M. E (Embedded Systems)

2021 Regulations, Curriculum & Syllabi

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

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BANNARI AMMAN INSTITUTE OF TECHNOLOGY
REGULATIONS 2021
(CHOICE BASED CREDIT SYSTEM)

Common to all M.E. / M.Tech. Degree Programmes

NOTE: *The regulations given hereunder are subject to amendments as may be decided by the Academic Council of the Institute from time to time. Any or all such amendments will be effective from such date and to such batches of students, including those already in the middle of the programme as may be decided by the Academic Council.*

1. ELIGIBILITY FOR ADMISSION

(i) Candidates seeking admission to the First Semester of M.E./M.Tech. degree programmes will be required to satisfy the eligibility criteria for admission thereto prescribed by the Directorate of Technical Education, Chennai and Anna University, Chennai.

(ii) Students admitted under 'Full-Time' should be available in the departments during the entire duration of working hours (from morning to evening on a full-time basis) for the curricular, co-curricular and extra-curricular activities.

The full-time students should not attend any other full-time programme(s) / course(s) or take up any full-time job / part-time job during working hours in any institution or company during the period of the full-time programme. Violation of the above rules will result in the cancellation of admission to the PG programme.

2. DURATION OF THE PROGRAMME

(i) **Minimum Duration:** Master of Engineering (M.E.) / Master of Technology (M.Tech.) extends over a period of two years. The two academic years will be divided into four semesters, with two semesters per year.

(ii) **Maximum Duration**: A candidate shall complete all the passing requirements of M.E./M.Tech. programmes within a maximum period of 4 years / 8 semesters, these periods being reckoned from the commencement of the first semester to which the candidate was first admitted, regardless of the break-of-study availed.

3. BRANCHES OF STUDY

Following M.E./M.Tech. programmes are offered by the institute

M.E. Programmes

1. Communication Systems
2. Computer Science and Engineering

3. Embedded Systems
4. Industrial Automation and Robotics
5. Industrial Safety Engineering
6. Power Electronics and Drives
7. Software Engineering
8. Structural Engineering

M. Tech. Programme

9. Biotechnology

4. STRUCTURE OF PROGRAMMES

(i) **Curriculum:** Every post-graduate programme will have a curriculum with syllabi consisting of theory and practical courses that include

Program Core Courses (PCC) include the core courses relevant to the chosen specialisation.

Program Elective Courses (PEC) include the elective courses relevant to the chosen specialisation.

Research Methodology and IPR Course to understand the importance and the process of creation of patents through research.

Employability Enhancement Courses (EEC) include project work, practical courses, internship, mini project and industrial/practical training.

Audit Courses (AC) expose the students to Disaster Management, Yoga, English for Research Paper Writing, Value education, Pedagogy Studies, Stress Management, and Personality Development through Life Enlightenment Skills. Registration for any of these courses is optional to students.

(ii) **Project Work:** Every student, individually, shall undertake Dissertation Phase I during the third semester and Dissertation Phase II during the fourth semester under the supervision of a qualified faculty. The project work can be undertaken in an industrial / research organisation or institute in consultation with the faculty guide and the Head of the Department. In the case of project work at an industrial / research organisation, the same shall be jointly supervised by a faculty guide and an expert from the organisation. The student shall be instructed to meet the supervisor periodically and attend the review committee meetings to evaluate the progress.

(iii) **Elective Courses: Five Elective** courses are offered to the students admitted in various disciplines as prescribed in the curriculum to widen their knowledge in their specialisation area.

(iv) **Online Courses:** A Student may be permitted to credit online courses with the approval of a Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of six credits. Such students may be exempted

from attending the classes if such course(s) are offered in the semester. Summary of such online courses, taken by the students, along with the offering agency shall be presented to the Academic Council for information and further suggestions. However, the student needs to obtain certification from the agency offering the course to become eligible for writing or seeking exemption from the End Semester Examinations. In case of credits earned through online mode from the Institute / University, the credits may also be transferred directly after due approval from the Departmental Consultative Committee and the Controller of Examinations.

(v) **Industrial Training:** Every full-time student shall take up training in industry/research laboratories, under the supervision of a faculty guide during summer/winter vacation till the pre-final semester of the programme subject to the evaluation prescribed in Clause 15.

If industrial training/internship is not prescribed in the curriculum, the student may undergo industrial training/internship optionally, and the credits earned will be indicated in the Mark Sheet. If the student earns three credits in industrial training/internship, the student may drop one Program Elective in the III semester. In such cases, industrial training/internships need to be undergone continuously from one organisation only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for the classification of the degree. The student is only allowed to undergo a maximum of 6 weeks of industrial training/internship during the entire duration of the study.

Duration of Training / Internship	**Credits**
2 Weeks	1
4 Weeks	2
6 Weeks	3

(vi) **Mini Project**: The students shall undertake a mini project individually in consultation with the respective faculty and Head of the Department, as specified in the curriculum. A student is expected to make a presentation about the mini-project during the final evaluation as given in Clause 15.

(vii) **Value Added / Certificate Courses:** Students can opt for any one of the value-added courses in II and III semesters, approved by the Academic Council. A separate certificate will be issued on successful completion of the course by the Controller of Examinations.

