Sanjay Ghodawat University
Kolhapur

Established under section 2 (f) of UGC Act 1956
Sanjay Ghodawat University Act XL of 2017 of Govt. of Maharashtra
Approved by PCI, COA & AICTE

Empowering Lives Globally !

School of Technology

Electronics Engineering

M.Tech. Curriculum

Academic Year 2021-22

Sanjay Ghodawat University

Kolhapur

School of Technology

Department of Electronics Engineering

M. Tech. Electronics Engineering
(Embedded Systems)

Syllabus

(Programme Structure and Course Contents)

Academic Year 2021 - 22

Sanjay Ghodawat University (SGU) is established in the Academic Year 2017-18, as a State Private University under Govt. of Maharashtra Act No. XL of 2017 dated 3rd May 2017, with the approval of the UGC and the state Government. "For the true measure of giving is giving without measure." Spread across 150 Acres, Sou. Sushila Danchand Ghodawat Charitable Trust's Sanjay Ghodawat University (SGU) is situated in serene atmosphere amidst idyllic hills and lush green meadows to study in harmony with Nature. The Institution aspires to run along the lines of best-in- the-world education and become a world-class institution where teaching-learning process gets a far deeper meaning. SGU always stands as the guiding star of brilliance, quality and deliverance beyond expectations. Innovativeness and Creativity are the hallmarks of a genius enterprise and SGU stands to be a stage where these qualities would be nurtured, encouraged and blossomed. The genius is incomplete without the sense of social responsibility and SGU's ultimate goal remains the development of an attitude of gratitude that freely gives back without expectations.

The Sanjay Ghodawat University stands as a beacon of light to guide the younger generation of the day on the right path to fulfilment in career and life. The USP of the University is its research based curriculum and academically oriented teaching staff. The world class ambience and infrastructure helps the students to easily accommodate themselves in an environment that is conducive to the teaching- learning process. Hands on experience, challenge based case studies, maximum participation of students in the classroom, use of modern digital technology, smart classrooms, solution oriented thinking promotion, stress on research and innovation, international tie ups, choice based credit system for flexibility in choosing areas of interest etc. are some of the features of the University.

The university will help students develop as a unique individual-to be educated as a whole person, intellectually, emotionally, socially, ethically, and spiritually. The educational program designs are worked out meticulously in line with best in class universities with special focus on:

- Flexible Choice Based Credit System
- OBE - Outcome Based Education System
- Experiential Learning
- Project Based Learning
- Case Based Learning
- Training need analysis based on Performance Appraisal System
- Active Learning tools for effective delivery
- Mentoring / Proctorship
- On line learning /Self learning platforms
- Flipped Classroom concept
- Effective Student Feedback Mechanism

VISION

Internationally recognized university of excellence in creating and disseminating knowledge through value-based quality education leading to betterment of mankind.

MISSION

- To prepare students for life-long learning and leadership in a global academic culture
- To create intellectual manpower relevant to the industry and society at large
- To collaborate with institutions of international repute for academic excellence
- To promote research and development through conducive environment
- To encourage entrepreneurship and skill development programs

CORE VALUES

- Integrity
- Transparency
- Accountability
- Equality
- Empathy
- Stewardship

QUALITY POLICY

Sanjay Ghodawat University is committed to establish high standards in value-based quality education to enhance and nurture young minds to excel in their chosen profession and develop into socially responsible citizens through resourceful collaboration, innovation and research

CHOICE BASED CREDIT SYSTEM (CBCS)

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.

University Grants Commission has come up with the Choice Based Credit System (CBCS) programme in which the students have a choice to choose from the prescribed courses, which are referred as core, elective or minor or soft skill courses and they can learn at their own pace and the entire assessment is graded-based on a credit system. The basic idea is to look into the needs of the students so as to keep up-to-date with development of higher education in India and abroad. CBCS aims to redefine the curriculum keeping pace with the liberalization and globalization in education. CBCS allows students an easy mode of mobility to various educational institutions spread across the world along with the facility of transfer of credits earned by students.

Where the students can choose the prescribed courses, as the core, and elective or soft skill courses, from a range of options, rather than to simply consume what the curriculum offers. They can learn at their own pace and the assessments are graded based on a credit system. It provides an opportunity for students to have a choice of courses or subjects within a programmed resembling a buffet, against the mostly fixed set of subjects now being offered (except for the limited choice of electives in professional degrees and postgraduate programmers) with the flexibility to complete the programmed by earning the required number of credits at a pace decided by the students.

The UGC has always initiated measures to bring efficiency and excellence in the Higher Education System of India. The basic motive is to expand academic quality in all aspects, right from the curriculum to the learning-teaching process to examination and evaluation systems. However, so far multiple methods are followed by different universities across the country towards examination, evaluation and grading system. Considering this diversity, the implementation of the choice based credit system seems to be a good system in assessing the overall performance of a student in a universal way of a single grading system.

OUTCOME BASED EDUCATION (OBE) MODEL

Sanjay Ghodawat University (SGU) has implemented OBE model of education, which is a learner centered approach. SGU has witnessed a sea change in the entire academic systems with implementation of all three components of OBE – Design, Delivery and Assessment. The SGU model of autonomy focuses on experiential learning which believes in learning by doing. This is achieved through hands on experience, industrial assignments, mini projects and live problem solving and collaboration with industries.

SGU is set in to dynamics of transformation and witnessing a shift in focus from teaching to learning and entire academic system of SGU is designed to provide multiple learning opportunities for students to acquire and demonstrate the Knowledge, Skills and Attitudes (KSA) for rewarding career.

The Vision and Mission of the Management, contribution from eminent BOG members and knowledgeable members of Academic Council and Board of Studies, the motivation and drive of the Director, the relentless efforts of the fellow Deans and Head of Departments and all teaching and non-teaching staff along with commitment to learning of students made it possible to successfully transform the institute and stand out to carve a niche for itself as an Institute of repute.

OBE is an approach of curriculum design and teaching that focuses on what students should be able to do (attained) at the end of course/ program. Outcome based education (OBE) is student-centered instruction model that focuses on measuring student performance through outcomes. Outcomes include knowledge, skills and attitudes (KSA). Its focus remains on evaluation of outcomes of the program by stating the knowledge, skill and behavior a graduate is expected to attain upon completion of a program and after 4 – 5 years of graduation. In the OBE model, the required knowledge and skill sets for a particular degree is predetermined and the students are evaluated for all the required parameters (Outcomes) during the course of the program.

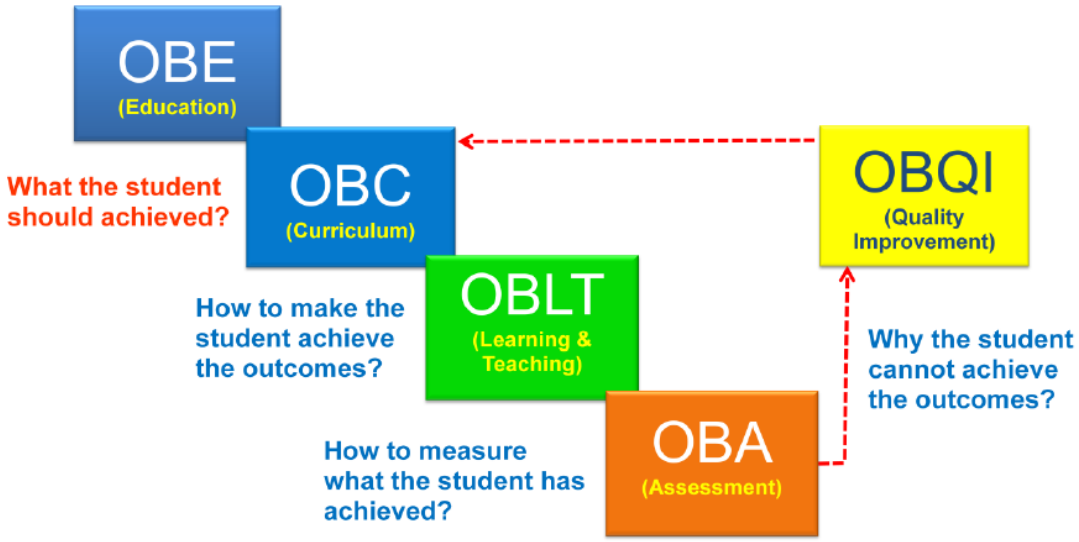
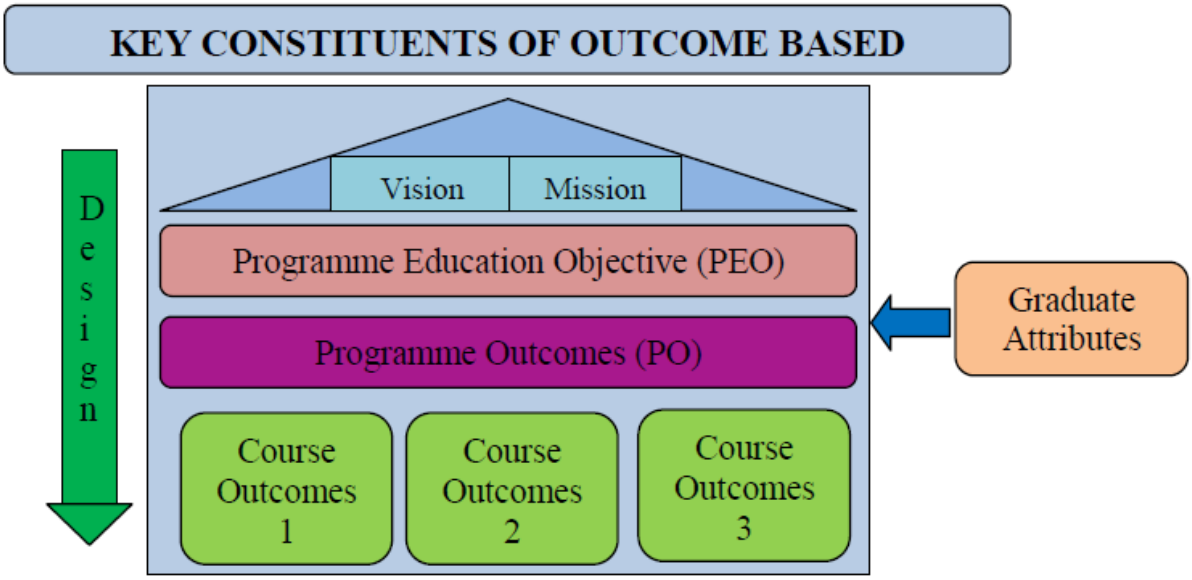


Figure 1: OBE flows and desciption

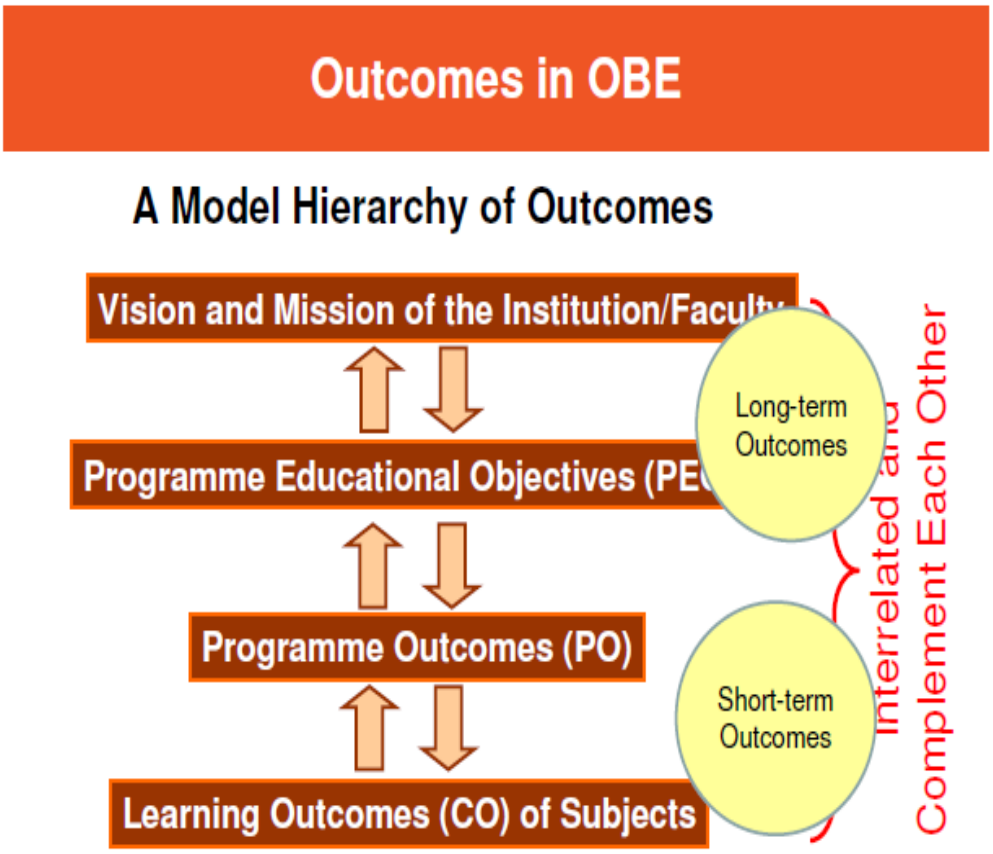


The OBE model measures the progress of the graduate in three parameters, which are

- Program Educational Objectives (PEO)
- Program Outcomes (PO)
- Course Outcomes (CO)

Program Educational Objectives (PEO) are broad statements that describe the career and professional accomplishments that the program is preparing the graduates to achieve. PEO's are measured 4-5 years after graduation. Program outcomes are narrower statements that describe what students are expected to know and be able to do by the time of graduation. They must reflect the Graduate attributes. Course outcomes are the measurable parameters which evaluates each students performance for each course that the student undertakes in every semester.

The various assessment tools for measuring Course Outcomes include Tests and End Semester Examinations, Tutorials, Assignments, Project work, Labs, Presentations, Employer/Alumni Feedback etc. These course outcomes are mapped to Graduate attributes and Program outcomes based on relevance. This evaluation pattern helps Institutions to measure the Program Outcome. The Program Educational Objective is measure through Employer satisfaction survey (Yearly), Alumni survey (Yearly), Placement records and higher education records.



