AND COMMUNICATION (10)

Network protocols (TCP/IP, MQTT, etc.), wireless communication (Wi-Fi, Bluetooth, etc.), IoT (Internet of Things) concepts.

V. TEXT BOOKS:

1. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley Publications, 3rd edition, 2006.

VI. REFERENCE BOOKS:

1. Raj Kamal, "Embedded Systems", TMH, 2nd edition, 2008.
2. Shibu K.V, "Introduction to Embedded Systems", McGraw Hill, 3rd edition, 2012.
3. Lyla, "Embedded Systems", Pearson Education 2nd edition, 2013.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

EMBEDDED SYSTEMS FOR MACHINE LEARNING								
III Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD15	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Embedded Systems, Real-time Operating Systems								

I. COURSE OVERVIEW:

This course aims to provide students with a solid foundation in embedded systems for machine learning. Students will learn about the design, development as well as the key components involved in creating efficient and reliable embedded solutions. This course aims to provide students with the skills needed to design and implement machine learning applications on embedded systems, taking into consideration the unique challenges posed by resource-constrained environments.

II. COURSES OBJECTIVES:

The students will try to learn

I. The difference between embedded systems and general-purpose systems.
II. Develop an understanding of hardware/software co-design and its significance.
III. Implement basic networking and communication capabilities in embedded systems.
IV. Define and explain the fundamental concepts of machine learning.
V. Provide an overview of the historical context and evolution of machine learning.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Describe the characteristics, challenges, and constraints of embedded systems.
CO 2 Apply the suitable memory technology and other components for different applications to meet the ever-growing needs of the embedded applications.
CO 3 Choose the fundamental components that make up an embedded board to implement an Instruction Set Architecture ‘s features in a processor.
CO 4 Apply machine learning techniques on appropriate problems.
CO 5 Apply Evaluation, hypothesis tests and compare learning techniques for various problems.
CO 6 Analyze real time problems in different areas and solve using Reinforcement learning technique.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION TO EMBEDDED SYSTEMS (10)

Overview of microcontrollers and microprocessors Architecture, memory organization, and I/O operations, Selection criteria for choosing microcontrollers, definition and characteristics of embedded systems.

MODULE –II: TYPICAL EMBEDDED SYSTEM (10)

Core of the Embedded System: General purpose and domain specific processors, ASICs, PLDs, commercial off- the-shelf components (COTS), memory: ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems, sensors and actuators, communication interface: onboard and external communication interfaces.

MODULE –III: INTRODUCTION TO MACHINE LEARNING (09)

Introduction: Examples, Applications of Machine Learning Applications - Learning Associations, Classification, Regression, Unsupervised learning, Reinforcement learning.

Supervised Learning: Regression: Introduction to Linear Regression and Multiple Linear Regression, KNN. Measuring regression model performance - R Square, Mean Square Error (MSE), Root Mean Square Error (RMSE), Mean Absolute Error (MAE) .**Classification**: Support vector machine- Characteristics, Linear SVM, Naive Bayes Classifier, KNN classifier, Logistic Regression. Measuring Classifier Performance: Precision, Recall, and Confusion Matrix.

MODULE –IV: COMBINING MULTIPLE LEARNERS (10)

Combining Multiple Learners– Model Combination schemes, voting, Bagging, Boosting.

Un Supervised Learning: K-Means, Expectation Maximization Algorithm, supervised learning after clustering, spectral clustering, choosing number of clusters.

MODULE –V: MULTILAYER PERCEPTRONS (09)

The Perceptron, training a Perceptron, Learning Boolean Functions, Multilayer Perceptron's, MLP as a Universal Approximator, Backpropagation Algorithm, Training Procedures, Dimensionality Reduction, Learning Time Reinforcement Learning: Single State Case: K-Armed Bandit, Elements of Reinforcement learning, Model based Learning, Temporal Difference learning, Generalizing from examples

V. TEXT BOOKS:

1. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley Publications, 3rd edition, 2006.
2. Introduction to Machine Learning, Ethem Alpaydin, 2nd edition, 2010, Prentice Hall of India.
3. Introduction to Data Mining, Tan, Vipin Kumar, Michael Steinbach, 9th Edition, 2013, Pearson.

VI. REFERENCE BOOKS:

1. Raj Kamal, "Embedded Systems", TMH, 2nd edition, 2008.
2. Shibu K.V, "Introduction to Embedded Systems, McGraw Hill, 3rd edition, 2012.
3. Lyla, "Embedded Systems", person education, 2nd edition, 2013.
4. Machine Learning a Probabilistic Perspective, Kevin P Murphy & Francis Bach, 1st edition, 2012, MIT Press.
5. "Deep Learning", Ian Goodfellow, Yoshua Bengio, Aaron Courville, 2016, MIT Press.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

SYSTEM DESIGN WITH EMBEDDED LINUX								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD16	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Linux Programming, Embedded Systems								

I. COURSE OVERVIEW:

This Course deals with the LINUX and embedded system. This online Embedded Linux course teaches how to configure the Linux kernel and develop custom peripheral drivers. Learners gain an understanding of the Linux architecture and acquire the practical skills involved in building an embedded Linux system, as well as debugging and profiling application performance. Linux-based embedded systems are widely used in smartphones, in-vehicle infotainment systems, in countless consumer electronics and for numerous industrial applications.

II. COURSES OBJECTIVES:

The students will try to learn

1. Software tools for the development of an embedded Linux system.
2. Implementation results (e.g. speed, cost, power) and correlate them to the appropriate system.
3. Industry standard tools to configure and build an embedded Linux system stack.
4. Kernel modules for customer peripherals (such as sensors).

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Understand embedded Linux development environment apply it for industrial applications in consur electronics
CO2	Design scripts which build a barebones kernel and root file system bootable with QEMU.
CO3	Design a socket server-based application which builds and runs natively on a Linux host machine.
CO4	Create a cross compile environment using scripts and existing tools.
CO5	Apply C code functions which demonstrate the use of system calls to invoke Linux processes.
CO6	Apply formal method, testing, verification, validation and simulation techniques and tools in order to engir reliable and safe embedded systems.

IV. COURSE CONTENT:

MODULE - I: EMBEDDED SOFTWARE, FIRMWARE CONCEPTS AND DESIGN-1 (09)

Embedded C-programming concepts (from embedded system point of view): Optimizing for Speed/Memory needs, Interrupt service routines, macros, functions, modifiers, data types, device drivers, multithreading programming. (Laboratory work on J2ME Java mobile application).

MODULE –II: EMBEDDED SOFTWARE, FIRMWARE CONCEPTS AND DESIGN-2 (10)
Real time operating system: POSIX Compliance, need of RTOS in Embedded system software, foreground / Background systems, multitasking, context switching, IPC, Scheduler policies, architecture of kernel, task scheduler, ISR, semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS.

MODULE –III: INTRODUCTION TO EMBEDDED LINUX (10)
History of Embedded Linux, Embedded Linux versus Desktop Linux, Embedded Linux Distributions, Architecture of Embedded Linux.

Linux kernel architecture, Linux start up sequence, GNU Cross-p\Platform Tool chain.

MODULE –IV: BOARD SUPPORT PACKAGE (10)
Inserting BSP In Kernel Build Procedure, boot Loader Interface, memory Map, interrupt Management. PCI Subsystem, timers, UART, and Power Management.

EMBEDDED STORAGE: Flash Map, MTD, memory technology device, MTD architecture, flash mapping drivers, MTD block and character devices, embedded file systems, optimizing storage space.

MODULE –V: N REAL-TIME LINUX (08)
Linux and real-time, real-time programming in Linux, hard real-time Linux.

V. TEXT BOOKS:

1. Embedded Linux System Design and Development, P. Raghavan, Amol Lad, Sriram Neelakandan, 2006, Auerbach Publications.

VI. REFERENCE BOOKS:

1. Embedded Microcomputer Systems, real Time Interfacing – Jonathan W. Valvano, Brookes / Cole, 1999, Thomas Learning.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

EMBEDDED SYSTEMS IN ROBOTICS								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD17	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Internet of Thins, Embedded Systems								

I. COURSE OVERVIEW:

Embedded systems are basically an extension of advanced robotic applications, which have had a profound impact on almost all our modern technology such as video cameras, computing machinery, smartphones, digital display systems, and so on. The course will begin with a brief introduction to robotics terminologies, control system, differential motion and path planning, mobile robot design and applications. The whole field of robotics and embedded systems has been predicted to be one of the most in-demand technologies of the decade, with exponential growth and job opportunities.

II. COURSES OBJECTIVES:

The students will try to learn

1. The fundamental knowledge of the robots and their characteristics.
2. Obtain knowledge on fixed base and mobile robots and their working principles
3. Identify the various areas of application for inclusion of the robotic technology.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Describe the concept of robots and robotic terminologies for robotic design and its applications.
CO2	Identify the sensors and actuators for the functioning and controlling of robots.
CO3	Analyze the working principle of the serial and parallel chain manipulators and transformation for kinematic analysis of a robot.
CO4	Illustrate the principle and characteristics of mobile robots to simulate and manipulates the robot.
CO5	Select the various robotic technologies to use in the different modern robotic applications.
CO6	Make use of modern robotic systems to design and implement the various applications.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION TO ROBOTIC TERMINOLOGIES (10)

Introduction, robot definitions by different agencies, history of robotics, laws of robotics, advantages and disadvantages, degrees of freedom, robot joints, robot coordinates, reference frames, characteristics of robots, workspace, applications, other robots and applications, social issues.

MODULE –II: SENSORS AND ACTUATORS (10)

Introduction, sensor characteristics, sensor utilization, position sensors, velocity sensors, acceleration sensors, force sensors, miscellaneous sensors. Introduction to actuators, pneumatic, hydraulic and electric actuators, characteristics and control, applications.

MODULE –III: INDUSTRIAL ROBOT MANIPULATORS (09)
Introduction, serial robots and parallel robots, classification of serial chain manipulators.

Mapping homogeneous transformation, end-effectors, introduction to forward and inverse kinematic analysis.

MODULE –IV: MOBILE ROBOTS (09)
Driving Robots, balancing Robots, autonomous Vessels and Underwater Vehicles, robot Manipulators, mobile Robot Simulation.

MODULE –V: MODERN ROBOTIC SYSTEMS AND APPLICATIONS (10)
Introduction, intelligence and autonomy, collaborative robots, humanoid robots, aerial robots, intelligent vehicles, industrial applications, applications of humanoids and other robotic systems, house hold robotic systems.

V. TEXT BOOKS:

1. Thomas Braunl, "Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems", 3rd edition, Springer-Verlag Berlin Heidelberg, 2008.
2. Saeed B Niku, (2019), introduction to robotics, analysis, control and applications, Wiley Publications.
3. R.K. Mittal and I J Nagrath, "Robotics and Control", Tata McGraw Hill, 1st edition, 2003.

VI. REFERENCE BOOKS:

1. Anis Koubaa, "Robot Operating System (ROS) The Complete Reference", First Volume, Springer, 2016.
2. K S Fu, Gonzalez, C S Lee, "Robotics: Control, Sensing, Vision and Intelligence ", Mc Graw Hill, int edition, 1987.
3. R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering- An Integrated approach", prentice Hall of India, 1st edition, 2003.
4. Steve heath, "Embedded system design", Elsevier, 2nd edition, 2004.