(viii) **Credit Assignment:** Each course is normally assigned a certain number of credits with 1 credit per lecture hour per week, 1 credit for 2 hours of practical per week, 1 credit for 1 hour of tutorial per week. The exact numbers of credits assigned to the different courses of various programmes are decided by the respective Board of Studies.

(ix) **Minimum Credits:** For the award of the degree, the student shall earn a minimum number of total credits as prescribed by the respective Board of Studies as given below:

S.No.	M.E./M. Tech. Programmes	Total Credits
1.	M.E. Communication Systems	68
2.	M.E. Computer Science and Engineering	68
3.	M.E. Embedded Systems	68
4.	M.E. Industrial Automation and Robotics	68
5.	M.E. Industrial Safety Engineering	68
6.	M.E. Power Electronics and Drives	68
7.	M.E. Software Engineering	68
8.	M.E. Structural Engineering	68
9.	M.Tech. Biotechnology	68

5. COURSE ENROLLMENT AND REGISTRATION

5.1 Each student, on admission, shall be assigned to a Faculty Advisor (vide Clause 7) who shall advise/counsel the student about the details of the academic programme and the choice of courses considering the student's academic background and career objectives.

5.2 Every student shall enrol for the courses of the succeeding semester in the current semester. However, the student shall confirm the enrolment by registering for the courses within the first five working days after the commencement of the semester concerned.

5.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

5.3.1 Each student on admission to the programme shall register for all the **courses prescribed in the curriculum** in the **first semester of study**.

5.3.2 The enrolment for all the courses of semester II will commence 10 working days prior to the last working day of the semester I. The student shall confirm the enrolment by registering for the courses within the first five working days after the commencement of semester II.

5.3.3 If a student wishes, the student may drop or add courses (vide Clause 5.5)

within **five** working days after the commencement of the semester concerned and complete the registration process duly authorised by the PG coordinator of the programme. In this case, if a student fails in a course, he/she may be permitted to register for the course in the subsequent semester or when it is offered.

5.3.4 A student who has passed all the courses prescribed in the curriculum for the award of the degree shall not be permitted to re-enrol to improve the student's marks in a course or the aggregate marks / CGPA.

5.4 Minimum Credits to Register for Project work

The Project work for M.E./M.Tech. consists of dissertation phase I and dissertation phase II. Dissertation phase I is to be undertaken during the III semester, and dissertation phase II, which is a continuation of phase I, is to be undertaken during the IV semester. Minimum 24 credits are required to be earned to enrol on dissertation phase I.

If a student fails to earn the requisite minimum credits, the student cannot enrol for dissertation phase I. In such a case, the student can enrol for the project work in a subsequent semester after earning the minimum credits specified.

5.5 Flexibility to Add or Drop courses

5.5.1 A student has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. However, if a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum of the student's programme by opting for additional courses.

5.5.2 From the II to final semesters, the student has the option to register for additional courses or drop existing courses. The total number of credits that a student can add or drop is limited to 6, subject to a maximum of 2 courses. In such cases, the attendance requirement as stated in Clause 6 is mandatory.

The courses that a student registers in a particular semester may include:

i. Courses of the current semester and

ii. Courses dropped in the lower semesters.

The maximum number of credits that can be registered in a semester is 36. However, this does not include the number of Re-appearance (RA) and Withdrawal (W) courses registered by the student for the appearance of Examination.

5.6 Reappearance Registration

5.6.1 If a student fails in a theory course, the student shall do reappearance registration for that course in the subsequent semester or when it is offered next.

5.6.2 On registration, a student may attend the classes for the reappearance registration courses if the student wishes. However, the attendance requirement (vide Clause 6) is not compulsory for such courses.

5.6.3 The student who fails in any practical/mini project or any other EEC courses shall register for the same in the subsequent semester or when offered next and **repeat** the course. In this case, the student shall attend the classes, satisfy the attendance requirements (vide Clause 6) and earn continuous assessment marks.

5.6.4 The student who fails in dissertation phase I / II shall register for the same in the subsequent semester or when offered next and **repeat** the course. In this case, the student shall attend the classes, satisfy the attendance requirements (vide Clause 6), earn continuous assessment marks and appear for the end semester examinations. Reappearance registration is not available for such courses.

5.6.5 If a student is prevented from writing the end semester examination of a course due to lack of attendance, the student has to register for that course again, when offered next, attend the classes and fulfil the attendance requirements as per Clause 6.

6. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide clause 6.1 and 6.2) shall be deemed to have satisfied the attendance requirements for appearing for the End Semester Examination of a particular course.

Each semester shall normally consist of 75 working days or 540 periods of each 50 minutes duration for the full-time mode of study.

6.1 Ideally, every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.

6.2 If a student secures attendance between 70% and 79% in any course in the current semester due to medical reasons (prolonged hospitalisation/accident / specific illness) or participation in Institution/University/State/National/International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate/participation certificate attested by the Head of the Department. Such certificates shall be forwarded to the Controller of Examinations for verification and permission to attend the examinations.