Special Features of OBE

- OBE is an educational process that focuses on what students **can do** or the **qualities** they should develop after they are taught.
- OBE involves the restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of high order learning and mastery rather than accumulation of course credits.
- Both structures and curricula are designed to achieve those **capabilities** or **qualities**.
- Discourages traditional education approaches based on direct instruction of facts and standard methods.
- It requires that the students demonstrate that they have learnt the required skills and content.

Sanjay Ghodawat University Kolhapur

(Established as a State University under Government of Maharashtra Act No XL dated 3rd May 2017)

Academic and Examination Rules and Regulations

Approved in the second Academic Council Meeting held on 27th May, 2019 and to be implemented from academic year 2019-20. [Version R1]

Sanjay Ghodawat University Kolhapur

Kolhapur - Sangli Highway, A/p Atigre - 416 118,
Tal. - Hatkanangale, Dist. Kolhapur,
Maharashtra, India

(Implemented from Academic year 2019-20)

Academic and Examination Rules and Regulations

1.0 Preamble

The Sanjay Ghodawat University (SGU) stands as a beacon of light to guide the younger generation of the day on the right path to fulfillment in career and life. Outcome Based Education (OBE) model is adopted to enhance the effectiveness of teaching learning process and Credit Based semester system is implemented.

The focus of the University is its research based curriculum and academically oriented teaching staff. The world class ambience and infrastructure helps the students to easily accommodate themselves in an environment that is conducive to the teaching- learning process. Hands on experience, challenge based case studies, maximum participation of students in the classroom, use of modern digital technology, smart classrooms, solution oriented thinking promotion, stress on research and innovation, international tie ups, choice based credit system for flexibility in choosing areas of interest etc. are some of the features of the University.

Vision of SGU is internationally recognized university of excellence in creating and disseminating knowledge through value-based quality education leading to betterment of mankind. To achieve the vision SGU will develop state-of-the-art infrastructure that promotes conducive ambience promoting innovation and research. Create intellectual manpower relevant to the industry and society at large. Foster mutually beneficial partnership with alumni, industry and academia. Inculcate ethics and values to develop socially responsible citizens and promote entrepreneurship.

SGU is offering various programs through schools such as School of Technology, School of Commerce and Management, School of Sciences and School of Arts.

SGU has implemented the outcome based Education (OBE) system and Credit based Evaluation System in all the schools.

The rules and regulations mentioned in this document are applicable to all the Under Graduate (UG) and Post Graduate programs offered by the Sanjay Ghodawat University from the academic year 2018-19. The rules and regulations stated here under are subjected to revisions / refinements, updates and modifications and amendments by academic council (AC) from time to time and applicable to all batches including those already undergoing programs at different year and are binding on all stakeholders including students, faculty, parents and University authorities.

The academic programs of the University shall be governed by rules and regulations approved by the academic council from time to time. Academic council is the supreme and statutory academic body that governs all academic matters of the university and the decisions of the academic council are final and binding in the matters related to academics.

2.0 Definition of Terms

1. University: University means Sanjay Ghodawat University, Kolhapur
2. Academic Year: The period of the year during which students attend university for all academic activities, usually it starts from first of July and ends on 30th of June next year.
3. **Semester:** Academic Year is divided in to 2 parts called Semester, Odd Semester which starts from July and Even Semester which starts from January.
4. **Duration of Semester**: Total duration of semester is usually 20weeks per semester including instructions, examination and evaluation. Total instructional days are 90 per semester.
5. **Course:** It is a Subject that is in a semester. The course may consist of Theory/Practical/Project/Seminar during semester. Usually taught by instructor in a class. e.g. Physics, Chemistry, Engineering Mechanics, Workshop etc.
6. **Program:** Collection of Courses is called Program. B Tech in Mechanical Engineering,
7. M Tech in Civil Engineering, Bachelor of Business Administration. Bachelor of Science etc.
8. **Department:** Department is a unit of the school which offers one or more programs.
9. **Contact Hours:** Time of students in class/laboratory with instructor. Usually in the range of 26-30 Hrs./Week. For the purpose of uniformity one contact hour is measured as 60 minutes
10. **Academic Council (AC):** Means apex academic body governing the academic programs responsible for framing policy, rules and regulations.
11. **Board of Examination (BOE):** Central body responsible for framing policy, rules and regulations for Examination.
12. **Board of Studies (BOS):** Departmental academic body to govern the academics of programs(BOS)offered by department.

3.0 Curriculum:

3.1. Curriculum:

Every program has a prescribed structure which, in general, is known as Curriculum. It prescribes courses to be studied in each semester. The booklet containing courses structure along with detail syllabus for each course of each program is updated periodically and made available on the website.

3.2. Semesters:

SGU implements a credit based semester system. The academic year is divided into two regular semesters. The semesters that begin in July are known as Odd semester and the semester that begin in January are known as Ev

en semesters. Total duration of each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

3.3. Course Credit System/Structure:

In general, a certain quantum of work measured in terms of credits is laid down as the requirement for a particular program. Calculation of number of credits

for a course in any semester is as per Table 3.1

Table 3.1: Calculation of number of credits for a course

Sr. No.	Course	Credits
1	Lecture of 1 hour/week	**1**
2	Tutorial of 1 hour/week	**1**
3	Practical / Laboratory / Drawing/mini-project of two hours/ week	**1**
4	Seminar (1 hour per week)	**1**

There are mainly two types of courses- viz. Theory courses and Laboratory courses. Generally a theory course consists of Lecture hours (L) and Tutorial hours (T). Tutorial hours may not be assigned to a particular theory course if it has a separate laboratory course. Laboratory course consists of practical hours (P) for which a student works in a Laboratory/Drawing Hall/Workshop. The other courses required to be taken by a student include seminar, mini project, and project at various levels of the program.

A student shall earn credits for a particular course by fulfilling the minimum academic requirements for attendance and evaluation. No credits shall be awarded if a student satisfies the minimum attendance requirements but fails to meet minimum evaluation requirements.

The total number of credits required for completing a program shall be mentioned in the course structure. The total number of credits in a semester which a student registers shall generally be 20--25. The maximum number of credits per semester shall not exceed 30

3.4 Audit Course:

3.4.1 A student may have to register for an audit course in a semester which could be institute requirement or department requirement.

3.4.2 An audit course may include either a) a regular course required to be done as per structure or required as pre-requisite of any higher level course or b) the programmes like practical training, industry visits, societal activities etc.

3.4.3 Audit course shall not carry any credits but shall be reflected in Grade Card as "PP”/"NP" depending upon the satisfactory performance in the semester evaluation as per the course curriculum structure.

4.0 Course Registration:

4.1 Every student must register for the courses that he/she wants to study for earning credits at the beginning of each semester on the prescribed dates announced from time to time and shall be mandatory for every student till

he/she completes the program. Only after registration his/her name shall appear in the roll list of each of such courses.

4.2 Students shall be required to fill up a Course Registration Form which shall be made available to them by the Student section of Administration office after payment of required fees.

4.3 Registration, according to rules, should be carried out as per the schedule given in academic calendar. Late registration may be permitted only for valid reasons and on payment of late registration fees. In any case, registration must be completed before the prescribed last date for registration, failing which his/her studentship shall be liable to be cancelled. Students having dues outstanding towards the institute or hostel shall be permitted to register only after clearing such dues.

4.4 In-absentia registration may be allowed only in rare cases at the discretion of the Dean Academics and with prior permission.

4.5 For registration in an odd semester, the student must have earned all the credits of the pre-previous year and at least 75% credits of the previous year. For example, for registration of the 5th semester courses (i.e. 3rd year of program), a student must have earned all the credits of the first year and 75% credits of the second year. Similarly, for registration of the 7th semester courses (i.e. 4th year of program), a student must have earned all the credits of the second year and 75% credits of the third year. However, if 75% calculation turns out to be a mixed number (integer + fraction) then only the integer part of that number shall be considered for taking decision related with this clause.

4.6 A student registered in odd semester shall be eligible to register for the courses offered in the even semester of that year irrespective of his/her SGPI or the number of credits earned by him/her in that odd semester.

5 .0 Lateral Entry for B Tech Programs

Post diploma students in engineering and B.Sc. Graduates can have lateral entry at third semester of the program. Such admissions are governed by the rules of regulatory bodies like AICTE New Delhi and Directorate of Technical Education Maharashtra state and Sanjay Ghodawat University for Admission criteria and shall undergo all academic requirements as specified by the Academic council.

For such students there shall not be First Year Performance Index (FYPI). Semester Performance Index (SGPI) and Cumulative Performance Index (CGPI) shall be calculated from the third semester onwards taking into consideration the courses undergone by them at Sanjay Ghodawat University Kolhapur.
Registration of the students not covered by the cases mentioned above shall be decided by the Academic Council. Such students shall undergo the academic program as specified by the Academic Council. Such odd entry students shall not be eligible for any medals or awards instituted by the institute.

6.0 Change of Program:

This is applicable to B Tech Program only. Students shall be eligible to apply for Change of Program after completing the first two semesters. The following rules/ guidelines shall be used for considering their applications for change:

6.1 The change of program shall be permitted strictly on merit basis subject to the rules of admissions prevailing at the time of such change.

6.2 Students without fail grades and/or backlogs shall be eligible to apply for change of program and can give their choices in the order of preference.

6.3 The request for change of program by a student from program A to program B shall be considered if number of students of program B does not exceed the sanctioned capacity of program B and also the minimum strength required to run the program as decided by Academic Council.

6.4 All such transfers can be effected only once at the beginning of the second academic year of the 4-year UG program. No application for change of program during subsequent academic years shall be entertained.

7.0 Facilitation to Students:

7.1 Faculty Advisor:

On joining the institute, a student or a group of students shall be assigned to a faculty advisor who shall be mentor for a student throughout his/her tenure in the institute. A student shall be expected to consult the faculty advisor on any matter relating to his/her academic performance and the courses he/she may take in various semesters / summer term. A faculty advisor shall be the person to whom the parents/guardians should contact for performance related issues of their ward. The role of a faculty advisor is as outlined below:

The role of the Faculty Adviser is outlined below:

a. Guide the students about the rules and regulations governing the courses of study for a particular degree.
b. Advise the students for registering courses as per curriculum given. For this purpose, the Faculty Adviser has to discuss with the student his/her academic performance during the previous semester and then decide the number and nature of the courses for which s/he can register during the semester as per the curriculum.
c. Approve the registration of the students.
d. Advice students to overload/ drop one or more courses/activities based on her/his academic performance as per the prescribed rules.
e. At the end of the first semester/year, the Faculty Adviser may even advise a reduced load program for a poorly performing student.
f. Pay special attention to weak students and carefully monitor performance of students recommended for slow track option.

g. Advice students for Course Adjustment / Dropping of courses during the Semester within the stipulated time frame given in the Academic calendar.
h. Advice students seeking semester drop either during the ongoing semester or before the commencement of the semester. FA has to ensure strict compliance of rules and regulations laid down for this purpose. Recommend the cases to the appropriate authorities for consideration.
i. Make revised plan of study for weak/bright students based on their semester wise performance.
j. Suggest modalities for course/credit requirements for the students recommended for exchange program.
k. Guidance and liaison with parents of students for their performance.
l. To ensure that students are not permitted to re-register for courses, which they have already passed.
m. Inform students that any academic activity (course / Lab. / seminar / project / noncredit requirement etc.) undergone without proper registration will not be counted towards the requirements of his/her degree.
n. Strictly warn students that if she/he fails to register during any semester without prior approval, his/her studentship is liable to be cancelled.
o. Keep the students updated about the Academic Administration of the University.

7 .2. Helping Weaker Students:

A student with backlog/s should continuously seek help from his/her faculty advisor, Head of the Department and the Dean of respective schools. Additionally, he/she must also be in constant touch with his/her parents/local guardians for keeping them informed about academic performance. The university also shall communicate to the parents/guardians of such student at-least once during each semester regarding his/her performance in in-in various tests and examination and also about his/her attendance. It shall be expected that the parents/guardians too keep constant touch with the concerned faculty advisor or Head of the Department, and if necessary - the Dean of the respective school.

8.0 Discipline and Conduct:

8.1 Every student shall be required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity, which shall tend to bring down the prestige of the university.

8.2 Any act of indiscipline of a student reported to the Dean, Student Development, shall be discussed in a Disciplinary Action Committee of the institute. The Committee shall enquire into the charges and recommend suitable punishment if the charges are substantiated.

8.3 If a student while studying in the university is found indulging in anti-national activities contrary to the provisions of acts and laws enforced by Government he/she shall be liable to be expelled from the institute without any notice.

8.4 If a student is involved in any kind of ragging, the student shall be liable for strict action as per provisions in the Maharashtra anti-ragging act.

8.5 If any statement/information supplied by the student in connection with his/her admission is found to be false/ incorrect at any time, his/ her admission shall be cancelled and he/she shall be expelled from the university and fees paid shall be forfeited.

8.6 If a student is found guilty of malpractice in examinations then he/she shall be punished as per the recommendations of the Grievance Redressed Committee (CRC) constituted by Board of Examinations.

8.7 Every admitted student shall be issued photo identification (ID) card which must be retained by the student while he/she is registered at Sanjay Ghodawat University Kolhapur. The student must have valid ID card with him/her while in the University Campus.

8.8 Any student who alters or intentionally mutilates an ID card or who uses the ID card of another student or allows his/her ID card to be used by another, student shall be subjected to disciplinary action.

8.9 The valid ID card must be presented for identification purpose as and when demanded by authorities. Any student refusing to provide an ID card shall be subjected to disciplinary action.

8.10 Students should switch off the Mobiles during the Instructional hours and in the academic areas of university Building, Library, Reading room etc. Strict action will be taken if students do not adhere to this.

8 .11 during the conduct of any Tests and Examination students must not bring their mobiles. A student in possession of the mobile whether in use or switched off condition will face disciplinary action and will be debarred from appearing for the Test / Examination.

9.0 Academic Calendar

The academic activities of the institute are regulated by Academic Calendar and is made available to the students/ faculty members and all other concerned in electronic form or hard copy. It shall be mandatory for students / faculty to strictly adhere to the academic calendar for completion of academic activities

10.0 Attendance:

10.1 Regular 100% attendance is expected from all students for every registered course in lectures, tutorial, laboratory, projects, mini-projects and other courses mentioned in program curriculum. Hence, attendance is compulsory and shall be monitored during the semester rigorously. Students shall be informed at the end of every month if they are failing short of attendance requirements.