VII. WEB RESOURCES:

1. http://www.gettextbooks.com/author/ Thomas Braunl
2. http://nptel.ac.in/video.php?subjectId=112101099
3. http://nptel.ac.in/courses/112101099/

VIII. TEXT BOOKS:

1. http://www.springer.com/us/book/9781846286414
2. http://www.robotee.com/index.php/download-free-robotic-e-books/
3. http://www.e-booksdirectory.com/listing.php?category=279
4. http://bookboon.com/en/automation-and-robotics-ebook

IX. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper – I
5. Model question paper – II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

EMBEDDED SYSTEMS IN BIOMEDICAL APPLICATIONS								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD18	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Digital Image Processing, Embedded Systems								

I. COURSE OVERVIEW:

This course focuses on the fundamental concepts and practical aspects of embedded systems as they apply to biomedical engineering. Students will learn how to design, program, and implement embedded systems for various biomedical applications, including medical devices, wearable health monitors, and other healthcare, related technologies.

II. COURSES OBJECTIVES:

The students will try to learn

I. The role of embedded systems in biomedical applications and their significance in modern healthcare technology.
II. The design and implement embedded systems for biomedical devices with a focus on reliability, safety and efficiency.
III. Analyze the challenges specific to biomedical applications and propose appropriate solutions.
IV. Demonstrate hands-on skills in programming and interfacing microcontrollers commonly used in biomedical systems.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Understand the basic principles of embedded systems and their applications in biomedical engineering.
CO 2 Analyze the requirements of biomedical applications and design embedded systems to meet those requirements.
CO 3 Develop software for embedded systems in biomedical applications.
CO 4 Understand the principles of signal processing and apply them to biomedical signals.
CO 5 Develop a project that applies embedded systems to a biomedical application.
CO 6 Analyze the performance of embedded systems in biomedical applications.

IV. COURSE CONTENT:

MODULE – I: INTRODUCTION TO EMBEDDED SYSTEMS IN BIOMEDICAL APPLICATIONS (09)

Definition and characteristics of embedded systems, overview of biomedical engineering and its applications, key challenges and opportunities in biomedical embedded systems.

MODULE – II: MICROCONTROLLERS AND SENSORS IN BIOMEDICAL SYSTEMS (09)

Introduction to microcontrollers and their architectures, selection criteria for microcontrollers in biomedical applications, sensor types and interfacing techniques.

MODULE – III: EMBEDDED PROGRAMMING FOR BIOMEDICAL DEVICES (10)
Embedded programming languages (e.g., C/C++) and IDEs.

Real-time operating systems (RTOS) for biomedical systems, device drivers and communication protocols.

MODULE –IV: SIGNAL PROCESSING IN BIOMEDICAL EMBEDDED SYSTEMS (10)
Basics of signal processing in biomedical data, filtering, amplification, and noise reduction techniques, digital signal processing algorithms for biomedical signals.

MODULE – V: WIRELESS COMMUNICATION IN BIOMEDICAL DEVICES (10)
Wireless technologies and standards (e.g., Bluetooth, Wi-Fi, Zigbee), data transmission and security considerations, wearable health monitoring systems.

V. TEXT BOOKS:

1. "Introduction to Biomedical Engineering," John Enderle et al.
2. "Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers," Jonathan W. Valvano.

VI. REFERENCE BOOKS:

1. Embedded Microcomputer Systems, real Time Interfacing – Jonathan W. Valvano, Brookes / Cole, 1999, Thomas Learning.
2. The AVR Microcontroller and Embedded Systems: Using Assembly and C by M. A. Mazida, 2nd, edition, person education limited, 2011.
3. ARM Assembly Language William Hohl, CRC Press, ISBN:978-81-89643-04-1.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

ADVANCED MOBILE AND WIRELESS NETWORKS								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD19	**Elective**	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Computer Networks, Wireless communications and Networks								

I. COURSE OVERVIEW:

This course introduces fundamental aspects of wireless networks, with emphasis on current and next-generation wireless networks. This course will cover cellular communication, mobile radio propagation, multiple access techniques, mobility support, channel allocation, wireless PAN/LAN/MAN standards, mobile ad-hoc networks, wireless sensor networks, and routing in wireless and mobile networks. The goal of this course is to introduce the students to state-of-the-art wireless network protocols and architectures in various communication networks.

II. COURSES OBJECTIVES:

The students will try to learn

I. The propagation mechanisms and radio wave propagation to know the behavior of radio waves.
II. The types of wireless local area networks and networking standards for implementing the network of computing devices.
III. The platforms and protocols used in mobile environment.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Understand the fundamentals of mobile communication systems.
CO2 Learn about Carrier Sense Multiple Access with Collision Detection (CSMA/CD).
CO3 Understand the difference between tree-based, mesh-based, and hybrid multicasting protocols.
CO4 Identify the limitations of 2G and 2.5G wireless mobile communication.
CO5 Understand the fading and shadowing concept in wireless communication systems.
CO6 Design 3G and beyond mobile communication systems.

IV. COURSE CONTENT:

MODULE – I: FUNDAMENTALS OF WIRELESS COMMUNICATION TECHNOLOGY (10)

Overview and applications, types of wireless and mobile networks; evolution and challenges of wireless networks; the electromagnetic spectrum; spread spectrum; frequency reuse; radio propagation mechanisms, signals, antennas; characteristics of wireless channels; modulation techniques and multiple access techniques for wireless systems.

MODULE – II: WIRELESS LANS AND PANS (09)

Wireless LANs & PANs: Use and design goals for WLANs; IEEE802.11 standard: architecture, infrastructure vs. Ad-hoc modes, physical & MAC layer, CSMA/CA mechanism; HIPERLAN 1/2 standards; technical features of HOMERF; BLUETOOTH specifications and architecture; introduction to other PAN technologies and their

applications.

MODULE – III: WIRELESS WANS & MANS (10)

The cellular concept; call set-up; frequency reuse channel allocation algorithms; handoffs; mobility management.

Telecommunication Systems: GSM and IS-95 architecture, channels and Call Establishment; Wireless Data Service; Generations in Wireless; DECT, TETRA, UMTS; Satellite Systems.

WiMAX: physical layer, media access control, mobility and networking, overview of IEEE 802.22, Wireless, regional area networks. Wireless internet: address mobility; mobile IP; IP and TCP for wireless domains; WAP.

MODULE –IV: ADHOC WIRELESS NETWORKS: (09)

Introduction; applications & design issues. **MAC Protocols for Ad Hoc Wireless Networks:** Issues, design goals and classification; Contention based protocols; Contention based mac protocols with reservation and scheduling mechanism; Other MAC Protocols. Cellular Networks and their features

Routing Protocols for Ad Hoc Networks: Introduction, issues; classification; table-driven routing protocols; on-demand routing protocols; hybrid routing protocols; routing protocols with efficient flooding mechanisms; Hierarchical routing protocols.

MODULE – V: MULTICAST ROUTING IN AD HOC NETWORKS (10)

Introduction; Issues; Operation of Multicast Routing Protocols; Classification; Tree-Based Multicast Routing Protocols; Mesh-Based Multicast Routing Protocols; Energy Efficient Multicasting.

Energy Management in Ad Hoc Wireless Networks: Need and classification of energy management schemes. Transport layer for Ad Hoc Wireless Networks: Introduction and design issues; TCP over Ad Hoc wireless networks.

V. TEXT BOOKS:

1. Dharma Prakash Agrawal and Qing, a Zeng, introduction to Wireless and Mobile Systems, Tomson, 2006, 2nd edition, (ISBN: 0-534-49303-3).
2. Jochen Schiller: Mobile Communication.

VI. REFERENCE BOOKS:

1. David Tso & Pramod Viswanath: Fundamentals of Wireless Communication, Cambridge University Press.
2. Ezio Bigler: MIMO Wireless Communications, Cambridge University Press ARM Assembly Language, William Hohl, CRC Press, ISBN:978-81-89643-04-1.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

WIRELESS SENSOR NETWORKS								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD20	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Wireless Communication Networks								

I. COURSE OVERVIEW:

This wireless sensor networks are a course wireless networks that are becoming very popular with a huge number of civilian and military applications. It provides an insight into foundation required for designing wireless sensor networks, through this course, the students will get an idea about different modules in a wireless sensor node and design of wireless sensor networks for different applications after considering the application specific challenges, requirements and trade-offs. This course also gives an insight in to the evolution of IOT from WSN and future scope of IOT and civilian, military applications.

II. COURSES OBJECTIVES:

The students will try to learn

I. The basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology.
II. Architecture of WSN, medium access control protocols and address physical layer issues.
III. Key routing protocols for sensor networks and main design issues.
IV. Transport layer protocols for sensor networks, and design requirements.
V. The Sensor management, sensor network middleware, operating systems.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Understand and explain common wireless sensor node architectures.
CO2 Analyze protocols developed for sensor networks.
CO3 Demonstrate knowledge of MAC protocols developed for WSN.
CO4 To identify and address the security threats in ad hoc and sensor networks.
CO5 Establish a Sensor network environment for different type of applications.
CO6 Explain various wireless standards and protocols associated with WSN.

IV. COURSE CONTENT:

MODULE – I: OVERVIEW OF WSN (10)

Introduction and overview of wireless sensor networks (WSN), commercial and scientific applications of WSN, category of applications of WSN, challenges for WSN, enabling technologies for WSN.

MODULE – II: NETWORK ARCHITECTURE (10)

Single node architecture: hardware components, energy consumption of sensor nodes, operating systems and execution environments, examples of sensor nodes, network architecture: WSN scenarios, optimization goalsand figures of merits, design principles for WSNS, service interfaces for WSNS, gateway concepts.

MODULE – III: PHYSICAL LAYER AND PROTOCOLS (09)

Physical layer: wireless channel and communication fundamentals, physical layer & transceiver design considerations in WSN, MAC protocols: fundamentals, MAC protocols for WSNs, IEEE802.15.4 MAC Protocol,

Routing Protocols: Gossip and agent based unicast protocols, energy efficient unicast, broadcast and multicast, geographic routing, transport control protocols: traditional protocols, design issues, examples of transport protocols, performance of transport control protocols.

MODULE –IV: SENSOR TASKING AND CONTROL (10)

Sensor tasking and control: information-based sensor tasking, joint routing information aggregation, sensor network databases: challenges, query interfaces, in-network aggregation, data centric storage, data indices and range queries, distributed hierarchical aggregation, temporal data.

MODULE – V: OPERATING SYSTEMS FOR SENSOR NETWORKS (09)

Operating systems for sensor networks: introduction, design issues, examples of operating systems, node level simulators, performance and traffic management issues: WSN design issues, performance modelling of WSNs, emerging applications and future research directions.

V. TEXT BOOKS:

1. Kazem Sohrab, Daniel Minoli, Taieb Znati, “Wireless Sensor Networks”, technology, protocols, and Applications.
2. Holger Karl, Andreas Willig, “Protocols and architectures for wireless sensor networks”, John Wiley & Sons.