6.3 A student shall normally be permitted to appear for the end semester examination of a course if the student has satisfied the attendance requirements (vide Clause 6.1-6.2) and has registered for the examination in those courses of that semester by paying the prescribed fee.

6.4 A student who does not satisfy clauses 6.1 and 6.2 and secures less than 70% attendance in a course will not be permitted to write the end semester examination. The student has to register and repeat this course in the subsequent semester or when it is offered next (vide clause 5.6.4).

6.5 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course to improve grades/marks.

7. FACULTY ADVISOR

To help students plan their courses of study and for general advice on the academic programme, the Head of the Department of the students will attach a certain number of students to a teacher of the department, who shall function as a faculty advisor for those students throughout their period of study. The faculty advisor shall advise the students in registration and reappearance (Arrear) registration of courses, authorise the process, monitor their attendance and progress and counsel them periodically. If necessary, the faculty advisor may also discuss with or inform the parents about the progress/performance of the students concerned.

The responsibilities of the faculty advisor shall be:

i. To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.

ii. To guide student enrolment and registration of the courses

iii. To authorise the final registration of the courses at the beginning of each semester.

iv. To monitor the academic and general performance of the students, including attendance, and to counsel them accordingly.

v. To collect and maintain the academic and co-curricular records of the students

8. COMMITTEES

8.1 Class Committee Meeting

i. For all the courses taught, prescribed in the curriculum, a class committee meeting shall be convened twice a semester, comprising faculty members handling all the courses and two student representatives from the class.

ii. One of the faculty members (not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of

this Committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

9. ASSESSMENT AND PASSING REQUIREMENTS

9.1 Assessment

The assessment will comprise continuous assessment and end semester examination, carrying marks as specified in the scheme (Clause 15). All assessments will be done on absolute marks basis. However, to report the performance of a student, letter grades and grade points will be awarded as per Clause 9.4.

9.2 End Semester Examinations

End semester examinations will normally be conducted as per the timetable circulated by the CoE's Office. A student will be permitted to appear for the end semester examination of a semester only if he/she completes the study of that semester satisfying the requirements given in Clause 5 and 6, and registers simultaneously for the examinations of the highest semester eligible and the courses, pertaining to that semester, that needs reappearance.

9.3 Employability Enhancement Courses

Every candidate shall submit reports on industrial training / mini-project, dissertation phase I and dissertation phase II on dates announced by the institute/department through the faculty guide to the head of the department. If a candidate fails to submit the reports of any of these courses not later than the specified date, he/she is deemed to have failed in it. The reports /papers shall be orally presented by the student before a team of experts consisting of an internal examiner, usually the supervisor, and an external examiner, appointed by the Controller of the Examination.

A candidate is permitted to register for dissertation phase II only after passing dissertation phase I. A candidate who fails in industrial training / mini-project, dissertation phase I or dissertation phase II shall register for redoing the same at the beginning of a subsequent semester.

9.4 Letter Grade and Grade Point

The letter grade and the grade point are awarded based on the percentage of total marks secured by a candidate in an individual course as detailed below:

Letter Grade	**Grade Points**
O (Outstanding)	10
A + (Excellent)	9
A (Very Good)	8
B + (Good)	7
B (Above average)	6
C (Satisfactory)	5
RA (Reappearance Registration)	0
I (Incomplete)	0
W (Withdrawal)	0
AB (Absent)	0
SA(Shortage of Attendance)	0

'RA' - Reappearance registration is required for that particular course

'I' - Continuous evaluation is required for that particular course in the subsequent examinations.

After completion of the evaluation process, Semester Grade Point Average (SGPA) and Cumulative Grade Point Average is calculated using the formula:

$$SGPA/CGPA = \frac{\sum_1^n C_i * g_i}{\sum_1^n C_i}$$

where

C_i Credit allotted to the course.

g_i Grade Point secured corresponding to the course.

n number of courses successfully cleared during the particular semester in the case of SGPA and all the semesters, under consideration, in the case CGPA.

9.5 A student can apply for revaluation of his/her semester examination answer paper in a theory course, within 3 working days from the declaration of results, along with prescribed application to the Controller of Examinations through the Head of Department. Revaluation is not permitted for laboratory courses, industrial training, and project works.

9.6 Passing a Course

A candidate who secures Grade Point 6 or more in any course of study will be declared to have passed that course, provided he/she secures a minimum of 50% of the total mark in the end semester examination of that course.

If a student fails to secure a pass in theory courses and laboratory courses in the current semester examination, he/she is allowed to write arrear examinations for the next three consecutive semesters, and their internal marks shall be carried over for the above mentioned period of three consecutive semesters.

In case if he/she has not completed all the courses of the semester I at the end of semester IV, he/she shall redo the semester I courses along with regular students. The same procedure shall be followed for the subsequent semesters of II, III and IV, subject to the maximum permissible period for this programme.