10.2 A Maximum of 25% absence for the attendance may be permitted only on valid grounds such as illness, death in family of blood relations (Father, Mother, Sister, and

Brother) and any other emergency reason which is beyond the control of the student and shall be approved by the authorities in respective departments.

10.3 If a student fails to put up 75% attendance individually in each course, the student will be put under X grade category and student will be debarred form attending the End Semester Examination (ESE) and Re-Exam for that semester in that course. However, student has an option to re-register for the course whenever it is offered next time or he can appear for 100% examination for which he will be awarded two grade penalties. Student's FET, CAT1 and CAT2 marks are treated as null and void.

10.4 The maximum number of days of absence for students participating in Co-curricular activities /Sports/ Cultural events during a semester shall not exceed 10. Any waiver in this context shall be on the approval of the Academic council only after the recommendation by Dean Academics of the university

The HOD and Dean of the respective school shall report and recommend to Academic Academic council the cases of students not having 75% attendance as per the records of course instructor. After rigorously analyzing these cases AC may take a decision to debar such student from End-Semester Examination (ESE) for that course. Such a student shall re-register for that course as and when it is offered next. ISE and MSE evaluations of such a student for this course during regular semester shall be treated as null & void.

10.5 A student remaining absent during ESE of a course either on medical ground (Accident and/or hospitalization of a student) or any other emergency circumstances (death of immediate close relative i.e. father, mother, brother and sister) or due to representing University at university/state level in sports/co-curricular activities shall be treated as per the rules of Sec 12.6.2 and 11.1.2

The critical cases of absenteeism which are not covered by any of the above clauses shall be reported by concerned Head of Department to Academic dean and all such cases the decision of Academic council is final.

11.0 Modes of Assessment:

11.1 Assessment of Theory Courses:

11.1.1 A student shall be evaluated for his/her academic performance in a theory course through Faculty Evaluation Theory (FET), Continuous Assessment Tests (CAT1 and CAT2) and End Semester Examination (ESE).

11.1.2 The relative weightage for the theory courses having ESE shall be generally as shown in the Table 11.1.2

Table 11.1.2: Weightage for the theory courses in %

FET	CAT1	CAT2	ESE
20	15	15	50

The details of the weightage of each course shall be listed in the structures of each program.

11.1.3 FET shall be based on student's performance in assignments, quizzes, seminars, Course projects and field assignments, term papers, etc. The mode of FET shall be decided and announced by the Course Instructor at the beginning of the course.

11.1.4 CAT1 shall generally be of one hour duration for each course and shall be held as per the schedule declared in the Academic calendar for that Semester. The test will be based on first two units of the course.

11.1.5 CAT2 shall generally be of one hour duration for each course and shall be held as per the schedule declared in the Academic calendar for that semester based on unit 3 and unit 4 of the syllabus.

11.1.6 ESE is of three hours comprehensive examination having the weightage of 60% for unit 5 and 6 and 40% to unit 1 to unit 4. It is of 100 marks

11.1.6 All examinations and evaluations shall be compulsory. Credits for a course shall be awarded only if a student satisfies evaluation criteria and acquires the necessary minimum grade.

11.1.7 There shall be no re-examination for CAT1 and CAT2 of the courses having all the three components of evaluation viz. FET, CAT1 CAT2 and ESE. However, a student remaining absent for CAT1 and CAT2 for representing the institute in state level or university level sports/co-curricular activities (on prior recommendation and approval from) or on valid grounds such as illness, death in family or other emergency reason which is beyond control of a student (on approval by the head of department and dean of respective school shall be considered for Make- up examinations.

11.1.8 A student remaining absent for ESE of a course either due to medical reason (Accident and/or hospitalization of a student) or other emergency circumstances (death of immediate close relative i.e. father, mother, brother and sister) or due to representing college at university/state level in sports/co-curricular activities shall be awarded with grade "I". Such a student shall be allowed to appear for make-up examination scheduled along with re-examinations of other courses. The student shall apply to COE with proper documentary evidence to appear for make-up examination. After make-up examination, a student shall be entitled to an appropriate

grade as per Table I of Sec. 10.1.2 based on his/her performance during the regular semester and in make-up examination.

11.2 Assessment of Laboratory Courses:

11.2.1 The assessment of laboratory course shall be continuous and based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in viva-voce examinations uniformly distributed throughout the semester. Where ESE for the laboratory course is specified ESE shall be based on performing an experiment followed by an oral examination. The relative weightage for FEP and ESE for assessment of laboratory courses shall be 50% each for FEP and ESE and a minimum performance of 40% in both ISE and ESE separately shall be required to get the passing grade.

11.2.2 ESE for laboratory course shall normally be held before the ESE for theory courses and shall be conducted by a panel of examiners appointed by COE from the panel of experts approved by BOS. This activity shall be coordinated by Department Examination Coordinator (DEC) in consultation with HOD of the respective department.

11.2.3 Student failed in ESE of a laboratory course in a regular semester shall be eligible to appear for 100% examination conducted alongwith ESEs of laboratory courses of the subsequent semester. Such examination shall be fairly comprehensive (generally of 3 hours similar to POE i.e. Practical-Oral-Examinations) to properly judge his/her practical skill and theoretical knowledge for that laboratory course. He/She shall suffer one grade penalty.

12.0 The Grading System:

Absolute Grading System (AGS) is adopted based on absolute numerical marks obtained by the student during all stages of evaluation for a course.

12.1. Award of Grade (Regular Semester):

12.1.1 For every course registered by a student in a semester, he/she shall be assigned a grade based on his/her combined performance in all components of evaluation scheme of a course as per the structure. The grade indicates an assessment of the student's performance and shall be associated with equivalent number called a grade point.

12.1.2 The academic performance of a student shall be graded on a ten point scale. The Absolute Grading System is followed. Letter grades, the guidelines for conversion of marks to letter grades and their equivalent grade points are as given in Table 12.1.2

Table 12.1.2: Grade Table for Regular Semester

Marks Obtained	Grade Letter GL	Grade Point GP	Performance Description
90-100	**O**	**10**	Outstanding
80-89	**A+**	**09**	Excellent
70-79	**A**	**08**	Very Good
60-69	**B+**	**07**	Good
50-59	**B**	**06**	Above Average
45-49	**C**	**05**	Average
40-44	**P**	**04**	Pass
00-39	**F**	**00**	Fail
-	**Ab**	**00**	Absent
-	**X**	**00**	Detained (Failed)
-	**Satisfactory**	**-**	Pass in Non Credit Courses
-	**Un Satisfactory**	**-**	Failed in Non Credit Courses

12.1.3 A student shall pass the course if he/she gets any grade in the range "O" to "P".

12.1.4 “FF" grade shall be awarded to a student in a course if he/she gets less than 40% marks jointly in the FET, CAT1, and CAT2 & ESE for a theory course and in PET & ESE for a laboratory course. A course shall then be eligible to apply for re-examination. A student failed in laboratory course shall be eligible to apply only for 100% examination conducted with the laboratory examinations of the subsequent semester. In both cases, a student has to suffer one grade penalty.

13.0 Assignment of X Grade

Grade "X" in a regular course shall be given to a student if he/she falls in any of the following categories.

13.1 A student does not maintain the minimum 75% attendance in any of the theory or laboratory courses.

13.2 A student has not completed most of the Evaluations like FET, CAT1 and CAT2 due to non-medical reasons (for example when a student has missed all or most of the components of internal evaluation conducted by the instructor in that semester).

13.3 The performance of a student is less than 40% in FET, CAT1 and CAT2 Combined.

13.4 A student is guilty of any academic malpractice during semester (Such cases shall be dealt by Grievance Redressed and Discipline Committee).

In above four cases grade "X" shall be declared one week before ESE and intimated to the Academic Office and COE immediately thereafter. Such a student shall not be permitted to take the ESE of that course.

13.5 Grade "X" may be given to a student if

13.5.1 A student eligible for ESE remains absent for ESE of a course with no written intimation to Exam Cell within four days after the respective ESE is over.

13.5.2 A student is guilty of any academic malpractice during examination. (Such cases shall be dealt by Grievance Redressal Committee).

In 13.5.2 grade "X" in that course shall be declared after Grievance Redressed Committee confirms the academic malpractice.

In above two cases when a student gets "X " grade in a course, then this shall be treated as "FF" for the purpose of calculation of Semester Performance Index (SGPI) and First Year Performance Index (FYPI) or Cumulative Performance Index (CGPI).

13.6 Following rules apply to the student who has obtained grade "X" in a regular semester:

13.6.1 A student obtaining grade "X" in a course in a regular semester or during examination shall be not be allowed to appear for End semester examination and also Re ESE conducted before the beginning of the next semester. His/her FET, CAT1 and CAT2 evaluations for all courses shall be treated as null and void. He/She needs to re-register for courses of that semester in the next academic year whenever they are offered and undergo all evaluations along with fresh regular students for which he will get one grade penalty.

13.6.2 Grade "I" shall be declared in a theory/laboratory course if a student has satisfactory performance FET, CAT1, CAT2 and has fulfilled the 75% attendance

requirement, but has not appeared for ESE due to genuine reasons. Such students shall be eligible for the make-up examination of ESE only on medical grounds/valid reasons and on production of authentic medical certificate or other supporting document/s (as required by the University) to the COE within ten days after the respective examination is over. The application form with requisite amount of fees must be submitted to the Exam Cell before the last date of filling such application forms for make-up examinations. These examinations shall be based on 100% syllabus and shall be scheduled before the commencement of the subsequent semester for theory courses and along with ESEs of laboratory courses of the subsequent semester. A student with "I" grade when appears for the make-up examination shall be eligible to obtain a regular performance grade ("O" to "F") as per Table 12.1.2 depending on his/her overall performance in FET, CAT1, CAT2 and make-up examination. If a student fails to appear for make-up examination too, a grade "XX" shall be awarded to him/her. Thus "I" is only a temporary grade and shall be replaced by a valid grade only after make-up examination.

13.6.3 There shall be a few audit courses as per the policies of the institute or as decided by DPC of respective program. The grade "PP" (Passed)/ "NP" (Not Passed) shall be awarded for such courses depending upon the performance of a student evaluated by the faculty in-charge. No grade points shall be associated with these grades and performance in these courses shall be not taken into account in the calculation of the performance indices (SGPI, CGPI). However, the award of the degree shall be subject to obtaining a "PP" grade in all such courses.

14.0 Award of Grades for Re-Examination:

14.1 A student who has obtained grade "F" in regular semester shall be eligible to appear for re-examination conducted before the commencement of the next regular semester. In such cases FET, CAT1 and CAT2 marks are carried forward and a student has to suffer one grade penalty

14.2 A student shall apply for re-examination before the last date of such application and shall appear for re-examination.

14.3 50% weightage similar to ESE shall be given to re-examination and there is one grade penalty.

14.3.1 A student who has obtained "F" grade in ESE of a regular semester and has not availed re-examination option or a student who has obtained "F" grade in both ESE and re-examination shall be eligible to choose one of the two options below to clear his/her backlog:

- Re-registration for the next regular semester course whenever that course is offered.
- Appearing for ESE of the course when conducted,

A student detained in a regular semester due to either a) by obtaining "X" grade or b) by involvement in academic malpractice or c) by breaking the institute code of conduct and discipline can re-register for the course when offered next

14.4 Following rules apply for these cases:

14.4.1 In first case i.e. Re- registration the earlier performance of a student in all the evaluations of that course shall be treated as null and void. The student has to undergo all the evaluations after re-registration.

14.4.2 Grades for Third and Subsequent attempts:

If A student opts for ESE or Re ESE who previously had obtained grade "F" in a course in two attempts, his/her FET, CAT1 and CAT2 performance of the regular semester shall be considered for evaluation and He/She has to suffer two grade penalty for the third attempt and for 4th and subsequent attempts shall be awarded a grade "P" or "F" or "X" based on his/her performance. However, if a student takes more than three chances (regular examination being the first chance, re-examination being the second chance, to clear a course, then the maximum passing grade that he/she can get shall be only "P". Thus a student has to suffer a grade penalty by accepting a lower grade than that obtained in the regular examination, re-examination, or examination for a re-registered course.

15.0 CALCULATION OF PERFORMANCE INDICES:

15.1. Semester Grade Point Average (SGPA)

The performance of a student in a one specific semester is indicated by SGPA. SGPA is a weighted average of the grade points obtained in all courses registered by the students during the semester. SGPA can be calculated by following equation.

$$SGPA = S_i = \frac{\sum_{i=1}^{n} C_i P_i}{\sum_{i=1}^{n} C_i}$$

Where, i = 1,2,3…….n are number of courses during semesters. C = No of credits associated with that course and P = Grade point earned in that course. SGPA will be rounded off to two decimal places.

15.2 Cumulative Grade Point Average (CGPA)

The total cumulative performance of a student at the end of specific semester is indicated by CGPA. An up-to-date assessment of the overall performance of a student for the courses from the first semester onwards till completion of the program shall be obtained by calculating Cumulative Grade Point Average (CGPA).

CGPA is a weighted average of the SGPA obtained in all semesters by the students during the semesters. CGPA can be calculated by following equation.

$$CGPA = \frac{\sum_{j=1}^{n} C_j S_j}{\sum_{j=1}^{n} C_j}$$

Where, j = 1,2,3…….n are number of semester during program. C = Total No of credits in the semester for which CGPA is to be calculated.

CGPA will be rounded off to two decimal places.

Conversion of CGPA to percentage marks for CGPA ≥ 4.5 can be obtained using equations. Percentage marks = (CGPA x 10) – 7.5.

15.3 For the students acquiring "I" grade (which is only a temporary grade) in any of the courses, SGPA, CGPA shall be calculated only after make-up examination.

15.4. First Year Performance Index (FYPI): (Applicable For B. Tech Programs Only)

15.4.1 For a student registered in Sanjay Ghodawat University Kolhapur right from the First semester, First-Year-Performance-Index (FYPI) shall be calculated as weighted average of the grade points obtained in all the courses registered by him/her in semesters I and II only.

$$\text{FYPI} = \frac{\sum_{i} C_i g_i}{\sum_{i} C_i}$$

Where summation is for all the courses registered by a student in first two semesters. FYPI shall be calculated when SPI for the second semester is calculated. FYPI shall be rounded off to two decimal places.