VI. REFERENCE BOOKS:

1. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks; An Information Processing Approach”, Elsevier.
2. C. S. Raghavendra, Krishna M. Shivalinga, Taieb Zenati, “Wireless sensor networks”, Springer Verlag.
3. H. Edgar, Jr. Callaway, “Wireless Sensor networks, Architectures and Protocols”, CRC Press.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

CRYPTOGRAPHY AND NETWORK SECURITY								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD21	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Wireless Sensor Networks								

I. COURSE OVERVIEW:

The aim of this course is to introduce the student to the areas of cryptography and cryptanalysis. it develops a basic understanding of the algorithms used to protect users online and to understand some of the design choices behind these algorithms. The course emphasizes to give a basic understanding of previous attacks on cryptosystems with the aim of preventing future attacks. A wide variety of basic cryptographic primitives will be discussed along with recent developments in some advanced topics like identity-based encryption, attribute- based encryption, functional encryption, two-party/multi-party computation, bitcoin and crypto-currency and postquantum cryptography. The cryptanalysis part will help us understanding challenges for cybersecurity that includes network security, data security, mobile security, cloud security and endpoint security.

II. COURSES OBJECTIVES:

The students will try to learn

I. About attacks, services and mechanisms, security attacks, security services, a model for internetwork security.
II. The simplified DES, block cipher principles, data encryption standard, strength of DES, differential and linear cryptanalysis, block cipher design principles and modes of operations.
III. The IP security overview, architecture, authentication, encapsulating security payload, combining security associations, key management.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Understand principles and practice of network security and cryptography by gaining knowledge in cryptographic algorithms;

CO2 Design basic security architectures through selection and integration of relevant security components

CO3 Make use of advanced cryptographic algorithms in network protocols and network applications.

CO4 Analyze and apply system security concept to recognize malicious code.

CO5 Understand Key management using smart cards for authentication requires the use of a PKI.

CO6 Illustrate various public key cryptographic techniques in encryption/ decryption.

IV. COURSE CONTENT:

MODULE – I: INTRODUCTION TO CRYPTOGRAPHY AND BLOCK CIPHERS (09)

Introduction to security attacks, services and mechanism, introduction to cryptography, conventional encryption:

conventional encryption model, classical encryption techniques, substitution ciphers and transposition ciphers, cryptanalysis, steganography, stream and block ciphers, modern block ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiesta structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, AES.

MODULE – II: CONFIDENTIALITY AND MODULAR ARITHMETIC (10)
Confidentiality using conventional encryption, traffic confidentiality, key distribution, random number generation-introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's algorithm, Chinese remainder theorem, discrete algorithms.

MODULE – III: PUBLIC KEY CRYPTOGRAPHY AND AUTHENTICATION REQUIREMENTS (10)
Principles of public key crypto systems, RSA algorithm, security of RSA, key management, Duffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elgamel encryption, message.

Authentication and hash function: authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS.

MODULE –IV: INTEGRITY CHECKS AND AUTHENTICATION ALGORITHMS (10)

MD5 message digest algorithm, secure hash algorithm (SHA) Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm, authentication applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP) - S/MIME.

MODULE – V: IP SECURITY AND WEB SECURITY (09) IP SECURITY:
Overview: Architecture, authentication, encapsulating security payload, combining security associations, key Management.
Web security: Web security requirements, secure sockets layer and transport layer security, secure electronic transaction.
Intruders, viruses and worms: Intruders, viruses and related threats.
Fire walls: Fire wall design principles, trusted systems.

V. TEXT BOOKS:

1. Cryptography and Network Security: Principles and Practice, William Stallings, person education.
2. Network Security Essentials (Applications and Standards) by William Stallings Pearson education.

VI. REFERENCE BOOKS:

1. Fundamentals of Network Security by Eric Maiwald (Dramatic press)
2. Network Security, Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Miken Speicher, person/PHI.
3. Principles of Information Security, Whitman, Thomson.
4. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

SENSORS AND ACTUATORS								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD22	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: **There are no prerequisites to take this course**								

I. COURSE OVERVIEW:

This course introduces the students to comprehensive fundamental and technical knowledge of advanced sensor systems and instrumentation and use numerical modeling for sensors understand the problem and select a sensor and design, model the system. Understanding basic laws and phenomena on which operation of sensors and actuators-transformation of energy is based.

II. COURSES OBJECTIVES:

The students will try to learn

I. The constructions and working principle of different types of sensors and transducers.
II. The measuring instruments and the methods of measurement and the use of different transducers.
III. The concepts of Electro analytic and smart sensors.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Illustrate fundamental physical and technical base of sensors and actuators.

CO2 Distinguish basic laws and phenomena that define behavior of sensors and actuators.

CO3 Analyze various premises, approaches, procedures and results related to sensors and actuators.

CO4 Create analytical design and development solutions for sensors and actuators.

CO5 Utilize the acquired data and measured results for sensors in IOT.

CO6 Interpret fundamental physical and technical base of sensors and actuators.

IV. COURSE CONTENT:

MODULE - I: SENSORS / TRANSDUCERS (09)

Principles, classification, parameters, characteristics, environmental parameters (EP), characterization. mechanical and electromechanical sensors: Introduction, resistive potentiometer, strain gauge, resistance strain gauge, semiconductor strain gauges, inductive sensors, sensitivity and linearity of the sensor. Types, capacitive sensors: electrostatic transducer, force/stress sensors using quartz resonators, ultrasonic sensors.

MODULE –II: THERMAL SENSORS (10)

Introduction, gas thermometric sensors, thermal expansion type thermometric sensors, acoustic temperature sensor, dielectric constant and refractive index thermo-sensors, helium low temperature thermometer, nuclear thermometer, magnetic thermometer, resistance change type thermometric sensors, thermo-EMF sensors, junction semiconductor types, thermal radiation sensors, quartz crystal thermo-electric sensors, NQR thermometry, spectroscopic thermometry, noise thermometry, heat flux sensors.

Magnetic Sensors: introduction, sensors and the principles behind, magneto-resistive sensors, anisotropic magneto-resistive sensing, semiconductor magneto-resistors, hall effect and sensors, inductance and eddy current sensors, angular/rotary movement transducers, synchro's, synchro resolvers, eddy current sensors, electromagnetic flowmeter, switching magnetic sensors, SQUID sensors.

MODULE –III: RADIATION SENSORS (10)

Introduction basic characteristics types of photo resistors /photo detectors– X-ray and nuclear radiation sensors fiber optic sensors. electro analytical sensors: Introduction the electrochemical cell the cell potential Standard Hydrogen Electrode (SHE).

Liquid junction and other potentials polarization, concentration polarization, reference electrodes, sensor electrodes electro ceramics in gas media.

MODULE –IV: SMART SENSORS (09)

Introduction, primary sensors, excitation, amplification, filters, converters, compensation, information coding/processing, data communication, standards for smart sensor interface, the automation. sensors applications: introduction, on-board automobile sensors (Automotive Sensors), home appliance sensors, aerospace sensors, sensors for manufacturing, sensors for environmental monitoring.

MODULE –V: ACTUATORS (10)

Pneumatic and hydraulic actuation systems, actuation systems, pneumatic and hydraulic systems, directional control valves, pressure control valves, cylinders, servo and proportional control valves, process control valves, rotary actuators, mechanical actuation systems types of motion, kinematic chains, cams, gears, ratchet and pawl, belt and chain drives, bearings, mechanical aspects of motor selection, electrical actuation systems, electrical systems, mechanical switches, solid-state switches, solenoids, D.C. Motors, A.C. Motors, stepper motors.

V. TEXT BOOKS:

1. D. Patra Nabis, "Sensors and Transducers", PHI Learning Private Limited.
2. W. Bolton, "Mechatronics", Pearson Education Limited.

VI. REFERENCE BOOKS:

1. Patra Nabis, "Sensors and Actuators", PHI, 2nd edition, 2013.
2. Evgeni Gusev and Eric Garfunkel. "Advanced Materials and Technologies for Micro/Nano-Devices, Sensors and Actuators". 3rd edition, 2010.

VII. WEB RESOURCES:

1. https://www.youtube.com/watch?v=sCTgZv33tuA.
2. https://www.youtube.com/watch?v=oRydUfgMdgA.
3. https://www.youtube.com/watch?v=1uPTyjxZzyo.
4. https://www.yokogawa.com/special/sensing-technology/definition.

VIII. E-TEXT BOOKS:

1. https://content.kopykitab.com/ebooks/2016/06/7440/sample/sample_7440.pdf
2. https://doc.lagout.org/science/0_Computer%20Science/8_Electronics%20%26%20Robotics/The%20Mechatronics%20 Handbook.pdf Definition and terminology.

IX. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

INTERNET OF THINGS (IoT) APPLICATIONS LABORATORY								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD23	**Core**	-	-	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Embedded C								

I. COURSE OVERVIEW:

This course outlines the design and implementation of embedded systems using suitable hardware (ARM and PSOC) and Keil Embedded C software tools. The instruction set, Embedded C programming for I/O and memory interfacing techniques are covered. The hands-on experience acquired by the student's during the course makes them to carry out processor/controller-based projects and extend their knowledge on the latest trends and technologies in the field of embedded system.

II. COURSES OBJECTIVES:

The students will try to learn

I. The IoT using Arduino programming.
II. The interfacing of data I/O devices with Arduino.
III. The design steps using Raspberry Pi.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Understand the concept of Internet of Things for implementation of digital measuring devices
CO2 Develop the Arduino programming for controlling lightning appliances.
CO3 Analyze the characteristics of Bluetooth modules for controlling the performance of appliances.
CO4 Make use of direct and alternating type of electrical instruments using Arduino
CO5 Categorize the protection schemes of induction motor against over current and under voltage.
CO6 Build a relay model for protection of home appliances from over and under voltages.

IV. LIST OF EXPERIMENTS:

WEEK-1: IOT WITH ARDUINO PROGRAMMING

Introduction to Internet of Things (IoT) using Arduino programming

WEEK-2: CONROLLING RGB LED

Programming for Controlling RGB LED using Arduino and Wi-Fi Module

WEEK-3: IOT TO CONTROL REMOTE LED

Programming for Internet of things with Android and Arduino. Build an Arduino IoT to control a remote LED

WEEK-4: INTERFACING BLUETOOTH MODULE
Programming for how to interface HC-05 Bluetooth Module with Arduino UNO for various application

WEEK-5: INTERFACING TO TEMPERATURE SENSOR
Programming to Interface Temperature sensor and Monitoring using IoT with Arduino Uno and display digital value on LCD.

WEEK-6: INTERFCAING IR SENSOR
Programming to Interface IR sensors and blue tooth for detecting obstacle using Arduino with android Application.

WEEK-7: TRACK LOCATION
Programming for Node MCU for track location without using GPS module.

WEEK-8: SEND DATA FROM ARDUINO TO WEB PAGE
Programming for how to send data from Arduino to Webpage using Wi-Fi module.