9.7 If a candidate fails in the end semester examinations of Phase I, he/she has to resubmit the project report within 30 days from the date of declaration of the results. If he/she fails in the end semester examination of Phase II of M.E. / M.Tech., he/she shall resubmit the project report within 60 days from the date of declaration of the results. The resubmission of the project report and the subsequent viva voce examination will be considered as reappearance with payment of the exam fee. If a student fails to resubmit the project report within the stipulated period and fails in the subsequent viva-voce examination, the student shall register for the course again in the subsequent semester.

10. REJOINING THE PROGRAMME

A candidate who has not completed the study of any of the semesters as per Clause 6 or who is allowed to rejoin the programme after the period of discontinuance or who on his/her own request is permitted to repeat the study of any semester (break of study), may join the semester which he/she is eligible or permitted to join, only at the time of its normal commencement for a regular batch of candidates and after obtaining the approval from the Director of Technical Education and Anna University, Chennai. In such a case, earlier continuous assessment in the repeated courses will be disregarded. However, no candidate will be allowed to enrol in more than one semester at any point of time.

11. QUALIFYING FOR THE AWARD OF THE DEGREE

A candidate will be declared to have qualified for the award of the M.E. / M.Tech. Degree provided:

i. He/she has completed the course requirements and has passed all the prescribed courses of study of the respective programme listed in Clause 3 within the duration specified in Clause 2.

ii. No disciplinary action is pending against the candidate.

12. CLASSIFICATION OF THE DEGREE AWARDED

12.1 First Class with Distinction:

A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the four semesters in the student's First Appearance within two years (Three years in case of authorised break of study of one year (if availed)). Withdrawal from examination (vide Clause 13) will not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50.
- Should NOT have been prevented from writing end Semester examination due to lack of attendance in any of the courses.

12.2 First Class:

A student who satisfies the following conditions shall be declared to have passed the examination in first-class:

- Should have passed the examination in all the courses of all four semesters within three years, including one year of authorised break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of not less than 6.50

12.3 Second Class:

All other students (not covered in clauses 12.1 and 12.2) who qualify for the award of the degree shall be declared to have passed the examination in the second class.

12.4 A student who is absent in the End Semester Examination in a course/project work after having registered for the same shall be considered to have appeared in that examination (except approved withdrawal from end semester examinations as per clause 13) for the purpose of classification.

13. WITHDRAWAL FROM EXAMINATION

13.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme.

13.2 Withdrawal application shall be valid only if the student is eligible to write the examination as per Clause 6 and if such withdrawal request is made prior to the submission of marks of the continuous assessment of the course(s) with the recommendations from the Head of the Department.

13.3 If a student withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examination(s)

13.4 Withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for first class with distinction or first class.

13.5 Withdrawal is permitted for the end semester examinations in the final semester only if the period of study the student concerned does not exceed 3 years for M.E. / M.Tech. as per clauses 12.1 and 12.2.

14. AUTHORISED BREAK OF STUDY FROM A PROGRAMME

14.1 A student is permitted to go on a break of study for a fixed period of one year as a single break in the entire course of study.

14.2 A student who would like to avail the break of study, on account of short term employment / medical treatment / personal reasons) shall apply to the Head of the Institution through the concerned Head of the Department (application available with the Controller of Examinations), in any case, not later than the last date for registering for the semester.

14.3 The students permitted to re-join the programme after a break of study/prevention

due to lack of attendance shall be governed by the curriculum and regulations in force at the time of re-joining. A committee constituted by the Head of the Institution shall prescribe additional/equivalent courses, if any, from the regulation in force to bridge the requirement between the curriculum in force and the old curriculum.

14.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 2, irrespective of the period of break of study in order that he/she may be eligible, for the award of the degree (vide Clause 11 and 12).

14.5 In case of any valid reasons for the extension of break-of-study, such extended break-of-study may be granted by the Head of the Institution for a period not more than one year in addition to the earlier authorised break of study. Such extended break-of-study shall be counted for the purpose of classification of degree (vide clause 12).

14.6 If a student does not report back to the institute, even after the extended break of study, the name of the student shall be deleted permanently from the college enrolment. Such candidates are not entitled to seek readmission under any circumstances.

15. SCHEME OF ASSESSMENT

I	**THEORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (15)	
	Periodical Test II (15)	
	Term Paper Report (10) & Presentation (10)	
	End Semester Examination	**50**
	Total Marks	**100**

II	**THEORY COURSES WITH LAB COMPONENT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (15)	
	Periodical Test II (15)	
	Lab Examination (10)	
	Viva-voce (10)	
	End Semester Examination	**50**
	(QP pattern as per (I))	
	Total Marks	**100**

III	**PRACTICAL COURSES**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Conduct of Experiment	
	i. Preparation (10)	
	ii. Experiment and Analysis of Results (20)	
	iii. Record (5)	
	Self-Learning Experiment (15)	
	Test - Cycle I (15)	
	Test - Cycle II (15)	
	Final Viva-voce (20)	
	Total Marks	**100**

IV	**DISSERTATION PHASE I**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Identification of topic and Justification (5)	
	Literature Survey (5)	
	Review II	
	Work plan & Approach (10)	
	Progress, Results and Discussion (10)	
	Review III	
	Conclusion (10)	
	Implementation & Applications (10)	

	End Semester Examination	
	Presentation (20)	**50**
	Report (10)	
	Viva Voce (20)	
	Total Marks	**100**