15.4.2 FYPI shall reflect all the courses undergone by a student in the first year including the courses in which he/she has failed. FYPI may get modified in the subsequent semesters whenever a student clears his/her first year backlog courses.

15.4.3 If a student has been awarded "I" grade in the regular semester course of the first year then, FYPI shall be calculated after the make-up examination on the basis of the grade obtained by that student in a make-up examination.

15.4.4 If a student has obtained grade "F" or "X" at any time in any of the courses registered by him, then zero grade points corresponding to these grades shall be taken into consideration for calculation of FYPI.

16.0 Maximum Duration for Completing the Program

Maximum duration for completing any program UG/PG offered by Sanjay Ghodawat University is respective program duration plus two additional years.

Maximum duration for getting the B. Tech degree for students admitted in the first semester of UG program is, program duration plus two additional years (i.e. 12 Semesters and 6 academic years) For lateral entry student academic admitted in the third semester shall be (10 Semester and 5 Years).

The maximum duration of the program includes the period of withdrawal, absence and different kind of leaves permission to student but excludes the period of rustication of the student from the university however genuine case an confidential of valid reason may be referred to academic council for extending this limit by additional criteria

17.0 NFTE (Not Fit for Technical Education) (Applicable to B Tech program only)

It is mandatory for the student to earn all credits of first year specified for semester I & II or eligible for ATKT as per the rules to seek admission to semester III of second year in three years from the date of admission to avoid NFTE. If a student fails to become eligible for admission to Semester III in three year form the date of his admission, he shall be declared as "Not Fit for Technical Education" leading to discontinuation of his/her registration with the university. Such cases should be put up in the academic council.

18.0 Academic Progress Rules (ATKT Rules):

18.1 A student shall be allowed to register for the courses of the next year's odd semester only if he/she has earned all the credits of the previous year and has earned at least 75% credits of the current year. If 75% calculation turns out to be a mixed number (integer + fraction) then only the integer part of that number shall be considered for deciding the eligibility for ATKT.
At the end of 1st year a student shall be allowed to keep terms (ATKT) to 2nd year of study provided he/she attends course work prescribed for 1st year with prescribed attendance and successfully earned at least 75% of the total credits specified for 1st year program.

For Example: Total credits for B. Tech first year 2017-18, are 45 (Total of Semester I and II). A Student should earn mininum75% of the 45 Credits i.e. 33.15 (Rounded to 33 Credits). A student can go to next higher class with a maximum backlog of 12 credits of semester I & II of the first year.

Student, who fails to earn those credits, cannot register for next semester, either it can re-registrar for the course and credits or can use the next opportunity to earn the credits when exams are conducted. **.**

(b) At the end of 2nd year a candidate shall be allowed to keep terms to 3rd year of study provided he/she attends course work prescribed for 2nd year with prescribed attendance, and successfully cleared 1st year program and at least 75% of total credits prescribed for 2nd year program.

(c) At the end of 3rd year a candidate shall be allowed to keep terms to final year of study provided he/she attendants course work prescribed for 3rd year with prescribed attendance, and should have completed 2nd year program and 75% of total credits prescribed for 3rd year program.

All such candidates fulfilling the above criteria shall be declared as FAILED, ATKT.

A student shall be allowed to take admission for odd semester of next academic year only if he/ she have earned all the credits of the previous year and 75% happens to be a decimal, it is rounded to only integer part.

19.0 Semester Grade Report:

19.1 Semester grade report reflects the performance of a student in that semester (SGPI) and also his/her cumulative performance for the first year (FYPI) and also the cumulative performance since the third semester of his/her study (CGPA).

19.2 The semester grade card issued at the end of each semester/ summer term to each student shall contain the following.

- The credits for each course registered for that semester.
- Any audit course/s undertaken by a student in a Semester.
- The letter grade obtained in each course.
- The total number of credits earned by a student for the first year separately.
- The total number of credits earned by a student since the 3rd semester onwards.
- SGPI, FYPI, CGPI.
- A list of backlog courses, if any.
- Remarks regarding eligibility of registration for the next semester.

19.3 Semester grade card shall not indicate class or division or rank however a conversion from grade point index to percentage based on CGPI shall be indicated on the final grade card of the program.

20.0 Award of Degree:

Following rules prevail for the award of degree.

- A student has registered and passed all the prescribed courses under the general institutional and departmental requirements.
- A student has obtained CGPI ≥ 4.75.
- A student has paid all the institute dues and satisfied all the requirements prescribed.
- A student has no case of indiscipline pending against him/her.
- Academic Council shall recommend the award of degree to a student who is declared to be eligible and qualified for above norms.

21.0 Grace Marks

- Maximum total grace marks will be 1 % of the total theory credit courses x 100 subjected
- To maximum 6 marks in that semester.
- Grace marks will be given candidate for change in grades for theory credit courses, i.e. from
- Fail to pass grade only and will be reflected in final ESE marks.
- The grace marks are applicable only for maximum 1/3rd courses (rounded to higher Integer part i.e. if there are 4 theory courses then 4/3 = 1.33 = 2 courses).
- Maximum grace marks will be distributed in maximum courses
- Benefit of grace marks is not applicable for any medal/award.
- Applicable to theory and (Theory + Practical Courses). If is not applicable for Practical courses.
- Scheme for grace marks only can be used when the student will pass in all courses of That semester.

22.0 CGPA Improvement Policy for Award of Degree:

An opportunity shall be given to a student who has earned all the credits required by the respective program with CGPA greater than or equal to 4.00 but less than 4.75 to improve his/her grade by allowing him/her to appear for ESE examinations of maximum two theory courses of seventh semester. Such examinations shall be scheduled along with re-examinations/make-up examinations. However, CGPA shall be limited to 4.75 even though the performance of a student as calculated through modified CGPA becomes greater than 4.75.

Conclusions:

The academic policies regarding conduct of programs in Sanjay Ghodawat University Kolhapur are published in this document. The Academic Council shall reserve the right to modify these policies as and when required from the point of view of achieving

academic excellence. In special and abnormal cases (i.e. the cases not covered through above rules) the decision of the (Chairman, Academic Council shall be final and shall be binding on all concerned.

Chairman

Academic Council

M. Tech. Electronics Engineering (Embedded Systems)
Curriculum Structure & Syllabus for A. Y. 2021-22

Semester I									
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	Evaluation Scheme for Theory and Practical			
						Compo-nent	**Exam**	**% WT**	**% Pass**
UC501R2 (UC|ST) Version: 2.0	Research Methodology	2	-	-	2	Theory	FET	20	40
							CAT	30	
							ESE	50	40
EES503R1 (PC | ST) Version: 1.0	Automotive Electronics-I	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
EES505R1 (PC | ST) Version: 1.0	Advanced Embedded Systems	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
EES507R1 (PE | ST) Version: 1.0	Program Elective - I	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
EES509R1 (PE | ST) Version: 1.0	Program Elective - II	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
EES511R1 (PC | ST) Version: 1.0	Automotive Electronics–I Lab	-	-	4	2	Practical	FEP	50	40
							POE	50	40
EES513R1 (PC | ST) Version: 1.0	Advanced Embedded Systems Lab	-	-	4	2	Practical	FEP	50	40
							POE	50	40
EES515R1 (PC | ST) Version: 1.0	Seminar	-	-	2	2	Practical	FEP	100	40
	Total	**14**	**00**	**10**	**20**	Total Hrs: 24, Total Credits: 20			

L: Lecture, T: Tutorial, Pr: Practical, C: Credits, Th. : Theory, WT: Weight Age
PC: Program Core, PE: Program Elective, UC: University Core, UE: University Elective
ST: School of Technology
FET: Faculty Evaluation Theory, CAT: Continuous Assessment Test, ESE End Semester Examination, TW : Term Work, POE : Practical Oral Examination.
Program Code: Electronics Engineering (Embedded Systems) (EES)

M. Tech. Electronics Engineering (Embedded Systems)
Curriculum Structure & Syllabus for A. Y. 2021-22

Semester II									
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	Evaluation Scheme for Theory and Practical			
						Compo-nent	**Exam**	**% WT**	**% Pass**
EES502R1 (PC | ST) Version: 1.0	Automotive Electronics-II	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
EES504R1 (PC | ST) Version: 1.0	IOT System Design	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
EES506R1 (PC | ST) Version: 1.0	Microcontrollers and Programmable Devices	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
EES508R1 (PE | ST) Version: 1.0	Program Elective III	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
EES510R1 (PE | ST) Version: 1.0	Program Elective IV	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
EES512R1 (PC | ST) Version: 1.0	Automotive Electronics–II Lab	-	-	4	2	Practical	FEP	50	40
							POE	50	40
EES514R1 (PC | ST) Version: 1.0	IOT System Design Lab	-	-	4	2	Practical	FEP	50	40
							POE	50	40
EES516R1 (PC | ST) Version: 1.0	Employability Skills (Project based Learning) – Level 1	-	-	2	1	Practical	FEP	100	40
	Total	**15**	**00**	**10**	**20**	Total Hrs: 25, Total Credits: 20			

L: Lecture, T: Tutorial, Pr: Practical, C: Credits, Th. : Theory, WT: Weight Age
PC: Program Core, PE: Program Elective, UC: University Core, UE: University Elective
ST: School of Technology
FET: Faculty Evaluation Theory, CAT: Continuous Assessment Test, ESE End Semester Examination, TW : Term Work, POE : Practical Oral Examination.
Program Code: Electronics Engineering (Embedded Systems) (EES)

Semester III									
Course Code	**Course Description**	**L**	**T**	**Pr**	**C**	**Evaluation Scheme**			
						Component	**Exam**	**WT**	**Min Pass %**
EES601R1 (PC | ST) Version: 1.0	Industry Internship	-	-	-	4	Presentation and Report	FEP	100	40
EES603R1 (PC | ST) Version: 1.0	Open Elective (Directed Learning)	-	-	-	2	NPTEL/MOOC Certificates should be produced	FET	100	40
EES605R1 (PC | ST) Version: 1.0	Dissertation Phase I	-	-	-	6	Presentation and Report	FEP	100	40
EES607R1 (PC | ST) Version: 1.0	Dissertation Phase II	-	-	-	8	Presentation, Report and Demo (Min 50% work)	FEP	50	40
							ESE	50	40
Credits					**20**				

Semester IV									
Course Code	**Course Description**	**L**	**T**	**Pr**	**C**	**Evaluation Scheme**			
						Component	**Exam**	**WT**	**Min Pass %**
EES602R1 (PC| ST) Version: 1.0	Dissertation Phase III	-	-	-	8	Presentation Report & Demonstration (100 % work)	FEP	100	40
EES604R1 (PC| ST) Version: 1.0	Dissertation Phase IV	-	-	-	10	Viva Voce Exam	ESE	100	40
EES606R1 (PC| ST) Version: 1.0	Dissertation outcome Dissemination	-	-	-	2	Publications and Patents	ESE	100	40
Credits					**20**				

Program Elective-I

Course Code	Course Title
EES5071R1	Real Time Operating Systems
EES5072R1	Intelligence Systems
EES5073R1	Embedded Wireless Sensor Networks

Program Elective-II

Course Code	Course Title
EES5091R1	Embedded System Design using FPGA
EES5092R1	Advanced Signal Processing
EES5093R1	Optimization Techniques

Program Elective-III

Course Code	Course Title
EES5061R1	Embedded Linux
EES5062R1	Advanced Digital Communication
EES5063R1	Advanced Digital Image Processing

Program Elective-IV

Course Code	Course Title
EES5081R1	Data Science
EES5082R1	Soft Computing
EES5083R1	Network Security & Cryptography

UC 501R2: Research Methodology

(Ver 2.0, University Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	% Pass
2	-	-	2	Theory (70)	FET	20	40
					CAT	30	
					ESE	50	40

Course Description: This course will provide an opportunity for participants to establish or advance their understanding of research through critical exploration of research language, ethics, and approaches. The course introduces the language of research, ethical principles and challenges, and the elements of the research process within quantitative, qualitative, and mixed methods approaches.

Course Outcomes: At the end of this course students will able to

CO1 Understand research terminology
CO2 Be aware of the ethical principles of research, ethical challenges
CO3 Describe quantitative, qualitative and mixed methods approaches to research
CO4 Identify the components of a literature review process

Contents

Units	Description	Hours
I	Foundations: Introduction to Research and the Research Process, Research Ethics and Integrity, Critical appraisal	07
II	Quantitative Research: Introduction to Quantitative Research, Study Designs and Methods, Analysis and Interpretation of Quantitative Data, Critical Appraisal of Quantitative Research	07
III	Qualitative Research: Introduction to Qualitative Research, Study Designs and Methods, Analysis and Interpretation of Qualitative Data, Critical Appraisal of Qualitative Research	07
IV	Mixed Methods Research: Introduction to Mixed Methods Research, Study Designs and Methods, Analysis and Interpretation of Mixed Methods Data, Critical Appraisal of Mixed Methods Research	07

Text Books

1. Gupta S. C. and Kapoor V. K, Fundamentals of Mathematical Statistics, Sultan Chand & Company New Delhi.
2. Creswell, J. W. Research design: Qualitative, quantitative and mixed methods approaches. 5th Ed. Thousand Oaks, CA: Sage, 2018

References

1. Stuart Melville and Wayne Goddard, Research methodology: an introduction for science & engineering students.
2. Wayne Goddard and Stuart Melville, Research Methodology: An Introduction,
3. Gupta S. C. and Kapoor V. K, "Fundamentals of Mathematical Statistics", Sultan Chand & Company New Delhi.
4. Douben K. J., "Research Methodologies – Principles and Guidelines of Applied Scientific Research", UNESCO-IHE Lecture Notes LN0317/07/01, Delft, the Netherlands
5. Ross S. M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edi, Elsevier
6. Holtom D. and E. Fisher, "Enjoy Writing Your Science Thesis - a Step by Step Guide to Planning and Writing Dissertations and Theses for Undergraduate and Graduate Science Students", Imperial College Press. ISBN 1-86094-207-5, London, UK.