WEEK-9: IOT WITH RASBERRY PI
Introduction to Internet of things (IoT) by using a Raspberry Pi to connect devices.

WEEK-10: SETUP WI-FI ON RASBERRY PI USING USB
Programming for how to Setup Wi-Fi on Raspberry Pi 2 using USB Dongle.

WEEK-11: INTERFACE TO MOTION SENSOR
Programming to interface a motion sensor to use GPIO pins with a Raspberry Pi.

WEEK-12: INTERFACE TO GAS SENSOR
Programming to interface Gas sensor for detection and monitoring using Arduino and IoT.

WEEK-13: INTERFACE TO SOIL MOSITURE SENSOR WITH NODE
Programming to interface soil moisture sensor with a node and irrigates plant automatically.

WEEK-14: INTERFACE TO SOLENOID VALVE WITH NODE
Programming to interface solenoid valve actuator for real time applications.

V. REFERENCE BOOKS:

1. Mark Torvalds, “Arduino Programming: Step-by-step guide to mastering Arduino hardware and software (Arduino, Arduino projects, Arduino uno, Arduino starter kit, Arduino ide, Arduino yun, Arduino mega, Arduino nano) Kindle Edition, 2nd Edition, 2009.
2. Michael J. Pont, “Embedded C”, Pearson Education, 2nd Edition, 2008.

VI. MATERIALS ONLINE
1. Course Template
2. Laboratory Manual

COURSE CONTENT

ARM CORTEX ARCHITECTURE AND PROGRAMMING LABORATORY								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD24	**Core**	-	-	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Embedded C.								

I. COURSE OVERVIEW:

This laboratory course is designed to provide students with practical experience in designing and implementing ARM Cortex Architecture and Programming Laboratory. The following experiments are to be performed on ARM Cortex- M TM4C123 Microcontroller using Embedded C.

II. COURSES OBJECTIVES:

The students will try to learn

I. Writing embedded C programs for ARM microcontrollers.
II. Using Sy stick counter of ARM microcontrollers.
III. Programming the interrupts of ARM microcontrollers
IV. Interfacing sensors with ARM microcontrollers

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Develop embedded C programs for ARM microcontrollers
CO2	Develop embedded C programs for transmit & receive data using UART
CO3	Develop embedded C programs for delay functions using timers
CO4	Develop embedded C programs for interfacing sensors with ARM microcontrollers
CO5	Develop Embedded Systems with “ARM Cortex M4” powered “STM32” Microcontroller.
CO6	Learn how to interpret the content of a message received through UART.

IV. LISTOFEXPERIMENTS:

WEEK-1: INTRODUCTION TO ARM CORTEX-M TM4C123 MICROCONTROLLER USING EMBEDDED C

Reading switches and displaying on LEDs.

WEEK-2: ARM CORTEX-M TM4C123 MICROCONTROLLER USING EMBEDDED C:

Initializing and displaying message on LCD display.

WEEK-3: TRANSMITTING DATA USING UART

Transmitting data using UART.

WEEK-4: RECEIVING DATA USING UART

Receiving data.

WEEK-5: TOGGLING LED USING SYS TICK COUNTER

Toggling LED.

WEEK-6: IMPLEMENTING DELAY FUNCTION USING TIMERS

Implementing delay function using Timers.

WEEK-7: USING GPIOF INTERRUPT

Using GPIOF interrupt.

WEEK-8: USING SYS TICK INTERRUPT

Using Sys Tick interrupt.

WEEK-9: INTERRUPT PRIORITY DEMONSTRATION

Interrupt priority demonstration.

WEEK-10: INTERFACING LM34 TEMPERATURE SENSOR

Interfacing LM34 temperature sensor.

WEEK-11: COMMUNICATING WITH REAL TIME CLOCK USING I2C

Communicating with Real time clock using I2C.

WEEK-12: USING PWM MODULE TO CONTROL LED INTENSITY

Using PWM module to control LED intensity.

WEEK-13: AUTOMATIC CA R PARKING SYSTEM USING ARM

An automa Design and implement tic car parking system using ARM.

WEEK-14: OBJECT DETECTION USING ARM

Design and implement an object detection using IR Sensor using ARM

V. TEXT BOOKS:

1. Microcontroller Based Embedded Systems Laboratory Manual, Steve Furber, ARM System on Chip Architecture, 2nd edition, New Delhi: Dorling Kindersley (India) Pvt. Ltd., 2000.

VI. REFERENCE BOOKS:

1. Muhammad Ali Mazidi, Shujen Chen, Sarmad Naimi, Sepehr Naimi, TI ARM.
2. Peripherals Programming and Interfacing Using C Language for ARM Cortex, Mazidi and Naimi, 2014.
3. Jonathan Valvano, Embedded Systems: Real-Time Operating Systems for Arm Cortex Microcontrollers, Charleston: Create Space Independent Publishing Platform, 2012.

VI. MATERIALS ONLINE

1. Course Template
2. Laboratory Manual

COURSE CONTENT

EMBEDDED SYSTEMS FOR AUTOMATIVE APPLICATIONS								
III Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD26	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Real time operating system								

I. COURSE OVERVIEW:

Embedded systems are basically an extension of advanced robotic applications, which have had a profound impact on almost all our modern technology such as video cameras, computing machinery, smartphones, digital display systems, and so on. Embedded systems are used to control and monitor various safety features of a vehicle, including airbags, seat belts, and anti-lock braking systems. These systems work together to ensure that the driver and passengers are safe in the event of an accident.

II. COURSES OBJECTIVES:

The students will try to learn

I. The fundamental knowledge of the Automotive applications.
II. Obtain knowledge and their working of Embedded systems control and monitor various safety features of a vehicle principles.
III. Identify the various areas of application for inclusion of Embedded systems.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Develop programming skills in embedded systems for various applications.

CO2 Identify and Acquire knowledge about the Life cycle of embedded design and its testing.

CO3 Analyze and acquire basic knowledge about programming and system control to perform a specific task.

CO4 Illustrate the principle and characteristics of automotive applications to simulate using tools

CO5 Select the Life cycle of embedded design and its testing.

CO6 Make use of modern embedded systems to design and implement the various applications.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION (09)

An embedded system-definition, examples, current technologies, integration in system design, embedded system design flow, hardware design concepts, software development, processor in an embedded system and other hardware units, introduction to processor based embedded system design concepts.

MODULE –II: EMBEDDED HARDWARE (09)

Embedded hardware building blocks, embedded processors, ISA architecture models, internal processor design, processor performance, board memory ROM, RAM, auxiliary memory, memory management of external memory, board memory and performance. embedded board input / output, serial versus parallel I/O, interfacing the I/O components, I/O

components and performance, board buses, bus arbitration and timing, integrating the bus with other board components, bus performance.

MODULE –III: EMBEDDED SOFTWARE (09)
Device drivers, device drivers for interrupt-handling, memory device drivers, on-board bus device drivers, board I/O drivers, explanation about above drivers with suitable examples. embedded operating systems, multitasking and process management, memory management, I/O and file system management.

OS standards example, POSIX OS performance guidelines, board support packages, middleware and application software, middle Ware examples, application layer software examples.

MODULE –IV: AUTOMOTIVE SYSTEMS OVERVIEW (09)
Automotive vehicle technology, overview of vehicle categories, various vehicle sub systems like chassis, body, driveline, engine technology, fueling technology, vehicle emission, brakes, suspension, emission, doors, dashboard instruments, wiring harness, safety & security, comfort and infotainment, communication & lighting, future trends in automotive embedded systems.

MODULE –V: AUTOMOTIVE SENSORY SYSTEM (09)
Automotive sensors and transducers: temperature, manifold and barometric pressures, humidity, carbon dioxide (CO2), carbon Monoxide (CO), oxygen (O2) Sensors, proximity distance sensors, engine speed sensors, throttle position sensors, pressure sensors, knock Sensor & Mass flow sensor.

V. TEXT BOOKS:

1. Thomas Braun, "Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems", 3rd edition, springer-Verlag Berlin Heidelberg, 2008.
2. Saeed B Niku, (2019), introduction to Robotics, analysis, control and applications, Wiley Publications. ISBN: 978-1-119-52760-2.
3. R.K. Mittal and I J Nagrath, "Robotics and Control", Tata McGraw Hill, 1st edition, 2003.

VI. REFERENCE BOOKS:

1. William B. Ribbens, "Understanding Automotive Electronics, an Engineering Perspective", seventh edition, butter worth-Heinemann Publications.
2. Ronald K. Jurgen, "Automotive Electronics Handbook", Mc-Graw Hill.
3. Kinckle, Uwe, Nielsen & Lars, "Automotive Control Systems for Engine, Driveline, and Vehicle", 2nd edition, springer publication.

VII. WEB RESOURCES:

1. http://www.gettextbooks.com/author/ Thomas Braunl
2. http://nptel.ac.in/video.php?subjectId=112101099
3. http://nptel.ac.in/courses/112101099/

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

FPGA BASED SYSTEM DESIGN								
III Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD27	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: VLSI Design, System on Chip								

I. COURSE OVERVIEW:

This course covers the advanced design and analysis of digital circuits with HDL. The primary goal is to provide in depth understanding of system design. The course enables students to apply their knowledge for the design of advanced digital hardware systems with help of FPGA tools.

II. COURSES OBJECTIVES:

The students will try to learn

I. Understand Digital system design using HDL.
II. Know FPGA architecture, interconnect and technologies.
III. Know different FPGA's and implementation methodologies.
IV. Understand configuring and implementing digital embedded system, microcontrollers, microprocessors, DSP algorithm on FPGA.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Design and optimize complex combinational and sequential digital circuits.

CO2 Model Combinational and sequential digital circuits by Verilog HDL.

CO3 Design and model digital circuits with Verilog HDL at behavioral, structural, and RTL Levels.

CO4 Develop test benches to simulate combinational and sequential circuits.

CO5 Understand the FPGA Architecture.

CO6 Implementation of the combinational and sequential digital circuits in FPGA.

IV. COURSE CONTENT:

MODULE - I: VERILOG HDL CODING STYLE (10)

Lexical conventions, ports and modules, operators, gate level modeling, system tasks & compiler directives - test bench, data flow modeling, behavioral level modeling, tasks & functions.

MODULE - II: OVERVIEW OF FPGA ARCHITECTURES AND TECHNOLOGIES (10)

FPGA architectural options, coarse vs fine grained, vendor specific issues (emphasis on Xilinx FPGA), antifuse, SRAM and EPROM based FPGAs, FPGA logic cells, interconnection network and I/O Pad.

MODULE - III: VERILOG MODELLING OF COMBINATIONAL AND SEQUENTIAL CIRCUITS (09)
Behavioral, data flow and structural realization, adders, multipliers, comparators, flip flops, realization of shift register, realization of a counter- synchronous.

Asynchronous FIFO, single port and dual port RAM, pseudo, random LFSR, cyclic redundancy check.

MODULE –IV: SYNCHRONOUS SEQUENTIAL CIRCUIT (10)
State diagram-state table, state assignment-choice of flipflops, timing diagram, one hot encoding mealy and Moore state machines, design of serial adder using mealy and Moore state machines, state minimization, sequence detection, design examples: sequence detector, serial adder, vending machine using one hot controller.