V	**DISSERTATION PHASE II**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Work plan & Approach (10)	
	Review II	
	Progress (10)	
	Results and Discussion (10)	
	Review II	
	Conclusion (10)	
	Implementation & Applications *(10)*	
	End Semester Examination	
	Presentation (20)	**50**
	Report (10)	
	Viva Voce (20)	
	Total Marks	**100**

VI	**MINI PROJECT**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Review I	**25**
	Review II	**25**
	Presentation & Viva voce	**50**
	Total Marks	**100**

VII	**INDUSTRIAL TRAINING / INTERNSHIP**	**Marks**
	Continuous Assessment	**100**
	Presentation	**30**
	Viva-voce	**30**
	Case study / Report	**40**
	Total Marks	**100**

VIII	**VALUE ADDED COURSES / CERTIFICATE COURSES (Continuous Assessment Only)**	**Marks**
	Test I	50
	Test II	50
	Grades: Excellent (>80) / Good (61≤Marks ≤ 80) / Satisfactory (50≤Marks ≤ 60))	

Optional Test: *A student becomes eligible to appear for the one optional test conducted after the Periodical Test II, only under the following circumstances, if absent for Test I or Test II or both, on account of (i) medical reasons (hospitalisation / accident / specific illness) (ii) participation in the college/university/state / national/international level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned faculty member who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are not conducted for the courses under the categories III, IV, V, VI, VII and VIII listed above.*

16. DISCIPLINE

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the end semester / continuous assessments, he/she shall be liable for punitive action as prescribed by the institution / university from time to time.

VISION

To empower the graduates with first-class engineering skill and make them excel in the field of automation to serve the National and International needs both at social and industrial fronts with the help of centre of excellence in the core domain.

MISSION

i. To strengthen the relation between academia and industry for their mutual benefits
ii. To empower the students with balanced technical education to confront multidisciplinary engineering problems.
iii. To update the existing infrastructure along with establishing a new one to encourage research and start-up related activities.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

On successful completion of two year ME degree programme quite a few years after graduation, our graduates will

I. Graduate will be able to solve computational problems by applying mathematical, scientific and engineering knowledge in multidisciplinary domain.

II. Graduate will be able to apply technical skills to meet the industrial challenges in the field of embedded systems.

III. Graduate will be able to enhance the research and managerial skills in the domain of embedded systems, integrating safety, sustainability and become successful professionals or an entrepreneur.

PROGRAMME OUTCOMES (POs)

Graduates will be able to:

PO a: Imparting domain knowledge in Electric equipments, information technology and communication engineering to develop a cyber physical approaches for real time systems

PO b: Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems.

PO c: Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems.

PO d: Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications.

PO e: Communicate the technical information effectively with the engineering community to make effective reports and presentations.

PO f: Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

MAPPING OF PEOs ANDPOs

POs / PEOs	a	b	c	d	e	f
I	X	X	X	X	X	X
II		X	X	X		
III	X				X	X

R2021 - M.E. – EMBEDDED SYSTEMS

ME: Embedded Systems

Minimum credits to be earned: 68

First Semester								
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours/ Week**
		PEOs	**Pos**					
21ES11	Research Methodology and IPR	I,II,III	e,f	2	0	0	2	2
21ES12	Machine Learning in Embedded System	I,II,III	a,c,d,e	3	0	0	3	3
21ES13	Embedded Processor and Interfacing Techniques	I,II,III	a,c,d,e	3	0	0	3	3
21ES14	Real Time Digital System Design	I,II,III	a,c,d,e	3	0	0	3	3
	Program Elective I		-	3	0	0	3	3
21ES16	Embedded Processor and Interfacing Techniques Laboratory	I,II,III	a,c,d,e	0	0	4	2	4
21ES17	Embedded System Design Laboratory	I,II,III	a,c,d,e	0	0	4	2	4
	Audit Course I[1]	-	-	2	0	0	-	2
			Total	16	0	8	**18**	**24**
Second Semester								**Course**
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours/ Week**
		PEOs	**POs**					
21ES21	Real Time Operating Systems	I,II,III	a,c,d,e	3	0	0	3	3
21ES22	System on Chip	I,II,III	a,c,d,e	3	0	0	3	3
21ES23	Programming for Embedded System	I,II,III	a,b,c,d,e	3	0	2	4	5
	Program Elective II		-	3	0	0	3	3
	Program Elective III		-	3	0	0	3	3
21ES26	Real Time Operating Systems Laboratory	I,II,III	a,b,c,d,e	0	0	4	2	4
21ES27	Mini project	I,II,III	-	0	0	4	2	4
	Audit course II*	-	-	2	0	0	-	2
			Total	**17**	**0**	**10**	**20**	**27**

[1]Audit Course is optional

Third Semester								**Course**
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours/ Week**
		PEOs	**POs**					
	Program Elective IV			3	0	0	3	3
	Program Elective V			3	0	0	3	3
21ES33	Dissertation Phase I	I,II,III	a,b,c,d,e,f	0	0	20	10	20
			Total	**6**	**0**	**20**	**16**	**26**
Fourth Semester								**Course**
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours/ Week**
		PEOs	**POs**					
21ES41	Dissertation Phase II	I,II,III	a,b,c,d,e,f	0	0	28	14	28