EES 503 R1: Automotive Electronics - I

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	% Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Illustrate transducer principles
CO2 Elaborate automotive architecture
CO3 Analyse gasoline engine management
CO4 Inspect vehicle batteries
CO5 Apply requirements of charging systems
CO6 Implement basic sensor arrangement

Contents

Units	Description	Hours
I	**Transducer Principles:** Transducers classification and basic principles, General Input-output configuration, static characteristics and dynamic characteristics of instruments, Variable resistance transducers, Metal and semiconductor strain gages and their signal conditioning, Inductive transducers, Electromagnetic sensors, Hall effect sensors, Capacitive transducers, Piezo electric transducers and their signal conditioning, Ultrasonic sensors.	07
II	**Electronics in the Automobile:** Automotive Architecture, Overview Auto electrical and Electronics systems: Starting and Charging system, HMI & Instrumentation, Lighting System, Switches, Power and Signal Distribution, Safety and Security.	07
III	**Powertrain Electronic Systems:** Gasoline Engine Management (EMS ECU), Diesel Engine Management system (EMS ECU), Transmission Control(TCU), Gasoline engine management, Infotainment electronics: Dashboard/instrument cluster, car audio, telematic systems navigation systems multimedia systems cross application technologies.	07
IV	**Batteries:** Vehicle Batteries –Lead-Acid batteries –maintenance and charging –diagnosing Lead acid battery faults –advanced battery technology –new developments in electrical storage and batteries.	07

V	**Charging systems:** Requirements of charging systems ––generation of electrical energy in motor vehicle –physical principles – alternators – characteristic curves –charging circuits –diagnosing charging system faults –advanced charging system technology –new developments.	07
VI	**Sensors for Automobile:** Basic sensor arrangement, types of sensors such as- oxygen sensors, crank angle position sensors- Fuel metering vehicle speed sensors and destination sensors, Altitude sensor, Flow sensor, exhaust temperature, air mass flow sensors. Throttle position sensor, solenoids, stepper motors, relays, Steering wheel angle sensor, Vibration and acceleration sensors, Pressure sensors, Speed and RPM sensors, torque sensors.	07

References

1. "Automotive Electrics, Automotive Electronics: Systems & Components, 4th Ed., BOSCH. 2005
2. Automotive Sensors, BOSCH. 2002
3. Ronald K. Jurgen, "Sensors and Transducers, 2nd Edition, SAE, 2003.
4. Ernest O. Doebelin, "Measurement Systems – Application and Design", 4th Edition, McGraw-Hill, 2000

EES 505 R1: Advanced Embedded Systems

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	% Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Summarize[2] evaluation of embedded systems and design issues
CO2 Develop[5] small scale embedded system using LPC2148
CO3 Outline[2] the features and capabilities of ARM Cortex M0/M0+ Microcontrollers
CO4 Demonstrate[3] the capabilities of PSoC4 BLE SoC.
CO5 Elaborate[4] the concept of RTOS and its services

Units	Description	Hours
I	**Introduction to Embedded Systems & ARM Processors:** Embedded system (ES) definition, Embedded System Evaluation, ES Types with examples, Distinguish a Real Time Embedded System from other systems, Components of an Embedded system, Embedded system design issues & Design flow, a comparative study ARM7TDMI, ARM8, ARM9TDMI, ARM10TDMI, ARM11.	07
II	**LPC 2148 Microcontroller:** ARM7TDMI-S microcontroller, LPC-2148: Architecture details, I/O ports, Timers, PWM module, ADC and Interrupts.	07
III	**Interfacing External Peripherals to LPC 2148:** Interfacing and Embedded C programming for LED's, LCD, Relay, Switch, Matrix keyboard, Stepper motor.	07
IV	**ARM Coterx M0/M0+ architecture:** Introduction to ARM Cortex family, block diagram of the Cortex_-M0 & M0+, Advantages of ARM Cortex M0/M0+ processor, Introduction to CMSIS, Bus system, Memory mapping, Interrupts and exceptions	07
V	**ARM Cortex M0 based PSoC4-BLE architecture:** Introduction, I/O System, chip operational modes, power modes, WDT, Serial Communication Block (SCB), Universal Digital Block (UDB), Analog to	07

	Digital Converter, Timer, Counter and PWM, Introduction to Bluetooth Low Energy Subsystem (BLESS).	
VI	**Real Time Operating Systems:** Introduction to RTOS concept, embedded software architectures: Round robin, round robin with interrupts, Function queue scheduling and real time operating system, RTOS basics, Shared data and re-entrancy, Tasks and task states, Context Switching, Pre-emptive and non-preemptive Schedulers, semaphores and shared data using semaphores, Priority Inversion, Deadly embrace, Inter task communication, Introduction to RTOS programming using uCOS-II.	07

References

1. "ARM System Developers Guide- Designing & Optimizing System Software", Andrew N, Dominic Sloss, and Chris Wright, Elsevier, 2010.
2. LPC2148 User guide and reference manual-UM10139, Rev.4-2012
3. "Programmable Microcontrollers with Applications" Cem Ünsalan and H. Deniz Gürhan, Mc Graw Hill Education, 2014
4. MSP430x2xx Family User's Guide, Texas Instruments, Literature Number: SLAU144J
   December 2004–Revised July 2013
5. "The Definitive Guide to ARM® Cortex®-M0 and Cortex-M0+ Processors", Joseph Yiu, Second Edition, Elsevier,2015
6. PSoC-4 Architecture TRM (Technical Reference Manual), Document No: 001-92738 Rev. *D, May 31, 2017 and Document No. 001-85634 Rev. *F, May 30, 2017
7. "Designer's Guide to the Cypress PSoC" by Robert Ashby, Newnes, Elsevier, 2005

Program Elective-I

EES 5071 R1: Real Time Operating Systems

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Classify different software architectures.
CO2 Analyze fundamental services in RTOS.
CO3 Estimate Worst Case Execution Time (WCET) of various tasks.
CO4 Distinguish between different Real Time Operating Systems (RTOS).
CO5 Explain threading basics and mutex fundamentals.
CO6 Determine the use of RTOS in various applications.

Contents

Units	Description	Hours
I	**Introduction to RTOS:** Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, Differences between General Purpose OS & RTOS, Embedded software architectures: Round robin, round robin with interrupts, Function queue scheduling and real time operating system, Basic architecture of an RTOS.	07
II	**RTOS Fundamentals:** Tasks and Task states – Semaphores – Shared data – Message queues, Mail boxes and pipes – Memory management – Interrupt routines – Encapsulating semaphore and queues Task management – Dual role of time – Intertask communication – Process input/output.	07
III	**Real Time Scheduling:** Schedulability problem: classification, schedulability test, worst case execution time (WCET) - static scheduling: - dynamic scheduling: dependent tasks, independent tasks.	07

IV	**Real Time Operating Systems:** VX works - uCOS – POSIX standards - RT Linux – device drivers – Real time library of Keil IDE - RTOS Porting to a Target.	07
V	**Threads:** Multithreading models, threading issues, thread libraries, synchronization, Mutex: creating, deleting, prioritizing mutex, mutex internals.	07
VI	**Case studies:** Free-RTOS architecture - Embedded RTOS for voice over IP – RTOS for fault Tolerant Applications – RTOS for Control Systems.	07

References

1. Hermann Kopetz, "Real–Time systems – Design Principles for distributed Embedded Applications", Second Edition, Springer 2011.
2. Micro C OS II reference manual.
3. VX works Programmers manual.
4. Keil Real Time library documentation
5. Doug Abbott, "Linux for embedded and real time applications", Elsevier Science, 2003

EES 5072 R1: Intelligence Systems

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Describe the process of machine learning.
CO2 Choose algorithms of multilayer neural networks.
CO3 Distinguish between various training algorithms
CO4 Plan a neural network model for particular application.
CO5 Summarize basic concept of Fuzzy set theory.
CO6 Illustrate the different systems developed using fuzzy logic.

Contents

Units	Description	Hours
I	**Introduction and Basic Concepts:** Introduction- Humans and Computers, the structure of the brain, learning in machines, the differences. The basic neuron- Introduction, modeling the single neuron, learning in simple neurons, the perception: a vectorial Perspective, the perception learning rule, proof, limitations of perceptrons.	07
II	**Multilayer Networks :** The multi-layer perceptron: Introduction, altering the perception model, the new model, the new learning rule, multi-layer perception algorithm, XOR problem. Multi-layer feed forward networks	07
III	**Back propagation training algorithm:** Problems with back propagation, Boltzman training, Cauchy training, combined back propagation.	07
IV	**Resonant Networks and Applications:** Hop-field networks: recurrent and bi-directional associative memories, counter propagation network, Artificial Resonance Theory (ART) Application of neural network: Hand written digit and character recognition- Traveling sales man problem, a neuro-controller.	07

V	**Fuzzy Set Theory:** Introduction to fuzzy set theory: Fuzzy set vs Crisp set, properties of fuzzy sets, operations on fuzzy set – fuzzy compliments, fuzzy intersection- T-norms, fuzzy union- t- co-norm, fuzzy relations.	07
VI	**Fuzzy Logic and Systems:** Fuzzy Logic: Classical logic, multi valued logic, fuzzy propositions, fuzzy quantifiers, linguistic hedges and their inferences. Fuzzy systems: fuzzy controllers, fuzzy systems and neural networks, fuzzy neural networks, fuzzy automata, fuzzy dynamic system.	07

Details of Tutorials / Assignments

Introduction and Basic Concepts of Neurons

Q1 Write a note on History and evolution of Artificial Neural Network.

Q2 Explain in detail the basic structure of a Neuron/Perceptron.

Q3 Describe types of machine learning with reference to neurons.

Multilayer Networks

Q1 Elaborate with a schematic XOR problem with a single perceptron.

Q2 Draw and explain the working of multilayer feed forward network.

Q3 List all and describe in detail any one perceptron learning rule.

Back propagation training algorithm

Q1 Describe the Disadvantages problems with back propagation algorithm.

Q2 Illustrate Boltzmann's training algorithm in neural networks

Q3 Elaborate Stability vs Plasticity dilemma in Neural N/W Training.

Resonant Networks and Applications

Q1 Describe Hopfield network with suitable diagram.

Q2 Explain Adaptive resonance theory (ART) in detail.

Q3 Explain with example character recognition using ANN

Fuzzy Set Theory

Q1 Compare and contrast between crisp set theory vs Fuzzy Set theory

Q2 Elaborate common operations on of Fuzzy Sets.

Q3 Explain t- norms and t-conorm used in Fuzzy sets.

References

1. G.J.Klir & Bo Yuan, "Fuzzy Sets and Fuzzy Logic Theory and Applications", Prentice Hall of India, 2009.
2. Timothy S.Ross, "Fuzzy Logic with engineering applications", Weily India Pvt. Ltd., 2011.
3. Kosko B, "Neural Networks and Fuzzy Systems: A dynamical system approach to machine intelligence", Prentice Hall of India, 2009.
4. R Beale & T Jackson, "Neural Computing, An Introduction", Adam Hilger, 1990.
5. Rao V.B and Rao H.V., "C++, Neural Networks and Fuzzy Logic", BPB Publications, 2003.
6. Simon Kendal, Malcolm Green, "An Introduction to Knowledge Engineering", Springer-Verlag Limited, 2007.

EES 5073R1: Embedded Wireless Sensor Networks

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	%Pass
3	-	-	3	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	

Course Outcomes: At the end of this course students will able to

CO1 Explain the overview of existing technologies, hurdles, challenges, opportunities and applications of Wireless sensor networks.
CO2 Understand the various hardware, software platforms, and architecture that exist for sensor networks.
CO3 Discuss the Basic primitives and suitable programming tools and techniques which are available to implement a sensor network.
CO4 Choose various Programming Methods for different architectures.
CO5 Use different wireless network simulators
CO6 Build various projects and research based on embedded wireless sensor networks potential and applications in different fields.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction to WSN:** Introduction to WSN-Challenges for WSNs-Characteristic requirements - Required mechanisms - Single-node architecture -Hardware components- Energy consumption of sensor nodes -Operating systems and execution environments-Some examples of sensor nodes.	08
II	**Network Architecture:** Sensor network scenarios- Optimization goals and figures of merit- Design principles for WSNs, Service interfaces of WSNs- Gateway concepts.	06
III	**Sensor Network Implementation:** Sensor Programming-Introduction to TinyOS Programming and fundamentals of Programming sensors using nesC- Algorithms for WSN – Techniques for Protocol Programming.	07
IV	**Programming Models:** An Introduction to the Concept of Cooperating Objects and Sensor Networks- System Architectures and Programming Models.	06

V	**Simulators for WSN:** Necessity of simulation, Types of simulations, Generic network simulators, code level simulators, Firmware level simulators, algorithm level simulators, Packet level simulators, limitations of WSN simulators	08
VI	**Case Studies:** Wireless sensor networks for environmental monitoring, Wireless sensor networks with mobile nodes, Autonomous robotic teams for surveillance and monitoring, Inter-vehicle communication networks.	06

References

1. Holger karl, Andreas Willig, “Protocols and architectures for wireless sensor networks”, John Wiley,2005.
2. Liljana Gavrilovska, Srdjan Krco, Veljko Milutinovic , Ivan Stojmenovic,Roman Trobec, “Application and Multidisciplinary Aspects of Wireless Sensor Networks”, Springer-Verlag, London Limited 2011.
3. Michel Banâtre, Pedro José Marrón, Anibal Ollero, Adam Wolisz, ”Cooperating Embedded Systems and Wireless Sensor Networks “, John Wiley & Sons, Inc .2008.
4. Seetharaman Iyengar, Nandhan, “Fundamentals of Sensor Network
5. Programming Applications and Technology”, John Wiley & Sons, Inc.2008.

Program Elective-II

EES 5091 R1: Embedded System Design using FPGA

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Summarize[2] evaluation of FPGA devices and soft processors
CO2 Develop[5] small scale reconfigurable system using FPGA
CO3 Outline[2] the features and capabilities of VHDL and Verilog
CO4 Design[3] a testable digital system.
CO5 Demonstrate[4] different FPGA interfacing skills.