MODULE –V: SYSTEM DESIGN EXAMPLES USING XILLINX FPGAS (09)
Traffic light controller, real time clock, interfacing using FPGA: VGA, keyboard, LCD, embedded Processor hardware design.

V. TEXT BOOKS:

1. M.J.S. Smith, "Application Specific Integrated Circuits", person, 2000.
2. Peter Ashenden, "Digital Design using VHDL", Elsevier, 2007.
3. Peter Ashenden, "Digital Design using Verilog", Elsevier, 2007. 4. W. Wolf, "FPGA based system design", Pearson, 2004.
4. Clive Maxfield, "The Design Warriors' Guide to FPGAs", Elsevier, 2004.
5. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis" Prentice Hall.

VI. REFERENCE BOOKS:

1. T.R. Padmanabhan, B. Bala Tripura Sundari, "Design through Verilog HDL" Wiley Inter science, 2004. S. Ramachandran, "Digital VLSI System Design: A Design Manual for implementation of Projects on FPGAs and ASICs Using Verilog" Springer Publication, 2007.
2. Wayne Wolf, "FPGA Based System Design", Prentices Hall Modern Semiconductor Design Series.
3. Stephen Brown & Zvonko Vranes, "Digital Logic Design with Verilog HDL" TATA McGraw Hill Ltd. 2nd edition, 2007.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

DISCRETE TIME SIGNAL PROCESSING								
III Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD28	**Elective**	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: There are no prerequisites to take this course								

I. COURSE OVERVIEW:

Discrete-Time Signal Processing (DTSP) is a field of study that deals with the analysis, processing, and manipulation of signals that are defined in discrete time. This field is crucial in various applications such as digital signal processing, telecommunications, audio processing, image processing, and more. A course on Discrete-Time Signal Processing typically covers fundamental concepts, theories, and techniques related to discrete-time signals and systems.

II. COURSES OBJECTIVES:

The students will try to learn

I. Understand the fundamental properties of discrete-time signals.
II. Analyze discrete-time systems, considering properties like linearity and stability.
III. Apply discrete-time signal processing to practical domains such as audio, image, and communication systems.
IV. Use the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) for frequency analysis.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Understand the illustration of discrete-time signals and systems
CO 2 Apply the Discrete/Fast Fourier Transform for discrete time signal processing.
CO 3 Analyze the design of Infinite Impulse Response (IIR) filters.
CO 4 Analyze the design of Finite Impulse Response (FIR) filters.
CO 5 Understand the concepts of programmable DSPs.
CO 6 Design the IIR filters by Impulse invariant and bilinear transformation methods.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION TO DISCRETE TIME SIGNAL PROCESSING (10)

Introduction to discrete time signals, review of signals and systems: discrete time complex exponentials and other basic signals, analysis of discrete time linear time invariant systems. Introduction to discrete convolution, impulse response and convolution sum, convolution of infinite sequences, circular shift and circular symmetry, periodic and circular convolution.

MODULE - II: TRANSFORM ANALYSIS OF SYSTEMS (10)

Introduction to Discrete Fourier Transform (DFT), Inverse DFT (IDFT), Properties of DFT, Relation between Z-Transform and DFT, Linear Convolution using DFT. Introduction to Fast Fourier Transform, Decimation in time radix–2 FFT, Decimation in frequency radix–2 FFT.

MODULE - III: DESIGN OF INFINITE IMPULSE RESPONSE (IIR) FILTERS (09)

Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from analog filters by impulse invariant and bilinear transformation methods.

Frequency transformations and basic structures of IIR filters.

MODULE –IV: DESIGN OF FINITE IMPULSE RESPONSE (FIR) FILTERS (10)

Characteristics of FIR filters with linear phase, frequency response of linear phase FIR filters, Design of FIR filters using windows (Rectangular, Triangular and Hanning), Basic structures of FIR filters and Comparison of IIR & FIR filters.

MODULE –V: INTRODUCTION TO DSP PROCESSORS (09)

Introduction to programmable DSPs, multiplier and multiplier accumulator (MAC) operation, multiple access memory Very Long Instruction Word (VLIW) architecture, Pipelining. Applications of DSP processors.

V. TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", 4th edition, Pearson Education / PHI, 2007.
2. A. Anand Kumar, "Digital Signal Processing", 2nd edition, PHI, Eastern Economy edition, 2015.

VI. REFERENCE BOOKS:

1. A.V. Oppenheim and R.W. Schafer, "Discrete–Time Signal Processing", 3rd Edition, PHI, 2010.
2. S.K. Mitra, "Digital Signal Processing – A practical approach", 4th Edition (Indian Edition), McGraw Hill Education, 2013.
3. M.H. Hayes, "Digital Signal Processing: Schaum's Outlines", 4th edition, Tata Mc-Graw Hill, 2011.
4. Robert. J. Schilling, Sandra. L. Harris, "Fundamentals of Digital Signal Processing using MATLAB", 3rd Edition, Cengage Learning, 2016.

VII. WEB RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105055/
2. https://nptel.ac.in/courses/117/102/117102060/

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

SENSOR TECHNOLOGIES AND MEMS								
III Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD29	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Sensors and Actuators								

II. COURSE OVERVIEW:

This course introduces the fundamental characteristics of the advanced sensor systems, the operating principles of transducers and development of MEMS Technology. It focuses on the mechanical and electromechanical Sensors, fabrication processes of MEMS and the recent advances in sensor technologies. The application aspects of sensors used in several fields such as automobiles, manufacturing, medical, environment and also designed to serve the needs of the engineering disciplines such as instrumentation, chemical, mechanical, and electrical.

III. COURSES OBJECTIVES:

The students will try to learn

I. The operating principles, parameters and characteristics of electromechanical sensors and transducers.
II. The different types of techniques for design and develop sensors and their applications.
III. To analyze materials used for fabrication processes of MEMS technology and acquire knowledge on polymer and optical MEMS.

IV. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Classify the electromechanical sensors for the conversion of physical to nonphysical quantity
CO2	Illustrate the characteristics of sensors to perform a required measurement.
CO3	Demonstrate the working principles of electro analytical sensors for the automatic sensor applications.
CO4	List the different types of smart sensors for the performance of analog and digital communication systems.
CO5	Examine the appropriate automotive sensors for the measurement of electro mechanical parameters to solve real time world problems.
CO6	Select an appropriate sensor to monitor the environmental conditions.

V. COURSE CONTENT:

MODULE - I: SENSORS / TRANSDUCERS (10)

Principles, classification, parameters, characteristics, environmental parameters (EP), characterization. mechanical and electromechanical sensors: introduction, resistive potentiometer, strain gauge, resistance strain gauge, semiconductor strain gauges, inductive sensors, sensitivity and linearity of the sensor. types- capacitive sensors: Electrostatic transducer, force/stress sensors using quartz resonators, ultrasonic sensors.

MODULE –II: RADIATION SENSORS (09)

Introduction, basic characteristics, types of photoresistors / photo detectors, x-ray and nuclear radiation sensors, fiber optic sensors. electro analytical sensors: introduction, the electrochemical cell, the cell potential, standard hydrogen

electrode (SHE), liquid junction and other potentials, polarization, concentration polarization, reference electrodes, sensor electrodes, electro ceramics in gas media.

MODULE –III: SMART SENSORS (10)
Introduction, primary sensors, excitation, amplification, filters, converters, compensation, i nformation coding/processing, data communication, standards for smart sensor interface, the automation sensors.

Applications: Introduction, on-board automobile sensors (Automotive Sensors), home appliance sensors, aerospace sensors, sensors for manufacturing, sensors for environmental monitoring.

MODULE –IV: INTRODUCTION TO MEMS (09)
Introduction, development of MEMS technology, present, future and challenges, fabrication processes: fundamentals of material science, substrates: single crystal substrates, silicon on insulator substrate, physical vapor deposition, chemical vapor deposition, etching processes, patterning, wafer bonding, annealing, chemical mechanical polishing, material doping, MEMS application in life sciences.

MODULE –V: POLYMER AND OPTICAL MEMS (10)
Polymers in MEMS, Polyimide - SU-8 - Liquid Crystal Polymer (LCP), PDMS, PMMA, perylene, fluorocarbon, application to acceleration, pressure, flow and Tactile sensors, optical MEMS, lenses.

VI. TEXT BOOKS:

1. D. Patra Nabis, “Sensors and Transducers”, PHI Learning Private Limited.
2. W. Bolton, “Mechatronics”, person education Limited.

VII. REFERENCE BOOKS:

1. Patra Nabis, “Sensors and Actuators”, second edition, PHI, 2013. Allen James J, Micro Electromechanical SystemDesign, first edition, Taylor and Francis, FL (USA), 2005.
2. Maluf Nadim and Williams Kirt, an Introduction to Micro electromechanical Systems Engineering, ARTECH House, MA (USA), 2nd edition, 2004.
3. N. Maluf, “An Introduction to Micro-electro Mechanical System Engineering", artech. House.

VIII. WEB RESOURCES:

1. https://www.youtube.com/watch?v=sCTgZv33tuA
2. https://www.youtube.com/watch?v=oRydUfgMdgA
3. https://www.youtube.com/watch?v=1uPTyjxZzyo\
4. https://www.yokogawa.com/special/sensing-technology/definition/
5. http://www.http//mail.vdivde-it.de/ut/EMSTO
6. https://nptel.ac.in/courses/117105082/

IX. E-TEXTBOOKS:

1. http://bookboon.com/en/communication-ebooks-zip
2. https://bookauthority.org/books/new-electronic-sensors-books
3. https://www.elsevier.com/books/sensor-technology-handbook/wilson

X. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

EMBEDDED SYSTEMS DESIGN								
III Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESD30	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 40	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Microcontrollers and Programmable Digital Signal Processing								

I. COURSE OVERVIEW:

This course aims to provide students with a solid foundation in embedded system design, covering both theoretical concepts and practical implementation. Students will learn about the design, development, and testing of embedded systems, as well as the key components involved in creating efficient and reliable embedded solutions.

II. COURSES OBJECTIVES:

The students will try to learn

I. The difference between embedded systems and general-purpose systems.
II. Hardware/software co-design and its significance for system development in embedded systems
III. Implement basic networking and communication capabilities in embedded systems.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Describe the characteristics, challenges, and constraints of embedded systems.
CO2	Apply the suitable memory technology and other components for different applications to meet the ever-growing needs of the embedded applications.
CO3	Choose the fundamental components that make up an embedded board to implement an Instruction Set Architecture ‘s features in a processor.
CO4	Categorize the embedded firmware design approaches and development languages used for programming embedded devices.
CO5	Make use of the memory hierarchy to minimize the access time in embedded architecture design.
CO6	Identify the hardware software co- design issues pertaining to design of an embedded system using low power microcontrollers.

IV. COURSE CONTENT:

MODULE - I: NTRODUCTION TO EMBEDDED SYSTEMS (10)

Overview of microcontrollers and microprocessors Architecture, memory organization, and I/O operations, Selection criteria for choosing microcontrollers, definition and characteristics of embedded systems, embedded system applications and real-world examples, challenges and constraints in embedded system design.