List of Core Electives								
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours /Week**
		PEOs	**POs**					
21ES51	Statistical Digital Signal Processing	I,II,III	a,b,c,d,e	3	0	0	3	3
21ES52	Embedded Linux	I,II,III	b,c,d	3	0	0	3	3
21ES53	Building Automation	I,II,III	a,b,c,d,f	3	0	0	3	3
21ES54	Image Processing Techniques	I,II,III	a,b,c,d,e	3	0	0	3	3
21ES55	Embedded Communication Software Design	I,II,III	b,c,d	3	0	0	3	3
21ES56	Automotive Networking	I,II,III	a,b,c,d,e	3	0	0	3	3
21ES57	Principles of Deep Learning	I,II,III	a,c,d,e	3	0	0	3	3
21ES58	Wireless And Mobile Communication	I,II,III	a,b,c,d,e	3	0	0	3	3
21ES59	Virtual Instrumentation in Embedded System	I,II,III	b,c,d	3	0	0	3	3
21ES60	Design of Embedded Computing System	I,II,III	b,c,d	3	0	0	3	3
21ES61	Data Analytics for Automation Industries	I,II,III	a,b,c,d	3	0	0	3	3
21ES62	Robotics and Automation	I,II,III	a,b,c,d,e	3	0	0	3	3
21ES63	Fault Tolerant Control System	I,II,III	a,b,c,e,f	3	0	0	3	3

21ES64	Optimal Control System	I,II,III	b,c,d	3	0	0	3	3
21ES65	System Identification and Adaptive Control	I,II,III	b,c,d	3	0	0	3	3
21ES66	Wireless Sensor Networks	I,II,III	a,b,c,d,f	3	0	0	3	3
21ES67	Machine vision	I,II,III	a,d,f	3	0	0	3	3
21ES68	Soft computing techniques	I,II,III	a,b,c,d,e	3	0	0	3	3
21ES69	Medical Image processing	I,II,III	a,b,c,d,e	3	0	0	3	3
21ES70	Bio signal Processing	I,II,III	a,b,c,d,e	3	0	0	3	3
21ES71	Electro Medical Instrumentation	I,II,III	a,b,c,d,f	3	0	0	3	3
21ES72	Industrial Control and Automation	I,II,III	a,b,c,d,f	3	0	0	3	3

List of Audit courses I & II								
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours /Week**
		PEOs	**POs**					
21XE01	English for Research Paper Writing	I,II,III	e,f	2	0	0	-	2
21XE02	Cost Management of Engineering Projects	I,II,III	e,f	2	0	0	-	2
21XE03	Stress Management	I,II,III	e,f	2	0	0	-	2
21XE04	Disaster Management	I,II,III	e,f	2	0	0	-	2
21XE05	Value Education	I,II,III	e,f	2	0	0	-	2
21XE06	Pedagogy Studies	I,II,III	e,f	2	0	0	-	2
21XE07	Business Analytics	I,II,III	e,f	2	0	0	-	2

21ES11 RESEARCH METHODOLOGY AND IPR 2 0 0 2

Course Objectives

- Recognizing the ensuring knowledge as property
- Create consciousness for Intellectual Property Rights and its constituents
- Perform documentation and administrative procedures relating to IPR in India as well as abroad.
- Understand that today''s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

Programme Outcomes (POs)

e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Understand research problem formulation
2. Analyze research related information and follow research ethics
3. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT I **6 Hours**

RESEARCH PROBLEM FORMULATION

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II **6 Hours**

THESIS PREPARATION

Effective literature studies approaches, analysis Plagiarism, Research ethics

UNIT III **6 Hours**

PROPOSAL WRITING

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT IV **6 Hours**

NATURE OF INTELLECTUAL PROPERTY RIGHTS

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V **6 Hours**

PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR

Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications. New Developments in IPR: Administration of Patent System.

Total: 30 Hours

Reference(s)

1. Stuart Melville and Wayne Goddard, Research methodology: an introduction for science & engineering students, Mayall, Industrial Design, McGraw Hill, 1992
2. Halbert, Resisting Intellectual Property, Taylor & Francis Ltd, 2007.
3. Mayall, Industrial Design, McGraw Hill, 1992
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, Intellectual Property in New Technological Age, 2016.
5. Ranjit Kumar, Research Methodology: A Step by Step Guide for beginners, Resisting Intellectual Property, 2nd Edition Halbert,Taylor & Francis Ltd,2007
6. Brian Roffel, Ben Petlem., Advanced Practical Process Control, Springer, 2011

21ES12 MACHINE LEARNING IN EMBEDDED SYSTEM

3 0 0 3

Course Objectives

- Interpret the introductory concepts and techniques of Machine Learning and thorough understanding of the Supervised and Unsupervised learning techniques
- Summarize the various probability based learning techniques
- Develop a graphical models of machine learning algorithms