Contents

Units	Description	Hours
I	**FPGA Devices:** Architecture of a FPGA, FPGA memory, Clock and PLL, Timing model and power analysis.	06
II	**FPGA-based Embedded Processor:** Soft Processors-MicroBlaze, diagram, Hardware–Software Co-design flow, Creating a Customized Microcontroller	06
III	**Introduction to VHDL:** Need of HDL, Features and capabilities of VHDL, Elements of VHDL (Entity, Architecture, Library, Package, and Configuration), Identifiers, literals, data types, operators and Attributes	06
IV	**Introduction to Verilog:** Basic Verilog naming conventions, Verilog operators, data types, assignment statements, control statements, behavioral modeling in Verilog HDL, combinational and sequential logic design using Verilog.	07
V	**Interfacing with FPGA:** LED, LCD, Seven Segment, ADC and DAC, Switch, Keypad, Stepper Motor Interfacing.	07

VI	**Prototyping Using FPGA:** Simulation and Verification**,** Debugging, FPGA Design Test Methodology, Hardware-in-the-loop Testing.	06

References

1. Wayne Wolf, —FPGA-Based System Design, Prentice Hall Modern Semiconductor Design Series, 2004.
2. "Principals of Digital System Design using VHDL" Roth, John, Cengage Learning
3. "Fundamentals of Digital Logic with VHDL design" Stephen Brown and Zvonko Vranesic, Tata – Mcgraw Hill
4. "Fundamentals of Digital Logic with Verilog design" Stephen Brown and Zvonko Vranesic, Tata – Mcgraw Hill
5. Rahul Dubey "Introduction to Embedded System Design Using Field Programmable Gate Arrays" ISBN 978-1-84882-015-9, Springer

EES 5092 R1: Advanced Signal Processing

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Familiar with basics of ideal and practical filters, their characteristics and implementation.
CO2 Compare and contrast the existing filters, Multirate filters and their applications
CO3 Select and define wavelet transformation, reconstruct filter using filter bank and wavelet.
CO4 Integrate filtering characteristics, liner prediction and their applications.

Contents

Units	Description	Hours
I	**Introduction:** Fundamentals frequency domain analysis and Fourier Transform, Basic Filters, Ideal Filter characteristics, Practical filter characteristics, Fundamentals of FIR and IIR filters, Structural realization of FIR and IIR filters.	08
II	**Multirate Digital Signal Processing:** Review of sampling theory, sampling rate conversion, Polyphase implementation of FIR filters for rate conversion, multistage implementation, applications of Multirate signal processing, digital filter banks, subband basics, subband decomposition.	08
III	**Wavelet and Short Time Fourier Analysis:** Fourier Transform: its power and limitations, Short time Fourier Transform, The Gabor Transform, Continuous Wavelet Transform, Ideal case of Wavelet Transform, Reconstruction of filter banks and wavelets, Haar wavelet, Daubechies Wavelet.	08
IV	**Adaptive Filtering:** Wiener filtering, optimum liner prediction, Levinson-Durbin algorithm, prediction error filters, adaptive filters, FIR adaptive LMS algorithm, convergence of adaptive algorithms, fast	10

	algorithms, applications: Noise canceller, echo canceller and equalizer. Recursive least – squares algorithms.	
V	**Digital Signal Processor:** basic architecture, computational building blocks, MAC bus, architecture and memory, data addressing, parallelism and pipelining, parallel input output interface. Interrupt, Direct memory Access (DMA).	08
VI	**Application of DSP:** Design of decimation and interpolation filter, FFT algorithm, PID Controller, Application of serial interfacing, DSP based power meter, position control.	06

References

1. J.G. Proakies & D.G. Manolakes, Digital Signal Processing, PHI 4th Edition, 2006.
2. Monson H. Hayes, Statistical Digital Signal Processing and Modelling, John Wiley and Sons, 2009
3. P.P. vaidyanathan, Multirate Systems and Filet banks, PHI, 1993.
4. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, Digital Signal Processing, TMH, 2000

EES 5093 R1: Optimization Techniques

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Understand basic theoretical principles in optimization
CO2 Use dynamic programming for finding optimized solution
CO3 Understand and apply the concept of optimality criteria for various type of optimization problems
CO4 Apply basic concepts of mathematics to formulate an optimization problem
CO5 Solve various constrained and unconstrained problems in single variable as well as multivariable
CO6 Apply the methods of optimization in real life situation

Contents

Units	Description	Hours
I	**Linear programming-extensions:** Revised simplex method, Dual Simplex method, Bounded variables method, primal-dual relationships, duality theorems, economic interpretation of dual, dual of transportation model, sensitivity analysis in LPP and transportation models, Karmarkar's interior point algorithm	07
II	**Dynamic programming:** Formulation, recursive approach, Goal programming: formulation, graphical solution, algorithm, Integer programming: Formulation, Cutting plane algorithm, Branch and bound algorithm	07
III	**Classical Optimization:** Single and Multi-variable Optimization, Hessian Matrix, Saddle Point, Lagrange Multipliers, Kuhn-Tucker Conditions **Single-variable:** Optimization: Unrestricted Search, Exhaustive Search, Dichotomous Search, Interval-halving Method, Fibonacci Method, Golden-section Method, Quadratic Interpolation Method, Newton Method, Quasi-Newton Method, Secant Method	07

IV	**Multi-variable Optimization:** Evolutionary Optimization Method, Simplex Search Method, Pattern Search Method	07
V	**Conjugate Direction Method:** Steepest Descent Method, Newton's Method, Conjugate Gradient Method, Davidon-Fletcher-Powell Method	07
VI	**Introduction to Constrained Optimization :** Interior Penalty Function Method, Exterior Penalty function Method	07

References

1. Hillier and Lieberman, Introduction to Operations Research, Tata McGraw Hill
2. N D Vora, Quantitative techniques in Management, Tata McGraw Hill
3. Deb K. (2004). Optimization for Engineering Design: Algorithms and Examples, Prentice Hall of India.
4. Rao S. (1996), Engineering optimization, Theory and Practice, New Age International Publishers
5. Ravindran A., Ragsdell K. and Reklaitis G. (2006), Engineering Optimization: Methods and Applications, 2/e, John Wiley and Sons Inc.

EES 511 R1: Automotive Electronics – I Lab

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	4	2	Practical	FEP	50	40
					POE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Make use of Basic sensor arrangement

CO2 Analyse Power windows and Automotive audio systems

CO3 Inspect Parking assistance systems and central locking system

CO4 Illustrate charging and lighting systems

Description

This laboratory is developed in collaboration with the Industry. The contents and experiments conducted in this laboratory are developed with the suggestions and guidelines from industry experts and are dynamic in nature in order to align it with the ever-changing needs of automotive industry.

List of Experiments

1. Study of Automotive Sensors
2. Working of Power windows
3. Demonstration of Automotive audio systems
4. Study of Parking assistance systems
5. Demonstration of Automotive central locking system
6. Study of Automotive lighting system
7. Study of Charging system
8. Study of Engine cooling systems
9. Working of Automotive wiper system
10. Study of Automobile batteries

EES 513 R1: Advanced Embedded Systems Lab

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	4	2	Practical	FEP	50	40
					POE	50	40

Course Outcomes: At the end of this lab, students will able to

CO1 Implement Embedded C programs
CO2 Make use of advanced software and debugging capabilities.
CO3 Design a subsystem of embedded system based on MSP430/LPC2148

Description

This laboratory consists of the study of different microcontroller platforms for developing embedded systems. In this laboratory, the experiments related to LPC 2148 based ARM microcontroller will be conducted. This also includes the study of uCOS-II real time operating system (RTOS).

List of Experiments:

1. Interfacing LED's to LPC2148
2. Tone generation using LPC2148
3. Square wave generation using timer & interrupt of LPC2148
4. Stepper Motor interfacing with LPC2148
5. Interfacing switch and relay to LPC2148
6. Up/Down Counter
7. LCD Interfacing
8. ADC Interfacing
9. Keyboard interfacing
10. Study of Multitasking and Priority inversion in RTOS
11. Study of I2C/SPI protocol
12. Demonstration of PSOC BLE kit

EES 515 R1: Seminar

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	2	2	Practical	FEP	100	40

Course Outcomes: At the end of this lab, students will able to

CO1 Communicate and report effectively project related activities and findings
CO2 Develop presentation and communication skills

Description

1. Seminar shall be based on one of the topic chosen in consultation with the supervisor. Mini project may be interdisciplinary nature. Areas of recent techno-management development shall be explored. Research innovations may be considered as prospective areas. Seminar may be related with main project to explore possibilities of continuation further and to study the pre-requisites.
2. The student is required to submit a report based on the work. The evaluation of the project shall be on continuous basis.

Semester II

EES 502 R1: Automotive Electronics - II

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Illustrate vehicle convenience and security systems.
CO2 Elaborate safety systems in automobiles.
CO3 Analyse MEMS based automotive sensors.
CO4 Examine electric and hybrid vehicle.
CO5 Apply auto-motive embedded System
CO6 Make use of instrumentation and advances in automobile engineering

Contents

Units	Description	Hours
I	**Vehicle Convenience and Security Systems:** Tyre pressure monitoring systems, Two-wheeler and Four-wheeler security systems, parking guide systems, anti-lock braking system, future safety technologies. Automatic parking system. Advanced driver assistance systems. Autonomous driving.	07
II	**Safety Systems in Automobiles:** Vehicle diagnostics and health monitoring, Safety and Reliability, Traction Control, Vehicle Dynamics Control, accelerators and tilt sensors for sensing skidding and anti-collision - anti-collision techniques using ultrasonic Doppler sensors, Connected car system.	07
III	**MEMS based Automotive Sensors**: Micro systems in Automobiles- an Overview, MEMS sensor over conventional Sensors, different types of MEMS based Sensors for Drivetrain Control, Safety Systems and Comfort Systems.	07
IV	**Electric and Hybrid vehicle:** Electric - Hybrid vehicle introduction. Historical background, Types of EV's, Motor drive technologies,	07

	Energy sourse, EV's subsystems and configurations, Hybrid Electric Vehical subsystems and configurations, HEV modes of operation	
V	**Automotive Embedded System:** GPS, Multiprocessor communication using CAN bus. Case study- cruise control of car. Artificial Intelligence. Electronic ignition systems. Integrated engine control system, Exhaust emission control engineering.	07
VI	**Instrumentation and Advances in Automobile Engineering:** Passenger comfort and security , Seat belts, Air bags, Automotive Electronics - Electronic Control Unit (ECU) - Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP).	07

References

1. "Automotive Electrics, Automotive Electronics: Systems & Components, 4th Ed., BOSCH. 2005
2. Automotive Sensors, BOSCH. 2002
3. Ronald K. Jurgen, "Sensors and Transducers, 2nd Edition, SAE, 2003.
4. Ernest O. Doebelin, "Measurement Systems – Application and Design", 4th Edition, McGraw-Hill, 2000
5. Tai-Ran Hsu, "MEMS & Microsystem, Design and Manufacture", McGraw Hill, 2002.
6. David A. Corolla, (2009), Automotive Engineering: Powertrain, Chassis System and Vehicle Body, Butterworth-Heinemann Publishing Ltd.
7. Richard Stone, Jeffrey K. Ball, (2004), Automotive Engineering Fundamentals" SAE International
8. Kirpal Singh, Automobile Engineering, Vol.1&2, Standard Publications.

EES 504 R1: IOT System Design

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 **Define**[1] the various concepts, terminologies and architecture of IoT systems.
CO2 **Select**[2] sensor for given IoT domain.
CO3 **Illustrate**[2] design & security challenges in IoT.
CO4 **Design**[5] simple IoT system.

Contents

Units	Description	Hours
I	**Overview of IoT systems, Components of an IoT system:** Introduction to IoT concept, Objective, IoT History, Introduction to IoT communication **IoT Network Architecture and Design:-** Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.	08
II	**Sensors, Endpoints, and Power Systems:** Sensing devices, Smart IoT endpoints, Sensor fusion, Energy sources and power management	08
III	**Embedded Platforms for IoT:** Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards, ESPXX and ARM cortex, Particle boards.	08
IV	**Wireless technologies for IoT (Layer 1 & 2)/Architecture:** WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems, LoRaWAN, ZWave.	08

V	**IoT Edge to Cloud Protocols: Message Queue Telemetry Transport (MQTT) and CoAP.** MQTT architecture details, packet structure, MQTT communication formats, MQTT-SN architecture and topology, Transparent and aggregating gateways, Gateway advertisement and discovery **Constrained Application Protocol :-** Architecture, Messaging Formats, STOMP, AMQP, HTTP/RESTful	08
VI	**Challenges in IoT Design**: Development Challenges, Security Challenges, Other challenges **IoT Applications** : Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, Communicating data with H/W units, mobiles, tablets, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Designing of smart street lights in smart city.	08

References

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach”, 2014.
2. Edward Ashford Lee and Sanjit Arunkumar Seshia, “Introduction to Embedded Systems: A Cyber-Physical Systems Approach”, 2E, MIT press, 2016.
3. John Guttag, “Introduction to Computation and Programming using Python”, MIT press, 2016.
4. Perry Lea, “Internet of Things for Architects”, Packt Publishing, 2018.
5. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press 2017.
6. Abhik Chaudhuri, “Internet of Things, for Things, and by Things”, Taylor & Francis 2019.
7. John C. Shovic, “Raspberry Pi IoT Projects Prototyping Experiments for Makers”, APress 2016.
8. Charles Bell, “Beginning Sensor Networks with Arduino and Raspberry Pi”, APress 2013.