MODULE –II: TYPICAL EMBEDDED SYSTEM (09)

Core of the Embedded System: General purpose and domain specific processors, ASICs, PLDs, commercial off- the-shelf components (COTS), memory: ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems, sensors and actuators, communication interface: onboard and external communication interfaces.

MODULE –III: EMBEDDED SYSTEM SOFTWARE (10)
Embedded software development process, embedded programming languages (C, Assembly), real-time operating systems (RTOS) and scheduling.
Hardware/Software Co-design: Hardware-software partitioning, communication between hardware and software components, trade-offs and optimization techniques.

MODULE –IV: RTOS BASED EMBEDDED SYSTEM DESIGN (10)
Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling.

MODULE –V: EMBEDDED NETWORKING AND COMMUNICATION (09)
Network protocols (TCP/IP, MQTT, etc.), wireless communication (Wi-Fi, Bluetooth, etc.), IoT (Internet of Things) concepts.

V. TEXT BOOKS:

1. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley Publications, 3rd edition, 2006.

VI. REFERENCE BOOKS:

1. Raj Kamal, "Embedded Systems", TMH, 2nd edition, 2008.
2. Shibu K.V, "Introduction to Embedded Systems, McGraw Hill, 3rd edition, 2012.
3. Lyla, "Embedded Systems", person education, 2nd edition, 2013.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

PRINCIPLES OF DISTRIBUTED EMBEDDED SYSTEMS								
III Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD31	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Real Time Operating System.								

I. COURSE OVERVIEW:

This course introduces the foundation in the system concepts of distributed computing for widely used in small embedded systems. It covers basic system concepts, real time systems, real time communications, system design and CAN protocols. Through the knowledge of distributed embedded computing used to design and implement the prototype on embedded intelligence in an ever-growing array of application fields, and engineering disciplines.

II. COURSES OBJECTIVES:

The students will try to learn

I. Design principles of real time systems and its classifications for the design of embedded system.
II. The working environment of real time operating system for processes data and events that have time constraints.
III. The CAN protocol and its standards to allow the all-embedded devices to communicate with each other in a network.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Illustrate the principles of real time computer systems for the system design to controls the environment.

CO2 Demonstrate the classifications of real time systems and its components for the design of reliable embed system.

CO3 Select the suitable Time based triggered or event-triggered control strategies for stabilization of rate constrai in the distributed real time communication systems.

CO4 Summarize the fundamental aspects of real time operating system as, task scheduling, task managem Intertek communication, process input/output to implement in the real time applications.

CO5 Identify the scheduling problems and algorithms to resolve it in order to design and implementation dependable distributed embedded systems.

CO6 Model a time-triggered architecture system for the use of a single interrupt and to activate any specific acti either hardware or software.

IV. COURSE CONTENT:

MODULE - I: REAL-TIME ENVIRONMENT (10)

Real-time computer system requirements, classification of real time systems, simplicity, global time, internal and external clock synchronization, real time model. Real time communication, temporal relations, dependability, power and energy awareness, real time communication, event triggered, rate constrained, time triggered.

MODULE –II: REAL-TIME OPERATING SYSTEMS (09)

Inter component communication, task management and dual role of time; Inter task interactions, process

input/output, agreement protocols, error detection.

MODULE –III: SYSTEM DESIGN (09)
Scheduling problem, static and dynamic scheduling, system design Validation, time-triggered architecture.

MODULE –IV: INTRODUCTION TO CAN (10)
Introduction to CAN open CAN open standard, object directory, electronic data sheets and devices.

MODULE –V: CAN STANDARDS (10)
D Introduction to CAN open CAN open standard, object directory, electronic data sheets and devices.

V. TEXT BOOKS:

1. Hermann Kopetz, "Real–Time Systems-Design Principles for distributed Embedded Applications", Springer, 2nd edition, 2011.
2. Glaf P. Feiffer, Andrew Ayre and Christian Key old, "Embedded networking with CAN and CAN open", Copperhill Media Corporation, 1st edition, 2008.

VI. REFERENCE BOOKS:

1. Rajkamal, "Embedded System-Architecture-Programming-Design", Tata McGraw Hill, 3rd edition, 2011.
2. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley and sons, 2nd edition, 2002.
3. Lyla B Das, "Embedded Systems-An Integrated Approach", Pearson, 1st edition, 2013.
4. David E. Simon, "An Embedded Software Primer", Pearson Education, 1st edition, 1999.

VII. WEB RESOURCES:

1. https://www.upf.edu/pra/en/3376/22580.
2. https://onlinecourses.nptel.ac.in/noc20_cs16/preview
3. https://www.coursera.org/learn/ real time embedded systems.
4. https://mitpress.mit.edu/books/ real time embedded systems.
5. http://www.apress.com

VIII. E-TEXT BOOKS:

1. http://infinity.wecabrio.com/1441982361-real-time-systems-design-principles-for-distribut.pdf
2. https://do1-vbox1.web.tku.edu.tw/kVuxfO_real-time-systems-design-principles-fordistribut_XJQN.pdf

IX. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

ADVANCED DIGITAL SYSTEM DESIGN								
III Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD32	**Elective**	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Digital System Design								

I. COURSE OVERVIEW:

This course introduces the fundamental concepts and basic building blocks of digital circuits. It focuses on number systems designing of optimized combinational and sequential circuits, memories, programmable logic devices and the key concepts of hardware description language (VHDL). The applications include in the area of VLSI design, microprocessors, microcontrollers and embedded systems.

II. COURSES OBJECTIVES:

The students will try to learn

I. To design asynchronous sequential circuits.
II. To learn about hazards in asynchronous sequential circuits.
III. To study the fault testing procedure for digital circuits.
IV. To understand the architecture of programmable devices.
V. To design and implement digital circuits using programming tools.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Outline binary arithmetic operations and optimize Boolean functions using Karnaugh and tabulat method.
CO2 Make use of basic logic gates to realize the combinational logic circuits used in conventional electrc circuits
CO3 Interpret the knowledge of flip-flops and latches in synchronous and asynchronous modules for mem Storing.
CO4 Develop Mealy/Moore models and state diagrams for the complex sequential circuit applications.
CO5 Identify the different logic families, memories and programmable logic devices for understanding architectural blocks of FPGA.
CO6 Demonstrate the different modelling styles and data types in VHDL for implementing combinational sequential circuits.

IV. COURSE CONTENT:

MODULE - I: SEQUENTIAL CIRCUIT DESIGN (10)

Analysis of clocked synchronous sequential circuits and modelling- state diagram, state table, state table assignment reduction-design of synchronous sequential circuits design of iterative circuits, ASM chart and realization using ASM.

MODULE –II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (09)

Analysis of asynchronous sequential circuit, flow table reduction-races-state assignment transition table and problems

in transition table, design of asynchronous sequential circuit, static, dynamic and essential hazards, mixed operating mode asynchronous circuits, designing vending machine controller.

MODULE –III: FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS (10)
Fault table method-path sensitization method, Boolean difference Method - D algorithm, tolerance Techniques.

The compact algorithm, fault in PLA, test generation, DFT schemes, built in self, test.

MODULE –IV: SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES (09)
Programming logic device families, designing a synchronous sequential circuit using PLA/PAL, designing ROM with PLA, realization of finite state machine using PLD, FPGA, Xilinx FPGA, Xilinx 4000.

MODULE –V: SYSTEM DESIGN USING VERILOG (10)
Hardware modelling with Verilog HDL, logic system, data types and operators for modelling in Verilog HDL, behavioral descriptions in Verilog HDL, HDL based synthesis, synthesis of finite state machines, structural modelling, compilation and simulation of Verilog code, test bench, realization of combinational and sequential circuits using Verilog, registers, counters, sequential machine, serial adder, multiplier, divider, design of simple microprocessor, introduction to system Verilog.

V. TEXT BOOKS:

1. Chandrakasan, teal, design of High, performance Microprocessor Circuits, IEEE Press, 2001.
2. Harris, Skew-tolerant Circuit Design, Morgan Kaufmann, 2000.
3. Bernstein, teal, high Speed CMOS Design Styles, Kluwer Academic Publishers, 1998.
4. Weste and D. Harris, CMOS VLSI Design, Addison, Wesley, 4th edition, 2010.

VI. REFERENCE BOOKS:

1. Charles H. Roth jr., “Fundamentals of Logic Design” Thomson Learning, 2013.
2. M.D. Ciletti, modeling, synthesis and Rapid Prototyping with the Verilog HDL, prentice Hall, 1999.
3. M.G. Arnold, Verilog Digital, computer Design, prentice Hall (PTR), 1999.
4. Nripendra N Biswas “Logic Design Theory” Prentice Hall of India, 2001.
5. Parag k. Lala “Fault Tolerant and Fault Testable Hardware Design” B S Publications, 2002.
6. Parag k. Lala “Digital System Design Using PLD” B S Publications, 2003.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

DIGITAL IMAGE AND VIDEO PROCESSING								
III Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESD33	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Digital Image Processing.								

I. COURSE OVERVIEW:

This course provides a mathematical framework to describe and analyze images and videos as two- and three-dimensional signals in the spatial and frequency domains. It focuses on fundamentals of digital images, transforms, image enhancement in spatial, frequency domains, image compression techniques and introduces video processing sampling, filtering operation and motion estimation in the videos. Digital image processing motivated by major applications to process images and videos for solving practical problems of commercial and scientific interests for machine applications in industries for quality control.

II. COURSES OBJECTIVES:

The students will try to learn

1. The fundamentals of digital image and video processing and algorithms for most of the image and video applications.
2. The image enhancement, image segmentation and compression techniques in spatial and frequency domains and motion estimation in videos.
3. The algorithms to solve image and video processing problems to meet design specifications of various applications of image processing in industry, medicine and defense.
4. Fundamentals of image and video representation and processing in MATLAB.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1	Outline the principles and terminology of digital image processing for describing the features of image.
CO 2	Demonstrate 2D Fourier transforms and its properties for frequency domain representation of the image.
CO 3	Make use of various image transform techniques like Walsh, Slant, Hadamard, DCT and Haar transforms for analyzing images in transform domain.
CO 4	Construct image intensity transformations and spatial filtering for image enhancement in the spatial domain.
CO 5	Identify 2D convolution and filtering techniques for smoothening and sharpening of Images in frequency domain.
CO 6	Illustrate the analog video to digital video conversion using sampling and quantization methods.

IV. COURSE CONTENT:

MODULE - I: FUNDAMENTALS OF IMAGE PROCESSING AND IMAGE TRANSFORMS (09)

Basic steps of image processing system sampling and quantization of an image, basic relationship between pixels. 2-D transforms of Haar, Walsh transformations. Image segmentation: segmentation concepts, point, line and edge detection,

thresholding, region-based segmentation.

MODULE –II: IMAGE ENHANCEMENT (09)
Spatial domain methods: Histogram processing, fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, smoothing, image sharpening, selective filtering.

MODULE –III: IMAGE COMPRESSION (09)
Image compression fundamentals, coding redundancy, spatial and temporal redundancy.