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Compare supervised, unsupervised and semi-supervised learning
2. Select any suitable linear models for given problem
3. Implement the tree and probabilistic model for any given problem
4. Attribute existing machine learning algorithms to improve classification efficiency
5. Design systems that use the appropriate graph models of machine learning

UNIT I **9 Hours**

INTRODUCTION

Learning -Types of Machine Learning - Supervised Learning - The Brain and the Neuron - Design a Learning System - Perspectives and Issues in Machine Learning - Concept Learning Task - Concept Learning as Search - Finding a Maximally Specific Hypothesis - Version Spaces and the Candidate Elimination Algorithm- Linear Discriminants - Perceptron-Linear Separability-Linear Regression models - Poison, Ridge regression-Regression Analysis - Kernel-Based Nonparametric Estimation of Regression

UNIT II **9 Hours**

LINEAR MODELS

Multi-layer Perceptron - Going Forwards - Going Backwards: Back Propagation Error - Multi-layer Perceptron in Practice- Examples of using the MLP - Overview - Deriving Back-Propagation - Radial Basis Functions and Splines - Concepts - RBF Network - Curse of Dimensionality - Interpolations and Basis Functions -Support Vector Machines.

UNIT III **9 Hours**

TREE AND PROBABILISTIC MODELS

Learning with Trees - Decision Trees - Constructing Decision Trees - Classification and Regression Trees - Ensemble Learning - Boosting - Bagging - Different ways to Combine Classifiers - Probability and Learning - Data into Probabilities - Basic Statistics - Gaussian Mixture Models - Nearest Neighbor Methods - Unsupervised Learning - K means Algorithms - Vector Quantization - Self Organizing Feature Map.

UNIT IV **9 Hours**

DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS

Dimensionality Reduction - Linear Discriminant Analysis - Principal Component Analysis - Factor Analysis - Independent Component Analysis - Locally Linear Embedding - Isomap - Least Squares Optimization - Evolutionary Learning - Genetic algorithms - Genetic Offspring: - Genetic Operators - Using Genetic Algorithms - Reinforcement Learning - Overview - Getting Lost Example - Markov Decision Process.

UNIT V **9 Hours**

GRAPHICAL MODELS

Markov Chain Monte Carlo Methods - Sampling - Proposal Distribution - Markov Chain Monte Carlo - Graphical Models - Bayesian Networks - Markov Random Fields.

Total: 45 Hours

Reference(s)

1. Norman Matlof, Statistical Regression and Classification: From Linear Models toMachine Learning, CRC Press, 2017.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. Tom M Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013.
4. Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
5. Jason Bell, Machine learning: Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014.

21ES13 EMBEDDED PROCESSOR AND INTERFACING TECHNIQUES

3 0 0 3

Course Objectives

- To understand the fundamentals of ARM microcontroller architecture
- To understand the basics of ARM microcontroller peripheral interfacing
- To obtain basic knowledge on Raspberry pi architecture and its peripheral interfacing

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Analyze the hardware design and development tools of ARM microcontroller
2. Construct the architecture and memory organization of LPC2148 ARM 7 microcontroller
3. Abstract the architectural support for high level language and memory hierarchy
4. Design microcontroller bus architecture and interfacing techniques
5. Apply the architecture and memory organization of Raspberry Pi

UNIT I **9 Hours**

INTRODUCTION

Introduction to PIC microcontrollers-PICarchitecture, comparison of PIC with other CISCand RISC-based systems and microprocessors-memory mapping- assembly language programming- addressing modes-instruction set. Applications: LCD Interfacing, ADC / DAC Interfacing.

UNIT II **9 Hours**

ARM ARCHITECTURE AND INSTRUCTION SET

ARM Design Philosophy, Registers, PSR, Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. Instruction Set: Data Processing Instructions, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

UNIT III **9 Hours**

ARM PROGRAMMING MODEL

Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Interrupts, Software Interrupt Instructions, Exception handling. LPC2148 ARM 7 microcontroller - Features of LPC2148 - Block diagram of LPC2148 - Pin diagram of LPC2148.

UNIT IV **9 Hours**

CACHE AND MEMORY MANAGEMENT

Architectural overview - On-chip flash program memory - On-chip static RAM.Memory Technologies Need for Memory Hierarchy, Hierarchical Memory Organization, Virtual Memory. Cache Memory, Mapping Functions. Cache Design, Unified or split cache, multiple level of caches, ARM cache features, coprocessor 15 for system control.

UNIT V **9 Hours**

RASPBERRY PI 4 ARCHITECTURE

Raspberry Pi Architecture - Interrupts - Timers - Memory organization - Execution sequence - I/O port expansion -GPIO pins - GPIO access - UART - Keyboard interfacing

Total: 45 Hours

Reference(s)

1. Steve Furber, ARM System on Chip Architecture, Addison Wesley Professional, 2000.
2. Ricardo Reis, Design of System on a Chip: Devices and Components, Springer, 2004.
3. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM Systems Developers Guides- Designing & Optimizing System Software, 2008, Elsevier.
4. Jason Andrews, Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology), Newnes, BK and CD-ROM, Aug 2004.
5. P.Rashinkar, L.Paterson and Singh, System on a Chip Verification - Methodologies and Techniques, Springer Science & Business Media, 2007.
6. https://www.macs.hw.ac.uk/~hwloidl/Courses/F28HS/slides_RPi_arch.pdf

21ES14 REAL TIME DIGITAL SYSTEM DESIGN 3 0 0 3

Course Objectives

- To introduce methods to analyse and design synchronous and asynchronous sequential circuits.
- To understand the architectures of programmable devices.
- To introduce design and implementation of digital circuits using programming tools.