EES 506R1: Microcontrollers and Programmable Devices

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Summarize evaluation of Embedded Systems and Programmable devices
CO2 Build small scale embedded system using MSP430
CO3 Understand the working of Microcontroller and PLDs
CO4 Build simple embedded system using FPGA

Contents

Units	Description	Hours
I	**Introduction to Programmable Devices & Embedded Systems:** Classification of programmable devices, Embedded system (ES) definition, Embedded System Evaluation, ES Types with examples, Components of an Embedded system, Embedded system design issues & Design flow	06
II	**Architecture of MSP430:** Architecture, Key features of the MSP430G2553, Flexible Clock System, Embedded Emulation, Address Space, Flash, RAM, Peripheral Modules, Special Function Registers (SFRs)	06
III	**Special Features and programming in MSP 430:** Memory Organization, I/O System, BCM+, Timer_A, WDT+, ADC10, Comparator, Interrupts (Non)- Maskable Interrupts (NMI), Maskable Interrupts, Interrupt Processing, Interrupt Vectors.	06
IV	**PLD Architectures** Detail study of Xillnx9500 series, CPLD(XC9572), Spartan-IIIE FPGA (XC3S500E)	06

V	**Programming PLDs using VHDL/Verilog** Level of abstraction. Need of HDL, VLSI Design flow, Features and capabilities of HDL, Elements of HDL, Identifiers, literals, data types, operators, Concurrent & Sequential statements	06
VI	**Combinational and Sequential design using VHDL/Verilog** Adder, subtractor, decoder, encoder, tristate-buffer, multiplexer, Flipflops, Counter and Shift Registers, Interfacing examples.	08

References

1. ARM System Developers Guide- Designing & Optimizing System Software", Andrew N, Dominic Sloss, and Chris Wright, Elsevier, 2010.
2. MSP430x2xx Family User's Guide, Texas Instruments, Literature Number: SLAU144J December 2004–Revised July 2013
3. "Embedded systems" by Raj Kamal, McGraw Hill
4. "Principals of Digital System Design using VHDL" Roth, John, Cengage Learning
5. "Fundamentals of Digital Logic with VHDL design" Stephen Brown and Zvonko Vranesic, Tata – Mcgraw Hill
6. "Fundamentals of Digital Logic with Verilog design" Stephen Brown and Zvonko Vranesic, Tata – Mcgraw Hill
7. Xilinx synthesis tool details- XST and Datasheets of XC 9500 CPLD and Spartan 3E FPGA

Program Elective III

EES 5081 R1: Embedded Linux

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Illustrate Linux development setups.
CO2 Elaborate Linux Kernel fundamentals.
CO3 Analyse tools and utilities required for device handling.
CO4 Inspect the use of development and debugging tools in Linux
CO5 Apply different commands for performing operations on processes
CO6 Make use of the hardware interfaces in different applications

Contents

Units	Description	Hours
I	**Linux Fundamentals** : Introduction - host-target development setup - hardware support - development languages and tools – RT Linux.	07
II	**Initialization:** Linux kernel and kernel initialization - system initialization – hardware support – bootloaders.	07
III	**Device Handling:** Device driver basics - module utilities - file systems - MTD subsystems – busybox	07
IV	**Development Tools:** Embedded development environment - GNU debugger - tracing & profiling tools - binary utilities - kernel debugging - debugging embedded Linux applications - porting Linux - Linux and real time - SDRAM interface	07
V	**Shell Programming** Processes – giving more than one command at a time – prioritizing and killing processes – Scheduling Commands – pipes and redirection –	07

	regular expression – pattern matching – Scripting using for while, if and other commands.	
VI	**Device Applications:** Asynchronous serial communication interface - parallel port interfacing - USB interfacing - memory I/O interfacing - using interrupts for timing.	07

References

1. Karim Yaghmour, Jon Masters, Gillad Ben Yossef, Philippe Gerum, “Building embedded linux systems”, O'Reilly, 2008.
2. Christopher Hallinan, “Embedded Linux Primer: A practical real world approach”, Prentice Hall, 2007.
3. Craig Hollabaugh, “Embedded Linux: Hardware, software and Interfacing”, Pearson Education, 2002.
4. Doug Abbott, “Linux for embedded and real time applications”, Elsevier Science, 2003.

EES 5082 R1: Advanced Digital Communication

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1	Design matched filter for detection of digital signals in the presence of white Gaussian noise.
CO2	Design waveforms to overcome ISI in band-limited channels
CO3	Design equalization circuits to overcome the effect of channel distortion
CO4	Compute probability of error for binary digital modulation schemes in the presence of AWGN
CO5	Extend the binary modulation schemes to M-ary modulation for symbols.
CO6	Design turbo and LDPC codes to overcome the effect of noise in the channel.

Contents

Units	Description	Hours
I	**Introduction to Detection and Estimation Theory** Detection of known signals in noise, Correlation receiver, Matched filter receiver, Detection of signals with unknown phase in noise. Minimum mean square error estimator, Maximum a posteriori estimator, Maximum likelihood estimation, Cramer Rao bound (CRB) for parameter estimation.	07
II	**Baseband Transmission Techniques** Digital transmission through band limited channels, Power spectrum of digitally modulated signals, Signal design for band limited channels, Band limited signal design for zero ISI, Band limited signal design for controlled ISI.	06
III	**Baseband Reception Techniques** Probability of error in detection of digital PAM, Eye pattern, Channel equalization, Linear Equalizers, Adaptive equalizers, Decision feedback equalizers, Fractionally spaced equalizers.	06

IV	**Binary Band Pass Modulation Schemes** Binary modulation schemes, Coherent and non-coherent detection of binary modulation schemes, Performance analysis of binary modulation schemes under AWGN channel, Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying (GMSK).	06
V	**M-ary Band Pass Modulation Schemes** M-ary Phase Shift Keying, M-ary Quadrature Amplitude Modulation, M-ary Frequency Shift Keying, Performance analysis of M-ary modulation schemes under AWGN channel, Non-coherent detection of M-ary orthogonal signals, Carrier and timing recovery, Synchronization, Applications.	07
VI	**Trellis ,Turbo and LDPC Codes** Convolutional codes, Viterbi Decoder for convolutional codes, Set partitioning, Trellis codes, Turbo encoders, Turbo decoders, MAP decoder and Max-Log-Map decoder, Irregular and Asymmetric turbo codes. Regular LDPC codes, Gallager construction of LDPC codes, Gallager based decoding algorithm for LDPC codes and its analysis, LDPC threshold, Irregular LDPC codes.	08

References

1. Marvin K. Simon, Sami M. Hinedi, William C. Lindsey, Digital Communication Techniques: Signal Design and Detection, 2015, 1st Edition, Pearson Education, India.
2. Richard J. Tervo, Practical Signals Theory with MATLAB Applications, 2013, 1st Edition, Wiley, India.
3. Simon S. Haykin, Michael Moher, Communication Systems, 2012, 5th Edition, Wiley, India.
4. Shu Lin, Daniel J. Costello, Error Control Coding, 2011, 2nd Edition, Pearson Education, UK.
5. http://nptel.ac.in/courses/117101051

EES 5083 R1: Advanced Digital Image Processing

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Understand image formation and the role human visual system plays in perception of grey and colour image data.
CO2 Apply image processing techniques in both the spatial and frequency (Fourier) domains.
CO3 Conduct independent study and analysis of feature extraction techniques.
CO4 Introduce the concepts of image registration and image fusion.

CO5 Apply different transforms on image data.

CO6 Analyse the constraints in image processing when dealing with 3D data sets.

Contents

Units	Description	Hours
I	**Fundamentals Of Digital Image Processing:** Elements of visual perception, brightness, contrast, hue, saturation, Mach band effect, 2D image transforms- DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing	07
II	**Segmentation:** Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature-based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods	07
III	**Feature Extraction:** First and second order edge detection operators, Phase congruency, Localized feature extraction-detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features,	06

	Run length features, Fractal model-based features, Gabor filter, wavelet features	
IV	**Registration:** Preprocessing, Feature selection-points, lines, regions and templates Feature correspondence - Point patter matching, Line matching, region matching Template matching.	06
V	**Image Fusion:** Transformation functions - Similarity transformation and Affine Transformation. Resampling- Nearest Neighbor and Cubic Splines Image Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusion discrete wavelet transforms, Curvelet transform. Region based fusion.	07
VI	**Image Visualization:** Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.	07

References

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing', Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, Fundamentals of Digital Image Processing', Pearson Education, Inc., 2002.
3. Rick S. Blum, Zheng Liu, " Multisensory image fusion and its Applications" ,Taylor& Francis,2006.
4. Ardeshir Goshtasby, "2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications", John Wiley and Sons, 2005.

Program Elective - IV

EES 5101 R1: Data Science

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 **Choose**[3] statistical analysis techniques for solving practical problems.
CO2 **Illustrate**[3] different machine learning algorithms
CO3 **Explain**[2] different types of supervised & unsupervised learning techniques.
CO4 **Select**[4] appropriate algorithms for solving a particular group of real-world problems

Contents

Units	Description	Hours
I	**Data Science Concept:** Data science:- definition of data, data types, meaning of variables, wholeness of data analytics, data processing chain, data distributions, Paths to data science, data mining, data warehousing, difference between database and data warehouse, advices for new data scientists, introduction to cloud, Data science tools and technology, Regression.	08
II	**Descriptive Statistics**, Probability Distributions, **Inferential Statistics** through hypothesis tests Permutation & Randomization Test, Regression ANOVA(Analysis of Variance)	08
III	**Machine Learning: Introduction and Concepts**, Differentiating algorithmic and model based frameworks Regression : Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification.	08
IV	**Supervised Learning with Regression and Classification techniques** Bias-Variance Dichotomy Model Validation Approaches, Logistic Regression Linear Discriminant Analysis, Quadratic Discriminant	08

	Analysis Regression and Classification Trees Support Vector Machines, Ensemble Methods: Random Forest Neural Networks Deep learning	
V	**Unsupervised Learning and Preprocessing** Types of Unsupervised Learning, Challenges in Unsupervised Learning, Preprocessing and Scaling, Dimensionality Reduction, Feature Extraction, and Manifold Learning, Clustering :- k-Means Clustering, Vector quantization, or seeing k-means as decomposition, Agglomerative Clustering.	08
VI	**Representing Data and Engineering Features:-** Categorical Variables, Binning, Discretization, Linear Models, and Trees, Univariate Nonlinear Transformations **Model Evaluation and Improvement :-** Cross-Validation, Grid Search, Evaluation Metrics and Scoring	08

References

1. Joel Grus, Data Science from Scratch, O'Reilly, 1Ed, 2016.
2. Douglas C. Montgomery, George C. Runger., "Applied Statistics and Probability for Engineers", Wiley, 6th Edition, 2014.
3. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly, 1Ed, 2016.

EES 5102 R1: Soft Computing

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Understand Soft Computing concepts, technologies, and applications

CO2 Understand the underlying principle of soft computing with its usage in various application

CO3 Understand different soft computing tools to solve real life problems

CO4 Develop application on different soft computing techniques like Fuzzy, GA and Neural network.

Contents

Units	Description	Hours
I	**Introduction to Soft Computing:** What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing. Artificial Neural networks – biological neurons, Basic models of artificial neural networks, connections, learning, activation functions, McCulloch and Pitts Neuron, Hebb network.	08
II	**Fuzzy Systems:** Introduction Basic definitions and terminology, set-theoretic operations, MF Formulation and parameterization, More on Fuzzy union, intersection and complement. Fuzzy Logic Crisp & fuzzy sets fuzzy relations fuzzy conditional statements fuzzy rules fuzzy algorithm. Fuzzy logic controller.	08
III	**Adaptive Networks**: Architecture, Back propagation for feed forward networks, Extended back propagation for recurrent networks, Hybrid learning rule. **Perceptron Networks:** Learning rule, Training and testing algorithm.	06
IV	**Artificial Neural Networks: Supervised Learning:** Introduction and how brain works, Neuron as a simple computing element, The	10

	perceptron, Back propagation networks: architecture, multilayer perceptron, back propagation learning-input layer, accelerated learning in multilayer perceptron, The Hopfield network, Bidirectional associative memories (BAM), RBF Neural Network.	
V	**Artificial Neural Networks: Unsupervised Learning:** Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning, Self- Organizing Computational Maps: Kohonen Network.	08
VI	**Genetic Algorithm:** Genetic algorithms basic concepts, encoding, fitness function, reproduction-Roulette wheel, Boltzmann, tournament, rank, and steady state selections, Convergence of GA, Applications of GA case studies. Introduction to genetic programming-basic concepts	08

References

1. R. Rajasekaran and G. A Vijayalakshmi, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, Prentice Hall of India
2. D. E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley
3. Kumar S., Neural Networks - A Classroom Approach, Tata McGraw Hill, 2004.
4. Ross T. J., Fuzzy Logic with Engineering Applications, McGraw Hill, 1997.

EES 5103 R1: Network Security & Cryptography

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Outcomes: At the end of this course students will able to

CO1 Understand cryptography and network security concepts and application
CO2 Apply security principles to system design
CO3 Identify and investigate network security threat
CO4 Analyze and design network security protocols
CO5 Conduct research in network security

Contents

Units	Description	Hours
I	**Security in Networks** : Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity, Strong Authentication, Access Controls, Wireless Security, Honeypots, Traffic flow security, Firewalls – Design and Types of Firewalls, Personal Firewalls, IDS, Email Security – PGP, S/MIME	8
II	**Cryptography** : Introduction to Cryptography, Security Threats, Vulnerability, Active and Passive attacks, Security services and mechanism, Conventional Encryption Model, CIA model, Math Background : Modular Arithmetic, Euclidean and Extended Euclidean algorithm, Prime numbers, Fermat and Euler's Theorem.	6
III	**Classical Cryptography** : Dimensions of Cryptography, Classical Cryptographic Techniques	6
IV	**Block Ciphers (DES, AES)** : Feistal Cipher Structure, Simplifies DES, DES, Double and Triple DES, Block Cipher design Principles, AES, Modes of Operations	8
V	**Public-Key Cryptography** : Principles Of Public-Key Cryptography, RSA Algorithm, Key Management, Diffie- Hellman Key Exchange, Elgamal Algorithm, Elliptic Curve Cryptography	8

VI	**Hash and MAC Algorithms** : Authentication Requirement, Functions, Message Authentication Code, Hash Functions, Security Of Hash Functions And Macs, MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital Signatures, Key Management : Key Distribution Techniques, Kerberos	8

References

1. William Stallings, Cryptography And Network Security Principles And Practice Pearson Education, 4th Edition, 2006.
2. Wenbo Mao, Modern Cryptography: Theory and Practice, Pearson Education, 3rd Edition, 2004.
3. William Stallings, Network Security Essentials: Applications and Standards, Pearson Education, 3rd Edition, 1999.
4. Douglas R. Stinson, Cryptography: Theory and Practice, CRC press, 3rd Edition, 2005.

EES 512 R1: Automotive Electronics – II Lab

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	4	2	Practical	FEP	100	40

Course Outcomes: At the end of this lab, students will able to

CO1 Elaborate Electrical and electronics architecture of a vehicle
CO2 Inspect Wiring harness distribution
CO3 Analyse ECU and communication protocols

This laboratory is developed in collaboration with the Industry. The contents and experiments conducted in this laboratory are developed with the suggestions and guidelines from industry experts and are dynamic in nature in order to align it with the ever-changing needs of automotive industry.