Compression models: Lossy & Lossless, Huffman coding, bit plane coding, wavelet coding, lossy Predictive coding, JPEG Standards.

MODULE –IV: BASIC STEPS OF VIDEO PROCESSING (09)
Analog video, digital video. time, varying image formation models: three, dimensional motion models, geometric image formation, photometric image formation, sampling of video signals, filtering operations.

MODULE –V: 2-DMOTIONESTIMATION (09)
Optical flow, general methodologies, pixel, based motion estimation, mesh, based motion estimation, global motion estimation, region, based motion estimation, multi resolution motion estimation, wave form-based coding, block- based transform coding, predictive coding, application of motion estimation in video coding.

V. TEXT BOOKS:

1. Gonzalez and Woods, "Digital Image Processing", Pearson 3rd edition, 2007.
2. Yao Wang, Joem Oster Mann and Ya–quin Zhang, "Video Processing and Communication", PHInt, 1st edition, 2007.

VI. REFERENCE BOOKS:

1. Scotte Umbaugh, "Digital Image Processing and Analysis Human and Computer Vision Application with CVIP Tools", CRC Press, 2nd edition, 2011.
2. M. Tek alp, "Digital Video Processing", Prentice Hall International.
3. S. Jayaraman, S. Esakkirajan, T. Veera Kumar, "Digital Image Processing", TMH, 2009.
4. John Woods, "Multidimensional Signal, Image and Video Processing and Coding", Elsevier, 2nd edition, 2009.
5. Vipula Singh, "Digital Image Processing with MATLAB and LabVIEW", Elsevier.
6. Keith Jack, "Video Demystified, a Hand Book for the Digital Engineer", Elsevier, 5th edition, 2010.

VII. WEB RESOURCES:

1. http://nptel.ac.in/courses/117105079/
2. http://nptel.ac.in/video.php?subjectId=117105079
3. http://nptel.ac.in/courses/106105032/

VIII. E-TEXT BOOKS:

1. iitlab.bit.edu.cn/.../Handbook%20of%20Image%20and%20Video%20Processing.pdf
2. www.sciencedirect.com/science/book/9780121197926.

IX. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations

COURSE CONTENT

RESEARCH METHODOLOGY AND IPR								
III Semester: AE, CSE, ES, EPS, & STE & CAD/CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD01	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		2	0	0	2	40	60	100
Contact Classes: 48	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

This course imparts research methodology and philosophy of intellectual property rights, including basic concepts employed in quantitative and qualitative research methods, Patents, Copyrights, and Trademarks. It provides the research framework, research methodology research design, and formulation hypothesis, sampling techniques, data analysis and report writing. It implies on research skills and intellectual property rights to encourage new creations, including technology, artwork, and inventions, that might increase economic growth.

II. COURSE OBJECTIVES:

The student will try to learn:

I. The Knowledge on formulate the research problem, characteristics of a good research and interpretation of collected data.
II. The importance of research ethics while preparing literature survey and writing thesis to achieve plagiarism free report.
III. The intellectual property rights such as patent, trademark, geographical indications and copyright for the protection of their invention done.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Interpret the technique of determining a research problem for a crucial part of the research study.
CO 2 Examine the way of methods for avoiding plagiarism in research.
CO 3 Apply the feasibility and practicality of research methodology for a proposed project.
CO 4 Make use of the legal procedure and document for claiming patent of invention.
CO 5 Identify different types of intellectual properties, the right of ownership and scope of protection to create and extract value from IP.
CO 6 Defend the intellectual property rights throughout the world with the involvement of world intellectual property organization

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION (10)
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II: RESEARCH ETHICS (09)
Effective literature studies approaches, analysis Plagiarism and Research ethics.

MODULE-III: RESEARCHPROPOSAL (09)
Effective technical writing, how to write report, Paper Developing a Research Proposal.

Format of research proposal, presentation and assessment by iare view committee.

MODULE-IV: PATENTING (10)
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V: PATENT RIGHTS (10)
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

V. TEXT BOOKS:

1. Panneerselvam, Ramasamy. Research methodology. PHI Learning Pvt. Ltd., 2014.
2. Goddard, Wayne, and Stuart Melville. Research methodology: An introduction. Juta and Company Ltd, 2004.
3. Ranjit Kumar, "Research Methodology: A Step-by-Step Guide for beginners". 2nd edition, 2007

VI. REFERENCE BOOKS:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
2. Correa, Carlos M. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed books, 2000.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962

VII. ELECTRONICS RESOURCES:

1. https://wac.colostate.edu/docs/books/try/chapter1.pdf
2. https://www.scribbr.com/dissertation/methodology/
3. http://nptel.ac.in/courses/107108011/

VIII. MATERIALS ONLINE:

1. Course Template
2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes

7. Early Lecture Readiness Videos
8. Power point presentation

COURSE CONTENT

ENGLISH FOR RESEARCH PAPER WRITING								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD02	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

In this course, students will be equipped with the necessary tools to effectively communicate their research findings in a scholarly manner. They will develop the ability to write clear, concise, and well-structured research papers that adhere to academic standards. These skills will not only benefit them in their academic pursuits but also in their future professional careers as researchers, scholars, and professionals in various fields

II. COURSE OBJECTIVES:

The students will try to learn:

I. How to improve the writing skills and level of readability.
II. The methodology that what to write in each section the skills needed when writing a Title Ensure the good quality of paper at very first-time submission.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Interpret the technique of determining a research problem for a crucial part of the research study
CO 2 Examine the way of methods for avoiding plagiarism in research
CO 3 Apply the feasibility and practicality of research methodology for a proposed project.
CO 4 Make use of the legal procedure and document for claiming patent of invention.
CO 5 Identify different types of intellectual properties, the right of ownership, scope of protection to create and extract value from IP

IV. SYLLABUS:

MODULE – I: PLANNING AND PREPARATION

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

MODULE – II: ABSTRACT

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

MODULE – III: DISCUSSION AND CONCLUSIONS

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

MODULE – IV: DISCUSSION AND CONCLUSIONS

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE – V: QUALITY AND TIME MAINTENANCE

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

V. TEXT BOOKS:

1. Goldbort R, "Writing for Science", Yale University Press. 2011.
2. Adrian Wallwork, "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011.

VI. REFERENCE BOOKS:

1. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM Highman's Book.

VII. WEB REFERENCES:

http://saba.kntu.ac.ir/eecd/ecourses/Seminar90/2011%20English%20for%20Writing%20Research%20Papers.pdf

VIII. E-TEXT BOOKS:

1. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.

COURSE CONTENT

DISASTER MANAGEMENT								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD03	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

In the course on disaster management, students will explore a range of important topics and gain valuable knowledge and skills to effectively address and mitigate the impact of disasters and covers areas like Repercussions of Disasters and Hazards, Disaster-Prone Areas in India, Risk Assessment and Disaster Mitigation

II. COURSE OBJECTIVES:

The students will try to learn:

I. How to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
II. How critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
III. The understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
IV. The strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Understand to describe the basic types of Environmental hazards and disasters. Understand how to react effectively to natural, manmade, and technological threats.
CO 2 Understand how to react effectively to natural, manmade, and planetary hazards
CO 3 Explore the history of the field and comprehend how past events are earthquake, landslides, and volcanic hazards.
CO 4 Describe the basic concepts of the emergency management cycle mitigation, preparedness, response, and recovery
CO 5 Recognizes the stakeholders in disaster management system, their jurisdiction and responsibilities

IV. SYLLABUS

MODULE – I: INTRODUCTION

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE – II: REPERCUSSIONS OF DISASTERS AND HAZARDS

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters:

Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease And Epidemics, War And Conflicts.

MODULE – III: DISASTER PRONE AREAS IN INDIA

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

MODULE – IV: DISASTER PREPAREDNESS AND MANAGEMENT

Preparedness: Monitoring of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

MODULE – IV: RISK ASSESSMENT & DISASTER MITIGATION

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival. Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

V. TEXT BOOKS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal
Book Company.

VI. REFERENCE BOOKS:

1. Sahni, PardeepEt.Al, "Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
2. Goel S. L. "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

VII. WEB REFERENCE:

1. http://nptel.ac.in/courses/105101010/downloads/Lecture37.pdf

VIII. E-TEXT BOOKS:

1. Disaster management by Vinod k. Sharma

COURSE CONTENT

SANSKRIT FOR TECHNICAL KNOWLEDGE								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD04	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

In this course, Studying Sanskrit enhances students' analytical thinking and problem-solving abilities. The intricate grammar and logical structure of Sanskrit nurture their analytical skills, enabling them to dissect complex concepts and extract profound insights. This heightened analytical thinking can be applied across different technical disciplines, fostering innovative solutions to contemporary challenges

II. COURSE OBJECTIVES:

The students will try to learn:

I. A working knowledge in illustrious Sanskrit, the scientific language in the world.
II. The Sanskrit to improve brain functioning.
III. The Sanskrit language to develop the logic in mathematics, science & other courses enhancing the memory power.
IV. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to

CO 1 Understand the basic Sanskrit grammar
CO 2 Formulate simple sentences
CO 3 Apply order and roots
CO 4 Understand Ancient Sanskrit literature about science & technology
CO 5 Develop logical thinking being a logical language in technical concepts

IV. SYLLUBUS:

MODULE – I: INTRODUCTION

Alphabets in Sanskrit, Past/Present/Future Tense.

MODULE – II: SENTENCES

Simple Sentences

MODULE – III: ROOTS

Order, Introduction of roots

MODULE – IV: SANSKRIT LITERATURE
Technical information about Sanskrit Literature

MODULE – V: TECHNICAL CONCEPTS
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

V. TEXT BOOKS:
1. Suresh Soni, "India's Glorious Scientific Tradition", Ocean books (P) Ltd., New Delhi.

VI. REFERENCE BOOKS:
1. Dr.Vishwas, "Abhyaspustakam", Samskrita-Bharti Publication, New Delhi.

VII. WEB REFERENCES:
1. http://learnsanskritonline.com/

VIII. E-TEXT BOOKS:
1. Prathama Deeksha-Vempati Kutumb Shastri, "Teach Yourself Sanskrit", Rashtriya Sanskri Sansthanam, New Delhi Publication.

COURSE CONTENT

VALUE EDUCATION								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BHSD05	**Audit**	-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

In the course on value education, students emerge with a heightened sense of self-awareness, a strong moral foundation, and the skills necessary for personal and professional success. They are equipped with the knowledge and tools to navigate ethical challenges, contribute positively to society, and lead a purposeful and fulfilling life based on their core values and principles.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The value of education and self- development.
II. Imbibe good values in students.
III. The importance of character.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Understand the significance of ethical human conduct and self-development
CO 2 Adopt value-based living and holistic technologies to save nature
CO 3 Inculcate positive thinking, dignity of labor and religious tolerance
CO 4 Develop the overall Character and Competence through self-management
CO 5 Practice Self-control. Honesty through Studying effectively all religious messages

IV. SYLLABUS:

MODULE – I: VALUES AND SELF-DEVELOPMENT

Values and self-development. Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments.

MODULE – II: CULTIVATION OF VALUES

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

MODULE – III: PERSONALITY AND BEHAVIOR DEVELOPMENT

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labor. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth.

Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

MODULE – IV: CHARACTER AND COMPETENCE

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women.

MODULE – V: SELF CONTROL

All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

V. TEXT BOOKS:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press,
New Delhi.

VI. WEB REFERENCES:

1. http://www.best-personal-development-books.com/personal-value-development.html
2. http://nptel.ac.in/courses/109104068/

VII. E-TEXT BOOKS:

1. R.P. Shukla, “Value education and human rights”.

COURSE CONTENT

CONSTITUTION OF INDIA								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BHSD06	**Audit**	-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

The course on the Constitution of India provides students with a comprehensive understanding of the historical context, principles, and structure of the Indian Constitution. It explores the journey and philosophy behind the making of the Indian Constitution, highlighting the vision and ideals of the founding fathers.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The premises informing the twin themes of liberty and freedom from a civil right perspective.
II. The growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
III. The role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Describe historical background of the constitution making and its importance for building a democratic India.
CO 2	Understand the Constitutional Rights and and duties
CO 3	Explain the functioning of three wings of the government i.e., executive, legislative and judiciary
CO 4	Analyse the decentralization of power between central, state and local self-government.
CO 5	Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy

IV. SYLLABUS:

MODULE – I: HISTORY OF MAKING OF THE INDIAN CONSTITUTION & PHILOSOPHY OF THE INDIAN CONSTITUTION

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features.

MODULE – II: CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

MODULE – III: ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive President, Governor, Council of Minister, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

MODULE – IV: LOCAL ADMINISTRATION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zilla Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

MODULE – V: ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

V. TEXT BOOKS:

1. Dr. S. N. Busi, "Dr. B. R. Ambedkar framing of Indian Constitution", 1st Edition, 2015.
2. M. P. Jain, "Indian Constitution Law", Lexis Nexis, 7th Edition, 2014.

VI. REFERENCE BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

VII. WEB REFERENCES:

1. http://www.constitution.org/cons/india/p18.html

VIII. E-TEXT BOOKS:

1. https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text

COURSE CONTENT

PEDAGOGY STUDIES								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BHSD07	**Audit**	-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

In this course in pedagogy studies, students gain a solid foundation in educational principles and practices. They develop a deep understanding of effective teaching and learning strategies, empowering them to create engaging and meaningful learning experiences for their future students. Whether pursuing a career in teaching or any other field that involves knowledge transfer, students emerge with the knowledge and skills to inspire and facilitate learning, making a positive impact on the lives of others.

II. COUSE OBJECTIVES:

The students will try to learn:

I. Review existing evidence on the review topic to inform program design and policy making undertaken by the DFID, other agencies and researchers.
II. The critical evidence gaps to guide the development.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Identify the Methodology and conceptual framework of teachers education
CO 2 Understand pedagogical practices are being used by teachers in formal and informal classrooms in developing countries
CO 3 Interpret the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners
CO 4 Classify the importance of class room practice, curriculum and learning in Professional Development.
CO 5 Summarize teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy

IV. SYLLABUS:

MODULE – I: INTRODUCTION

Introduction And Methodology: Aims and rationale, Policy background, Conceptual framework and terminology. Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

MODULE – II: THEMATIC OVERVIEW

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

MODULE – III: PEDAGOGICAL PRACTICES

Evidence on the effectiveness of pedagogical practices. Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change.

Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE – IV: PROFESSIONAL DEVELOPMENT

Professional Development: alignment with classroom practices and follows up Support. Peer support. Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources
and large class sizes.

MODULE – V: RESEARCH GAPS

Research gaps and future directions, Research design**,** Contexts**,** Pedagogy**.** Teacher education**.** Curriculum and assessment**.** Dissemination and research impact.

V. TEXT BOOKS:

1. Ackers J, Hardman F, "Classroom interaction in Kenyan primary schools", Compare, 31 (2), 245-261.
2. Agrawal M, "Curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379.

VI. REFERENCE BOOKS:

1. AkyeampongK, "Teacher training in Ghana - does it count?" Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving Teaching and Learning of Basic Maths and
   Rreading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282.

VII. WEB REFERENCE:

1. www.pratham.org/images/resource%20working%20paper%202.pdf.
2. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education Oxford and Boston: Blackwell

VIII. E-TEXT BOOKS:

1. www.pratham.org/images/resource%20working%20paper%202.pdf.

COURSE CONTENT

STRESS MANAGEMENT BY YOGA								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD08	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

In a course on stress management by yoga, engineering students learn a variety of yoga techniques and principles that promote physical, mental, and emotional well-being. These techniques include yoga postures (asanas), breathing exercises (pranayama), meditation, and relaxation techniques.

II. COURSE OBJECTIVES:

The students will try to learn:

I. How to achieve overall health of body and mind.
II. How to overcome stress.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Understand Ashtanga yog and its impartance

CO 2 Identify the Dos and Do nots of Life by practicing the Yam and Niyam

CO 3 Interpret the Shaucha and its components

CO 4 Make use of breathing techniques and Asan and Pranayam

CO 5 Develop healthy mind in a healthy body thus improving social health also

IV. SYLLABUS:

MODULE – I: INTRODUCTION

Definitions of Eight parts of yog. (Ashtanga)

MODULE – II: YAM AND NIYAM

Yam and Niyam. Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha.

MODULE – III: SHAUCHA

Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE – IV: ASAN AND PRANAYAM

Asan and Pranayam. Various yog poses and their benefits for mind & body

MODULE – V: BREATHING TECHNIQUES

Regularization of breathing techniques and its effects-Types of pranayam

V.TEXT BOOKS:

1. Swami Vivekananda, “Rajayoga or conquering the Internal Nature”, Advaita Ashrama (Publication Department), Kolkata.

VI.REFERENCE BOOKS:

1. Janardan Swami, “Yogic Asanas for Group Tarining-Part-I”, Yogabhyasi Mandal, Nagpur.

VII. WEB REFERENCES:

1. https://americanyoga.school/course/anatomy-for-asana/
2. https://www.yogaasanasonline.com/

VIII. E-TEXT BOOKS:

1. Todd A. Hoover, M. D. D., Ht, “Stress Management by Yoga”.

COURSE CONTENT

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD09	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

In this course, students delve into various aspects of personal development and self-awareness. They learn techniques to improve self-confidence, self-esteem, and self-awareness, which are vital for thriving in their engineering careers. Students explore their strengths, weaknesses, values, and beliefs, enabling them to develop a clearer understanding of themselves and their goals.

II. COURSE OBJECTIVES:

The students will try to learn:

I. How to achieve the highest goal happily.
II. How a person become with stable mind, pleasing personality and determination.
III. Awaken wisdom in students.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Summarize steps to develop personality with stable mind, pleasing manners and determination.

CO 2 Identify day to day work and duties for developing peace and prosperity as depicted in Geeta.

CO 3 Formulate the daily life style by depicting the verses from Bhagavatgeetha.

CO 4 Outline the verses of Shrimad Bhagavad Geetha for holistic development.

CO 5 Demonstrates personality development by verses of Bhagavatgeetha.

IV. SYLLUBUS:

MODULE – I: HOLISTIC DEVELOPMENT

Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue),Verses- 52,53,59 (dont's),Verses- 71,73,75,78 (do's)

MODULE – II: BHAGWAD GEETA

Approach to day to day work and duties. Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48. Chapter 3- Verses 13, 21, 27, 35.

MODULE – III: BHAGWAD GEETA

Shrimad BhagwadGeeta: Chapter 6-Verses 5, 13, 17, 23, 35, Chapter 18-Verses 45, 46, 48.

MODULE – IV: BASIC KNOWLEDGE

Statements of basic knowledge. Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68. Chapter 12 - Verses 13, 14, 15, 16,17, 18

MODULE – V: ROLE MODEL

Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39. Chapter18 – Verses 37,38,63

V. TEXT BOOKS:

1. P.Gopinath, “Bhartrihari’s Three Satakam (Niti-sringar-vairagya)”, Rashtriya Sanskrit Sansthanam, New Delhi.

VI. REFERENCE BOOKS:

1. Swami Swarupananda, “Srimad Bhagavad Gita”, Advaita Ashram (Publication Department), Kolkata.

VII. WEB REFERENCES:

1. http://openlearningworld.com/section_personality_development.html

VIII. E-TEXT BOOKS:

1. http://persmin.gov.in/otraining/UNDPProject/undp_UNITs/Personality%20Dev%20N%20DLM.pdf

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

UNDERTAKING BY STUDENT/PARENT

"To make the students attend the classes regularly from the first day of starting of classes and be aware of the College regulations, the following Undertaking Form is introduced which should be signed by both student and parent. The same should be submitted to the Dean, Academic".

I, Mr./Ms ---------- joining I Semester for the academic year 2023-2024 in Institute of Aeronautical Engineering, Hyderabad, do hereby undertake and abide by the following terms, and I will bring the ACKNOWLEDGEMENT duly signed by me and my parent and submit it to the Dean of Academic.

1. I will attend all the classes as per the timetable from the starting day of the semester specified in the institute Academic Calendar. In case, I do not turn up even after two weeks of starting of classes, I shall be ineligible to continue for the current academic year.
2. I will be regular and punctual to all the classes (theory/practical/drawing) and secure attendance of not less than 75% in every course as stipulated by Institute. I am fully aware that an attendance of less than 75% in more than three courses will make me lose one year.
3. I will compulsorily follow the dress code prescribed by the college.
4. I will conduct myself in a highly disciplined and decent manner both inside the classroom and on campus, failing which suitable action may be taken against me as per the rules and regulations of the institute.
5. I will concentrate on my studies without wasting time in the Campus / Hostel / Residence and attend all the tests to secure more than the minimum prescribed Class / Sessional marks in each course. I will submit the assignments given in time to improve my performance.
6. I will not use Mobile Phone in the institute premises and also, I will not involve in any form of ragging inside or outside the campus. I am fully aware that using mobile phone to the institute premises is not permissible and involving in Ragging is an offence and punishable as per JNTUH/UGC rules and the law.
7. I declare that I shall not indulge in ragging, eve-teasing, smoking, consuming alcohol drug abuse or any other anti-social activity in the college premises, hostel, on educational tours, industrial visits or elsewhere.
8. I will pay tuition fees, examination fees and any other dues within the stipulated time as required by the Institution / authorities, failing which I will not be permitted to attend the classes.
9. I will not cause or involve in any sort of violence or disturbance both within and outside the college campus.
10. If I absent myself continuously for 3 days, my parents will have to meet the concerned HOD / Principal.
11. I hereby acknowledge that I have received a copy of MT23 Academic Rules and Regulations, Syllabus copy and hence, I shall abide by all the rules specified in it.

ACKNOWLEDGEMENT

I have carefully gone through the terms of the undertaking mentioned above and I understand that following these are for my/his/her own benefit and improvement. I also understand that if I/he/she fail to comply with these terms, shall be liable for suitable action as per Institute/JNTUH/AICTE/UGC rules and the law. I undertake that I/he/she will strictly follow the above terms.

Signature of Student with Date

Signature of Parent with Date
Name & Address with Phone Number