List of Experiments

1. Study of Electrical and Electronics architecture of a vehicle
2. Wiring harness distribution in a vehicle
3. Automotive sensors
4. Starting system in a vehicle
5. Wiring of lighting system in a vehicle
6. ECU communication in a vehicle
7. Communication protocols used in vehicle
8. Controller area network
9. CAN bus arbitration

EES 514 R1: IOT System Design Lab

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	4	2	Practical	FEP	50	40
					POE	50	40

Prerequisite: Fundamentals of Arduino programming

Course Outcomes: At the end of this lab, students will able to

CO1 **Demonstrate**[3] basic principles of C/C+ + & Python programming language.
CO2 **Design**[5] IoT based systems using Arduino, ESP8266m Raspberry Pi board.

List of Experiments:

1. Interfacing analog sensors to Arduino
2. Interfacing digital sensors to Arduino
3. Interfacing Arduino Uno with ESP8266
4. Interfacing analog sensors to ESP8266 & sending data on Cloud.
5. Interfacing digital sensors to ESP8266 & sending data on Cloud.
6. Installing Noobs on Raspberry pi.
7. Setting up MQTT based system using node MCU & Raspberry Pi.
8. Setting up CoAP Server on Raspberry-Pi using SSH.

Text books

1. Simon Monk, “Programming the Raspberry Pi: Getting Started with Python”, McGraw Hill Professional, 23-Nov-2012
2. Agus Kurniawan, “Raspberry Pi I/O Programming Using Python”, APress 2017.
3. Ying Bai, “Practical Microcontroller Engineering with ARM Technology”, John Wiley & Sons, 2015

EES 516 R1: Employability Skills – (Project based learning) Level I

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	4	2	Practical	FEP	100	40

Course Outcomes: At the end of this, students will able to

CO1 Identify recent trends in the research area
CO2 Analyze the proposed research trends

Description

Students have to do the following to fulfill the credit requirement

1. Students have to analyze the recent trends in research, especially in Embedded Systems field and choose any specific area. (Should be in Scopus/SCI indexed journals)

2. Students should identify the problem based on his/her own interest and recent trends

3. Analyze the effectiveness of the system

4. Develop the model using MATLAB or Python or Scilab or any other software/hardware.

5. Analyze the performance and modify the system based on demerits of the existing system

6. Submit the report

Semester III

EES 601 R1: Industry Internship

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	-	4	Report & Presentation	FEP	100	40

Course Outcomes: At the end of this lab, students will able to

CO1 Develop an attitude to adjust with the company culture, work norms, code of conduct.

CO2 Understand the functioning of the company in the terms of inputs, transformation process and the outputs

Description

All the students enrolled for M. Tech program irrespective of their program of study are required to undergo 4 weeks industry internship in industries pertaining to the respective domain of their program. This internship is aimed at giving sufficient exposure to the students regarding the working of business, various functional areas, norms of work, organization structure, products and services along with the work procedure and systems. This help the students to visualize the inter connectivity between what they learn in classes (theory) to the real world of work. It also helps to understand the expectation of industries regarding Code of Conduct, time management, commitment, planning and scheduling the work activities and meeting and analytical and critical thinking skills required. Industry internship is to be done by the students at the end of semester II (during the vacation) or students have option to carryout internship in the company where they will take up dissertation work.

Industry Internship Program with Dissertation

It is full one year two semester program in the second year of the program semester III and IV This course aims at giving students hands on experience to imbibe in them the skills and competencies required to make them competent post graduates for employment as per the expectation of the industry where the students are expected to

work as interns and carry out the individual project assigned to them by the company. The students learning progress is monitored by both industry person concerned and the supervisor assigned.

OUTCOME EXPECTED AT THE END OF INTERNSHIP

After the successful completion of the internship the student should be able to

1. Understand the functioning of the company in the terms of inputs, transformation process and the outputs (products and services)
2. Develop an attitude to adjust with the company culture, work norms, code of conduct.
3. Understand and follow the safety norms, Code of conduct.
4. Demonstrate the ability to observe, analyze and document the details as per the industry practices.
5. Understand the processes, systems and procedures and to relate to the theoretical concepts- studied.
6. Analyze the company with respect to its competitors.
7. Carry out SWOT analysis of the company
8. Improve the leadership abilities, interpersonal communication.
9. Demonstrate project management and finance sense

WORK DIARY

Each student should maintain a work which contains details regarding internship, do's and don'ts and evaluation scheme. Students is required to write the dairy regularly and get it signed by the industry guide periodically during the visit the faculty assigned to the student should be able to go through the dairy to access the work done and write the remarks/ instruction. At the end of the internship, the duly completed dairy to be submitted to the department.

CODE OF CONDUCT:

The students should strictly abide by the rules and regulations of the company with respective to safety, timing, discipline. Any violation of the norms will view seriously and the institute may take strict action in such situation and student may face a severe setback in both his academics and career.

EXPENSES OF THE INTERSHIP TRAINING and DISSERTATION IN COMPANY:

All the expenses of the training like travelling, boarding and lodging should be borne by the students. However, if the company offers, they are eligible to get subsidized canteen facility, transport facility.

EVALUATION OF INTERNSHIP: (4 CREDITS)

The assessment of the internship will be done jointly by the industry and the faculty assigned to the students. The tentative scheme of assessment will be

1.	Punctuality, behavior and following code of conduct (to be assessed by the company personal)	20%
2.	Initiative, observation and interest in learning new things (faculty in charge)	20%
3.	Familiarization with specific Department/shop/function assigned to student (to be assessed by the company personal)	20%
4.	Final evaluation based on presentation of work, internship report (By DPGC committee and Supervisors)	40%

Minimum 50% is mandatory for successful completion of internship or else the extension will be given to make the student to come up to the expectation.

EES 603 R1: Open Elective (Directed Learning)

(Ver 1.0, University Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	-	2	NPTEL/ MOOC Certificates should be produced	FET	100	40

Course Outcomes: At the end of this lab, students will able to

CO1 **Develop**[3] self-learning skills

CO2 **Demonstrate**[3] theoretical knowledge required for project implementation

Instructions

- Student shall register for the 4-credit course offered by authorized institutions/Agencies, through online with the approval of Head of the Department. Allowed MOOC courses agencies are NPTEL/ SWAYAM/ EDX/Coursera only.
- The Head of the Department shall appoint one mentor for MOOC subject opted and the mentor shall monitor the progress. The student shall submit an application not later than one week prior to the scheduled normal date of semester registration to the Head of the Department (HoD) giving the following details : Course Title, Agency Offering MOOC, Examination system and Credits of the Course, Timing and duration of course and its examination, centres of conducting of examination.
- On receipt of the application, the HoD shall forward the course details for aapproval to the DPGC committee. This committee shall examine the proposal in detail regarding course contents, examination system, suitability of the course and equivalence of course as per the Institute norms and give its recommendations for approval or non-approval including any special conditions to be imposed. Fees and other charges, if any, payable to MOOC certification agency shall be borne by concerned student at his/ her own level.
- The student shall submit the original certificate issued by MOOC authorities along with a photocopy of the same to the Department. The original will be returned after verification. Verification shall be certified by the HOD on the photocopy which shall be kept in records.

EES 605 R1: Dissertation Phase I

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	-	6	Synopsis & Presentation	FEP	100	40

Course Outcomes: At the end of this, students will able to

CO1 Exhibit both analytical and practical skills through dissertation work.
CO2 Use new analytical and computer based tools for solving the identified problem

Description

Dissertation is a program requirement for M. Tech wherein under the guidance of a supervisor/ co-supervisor from the industry in case of industry sponsored projects, a second year student is required to some innovative/ contributory/ developmental work with the application of knowledge earned while undergoing various theory and laboratory courses. A student has to exhibit both analytical and practical skills through dissertation work.

A student is expected to carry out intensive literature survey/ identification of a major issue or problem in case of industry projects with observations and discussions in the area of interest specific to the domain in consultation with the dissertation supervisor and industry co- supervisor. The objectives and scope of the dissertation will be expected at a higher level and the use of the new analytical and computer based tools for solving the identified problem is recommended.

A student is required to submit the dissertation synopsis duly signed by supervisor and co- supervisor to the M. Tech Co- coordinator of the department who schedules the synopsis presentation seminar in the DPGC (Departmental Program Committee).

The dissertation synopsis seminar presentation comprises of the following details:

- A Dissertation title
- General introduction to the area of the topic
- Relevance of the dissertation work
- Literature review/ prior work done in the area
- Dissertation objectives and scope

- Expected outcomes
- Methodology
- Phases of work and representation on a Gantt chart with deadlines
- Resources required to complete the work
- Commitment from the student (Ethical conduct)
- References

Based on the report and the presentation, the DPGC will give approval to the dissertation/ give suggestions/ suggest changes/modifications, additional scope, etc. specific to make dissertation to come to the expected level of PG requirement. The student will incorporate the suggestions and resubmit the same for approval.

The final copy of the synopsis with approval seal will be issued to the student, supervisor and the co- supervisor of the company which becomes the guiding document for the dissertation.

The Evaluation Guidelines

1. Based on the initiative, the novelty and the skill in identifying the problem and collecting and analyzing the information and co-Supervisor : 50 %
2. Presentation, scope, outcomes, research compilation, relevance DPGC: 50%

EES 607 R1: Dissertation Phase II

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	-	6	Presentation, Report & Demo	FEP	50	40
					ESE	50	40

Course Outcomes: At the end of this, students will able to

CO1 Exhibit both analytical and practical skills through dissertation work.

CO2 Use new analytical and computer based tools for solving the identified problem

Description

Followed by approval of the synopsis, this phase aims at completing at least 40 % of the dissertation work specified in the synopsis.

Phase II evaluation consists of a progress review based on the efforts put in by the student to carry out the work and results obtained thereof to seek suggestions and improvements and to ascertain that the student is going in the right direction.

This phase consists of both the In- semester evaluation by the supervisor and DPGC (ISE) and the end semester evaluation (consisting of presentation followed by demonstration) by a panel of examiners appointed by the COE of the university based on the panel of experts approved by BOS submitted to the COE.

The Evaluation Scheme	Weightage%
Supervisor and co- supervisor	25
DPGC of the program department	25
Panel of Examiners [Chairman, internal supervisor, external expert]	50

In the DPGC Evaluation, if the progress is not found satisfactory, the student will be given the grace period of 4 weeks to work on the dissertation and present it to the committee again and on approval the ESE will be conducted. In this case, the student has to suffer one grade penalty and the next semester Phase III starts only on satisfactory completion of Phase II

Semester IV

EES 602 R1: Dissertation Phase III

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	-	8	Presentation Report & Demonstration (100 % work)	FEP	100	40

Course Outcomes: At the end of this, students will able to

CO1 Exhibit both analytical and practical skills through dissertation work.

CO2 Use new analytical and computer based tools for solving the identified problem

Description

This stage marks the final progress review which indicates the completion of all the defined phases of the dissertation satisfactorily on the periodic progress reviews by supervisor and co- supervisor. A student by this time has used an opportunity to present his dissertation work in a reputed international/national conference to receive the feedbacks/ comments on the work and any new dimension to be incorporated to make the work novel and worthy of publishing in peer reviewed journals and should also prepare a journal paper based on the complete work of dissertation with results, discussions and conclusions.

A student is required to prepare the draft dissertation report as per the format of the university and with approval of supervisor and co- supervisor submit the same to the PG program coordinator of department.

The Program coordinator will schedule the presentation of student (Pre submission) before the DPGC members once the student has completed all the academic requirements for the prescribed program.

1. Submission of Draft Dissertation Report
2. Completion of internship
3. Completion of the online/self-study.
4. Earning 100% credits of Sem I to III

5. Proof of presentation of the work in the International Conference (Certificate publication and draft paper in a template for an identified journal/uploading of same in peer reviewed journal)

Based on the recommendation of DPGC, the dissertation is processed further. Viva-Voce examination is to be scheduled preferably with the same external expert appointed for the Dissertation Phase II by COE.

The successful completion of the Viva- voce, the panel of examiners recommends the candidate as successfully completed and submits the evaluation in the sealed envelope.

Evaluation Scheme for Phase III

S No		Weightage %	Min. Passing %
1	Supervisor and Co supervisor	50	40
2	DPGC Committee	50	

EES 604 R1: Dissertation Phase IV

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	-	10	Viva Voce Exam	ESE	100	40

Course Outcomes: At the end of this, students will able to

CO1 Exhibit both analytical and practical skills through dissertation work.

CO2 Use new analytical and computer based tools for solving the identified problem

Description

Evaluation Scheme for Phase IV

	Weightage %	Min. for Passing%
External Viva-voce examination by a panel (ESE)	100	40%

If the DPGC committee is of the opinion that a student is required to work further to achieve the stated objectives and incorporate some additional work, an extension based on the work is given to the student to complete the work and the student is required to re-submit the dissertation and a presentation is to be given to DPGC. The DPGC will take a final decision on whether to schedule the final exam or give additional extension of the work.

EES 606 R1: Dissertation Outcome & Dissemination

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	% WT	%Pass
-	-	-	2	Publication & Patents	FEP	100	40

Course Outcomes: At the end, students will able to

CO1 Present and publish their work to the society

Description

1. Participate and present a paper in a reputed national/ international conference organized by the premium institutions/ professional bodies. It is recommended to participate and publish in conferences whose proceedings are published by IEEE, Elsevier, Springer, Materials Today or any other reputed conferences.

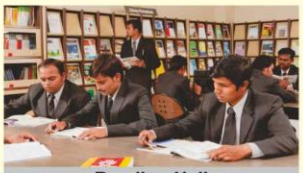
2. Paper for a peer reviewed journal is to be prepared as per the journal format and uploaded to the journal website. It is desirable that at least the paper will be selected in initial review regarding Scope and it enters the second phase of editor.

3. If the work of a student is novel and patentable in this case, a student need not have to bring his research findings in public domain through publication but he can file the patent. Student should be able to get provisional registration of patent with patent office.

Facilities

Administrative Building


Auditorium


Reading Hall


Well Equipped Classroom


Sophisticated Computer Lab


Advanced Laboratories


Workshop


Food Court


Stadium


Gymnasium


Music Academy


Transport

SGU

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Kolhapur

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