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Understand the fundamentals of sequential circuits and design the synchronous sequential circuits
2. Analyse and design asynchronous sequential circuits
3. Apply the testing algorithms and fault diagnostic techniques for digital systems
4. Explain the different types of programmable logic devices
5. Design and use programming tools for implementing digital circuits of industry standards

UNIT I **9 Hours**

SEQUENTIAL CIRCUIT DESIGN

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

UNIT II **9 Hours**

ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN

Analysis of asynchronous sequential circuit-flow table reduction-races-state assignment-transition table and problems in transition table- design of asynchronous sequential circuit-Static, dynamic and essential hazards-data synchronizers- mixed operating mode asynchronous circuits-designing vending machine controller

UNIT III **9 Hours**

FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS

Fault table method-path sensitization method - Boolean difference method-D algorithm- Tolerance techniques-The compact algorithm - Fault in PLA-Test generation-DFT schemes- Built in self-test.

UNIT IV **9 Hours**

SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES

Programming logic device families-Designing a synchronous sequential circuit using PLA/PAL - Realization of finite state machine using PLD-FPGA-Xilinx FPGA-Xilinx 4000

UNIT V **9 Hours**

SYSTEM DESIGN USING VHDL

VHDL Description of Combinational Circuits - Arrays -VHDL Operators - Compilation and Simulation of VHDL Code -Modeling using VHDL - Flip Flops - Registers-Counters Sequential Machine - Combinational Logic Circuits - VHDL Code for - Serial Adder, Binary Multiplier - Binary Divider - complete Sequential Systems.

Total: 45 Hours

Reference(s)

1. Charles H.Roth Jr Fundamentals of Logic Design Thomson Learning 7 th Edition 2014
2. M.D.Ciletti , Modeling, Synthesis and Rapid Prototyping with the Verilog HDL, Prentice Hall, 1999
3. M.G.Arnold, Verilog Digital - Computer Design, Prentice Hall (PTR), 1999.
4. Nripendra N Biswas Logic Design Theory Prentice Hall of India,2001
5. Donald G. Givone, Digital principles and Design, Tata McGraw Hill 2002.
6. John V.Oldfeild,Richard C.Dorf,Field Programmable Gate Arrays, Wiley India Edition,2008

21ES16 EMBEDDED PROCESSOR AND INTERFACING TECHNIQUES LABORATORY

0 0 4 2

Course Objectives

- To focus on the embedded system hardware development
- To implement and simulate assembly language and C programs
- To analyze system performance using different processing units

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Apply the hardware design and development tools of ARM microcontroller
2. Use the architecture and memory organization of LPC2148 ARM 7 microcontroller
3. Abstract the architectural support for high level language and memory hierarchy
4. Design microcontroller bus architecture and interfacing techniques
5. Apply the architecture and memory organization of Raspberry Pi

1 **4 Hours**

EXPERIMENT 1

Interface LCD and display Hello World using ARM 7

2 **4 Hours**

EXPERIMENT 2

Interface 4*4 matrix keyboard using ARM 7

3 **4 Hours**

EXPERIMENT 3
Interface stepper motor using ARM 7

4 **4 Hours**

EXPERIMENT 4
Interface 7 Segment Display using I2C using ARM 7

5 **4 Hours**

EXPERIMENT 5
Interface LM35 temperature sensor using ADC with ARM 7

6 **4 Hours**

EXPERIMENT 6
Generation of RAMP wave using on-chip DAC with ARM 7

7 **4 Hours**

EXPERIMENT 7
Input and Output handling using Raspberry Pi

8 **4 Hours**

EXPERIMENT 8
Interface DH11 sensor using Raspberry Pi

9 **4 Hours**

EXPERIMENT 9
Interface of Bluetooth using Raspberry Pi

10 **4 Hours**

EXPERIMENT 10
Interface of Wi-Fi module using Raspberry Pi

11 **5 Hours**

EXPERIMENT 11
RFID based attendance monitoring system using ARM 7

12 **5 Hours**

EXPERIMENT 12
Implement of Smart irrigation system for agriculture using Raspberry Pi

13 **10 Hours**

EXPERIMENT 13
Self-Learning Experiment

Total: 60 Hours

21ES17 EMBEDDED SYSTEM DESIGN LABORATORY

0 0 4 2

Course Objectives

- To design and simulate the sequential circuits usinh HDL and FPGAs
- To design and simulate microcontroller based projects
- To study the simulation and synthesis tools.

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Design and simulate the various types of sequential circuits using HDL
2. Implement the digital systems using FPGAs
3. Design and simulate microcontroller based projects
4. Understand the concept of built in self-test and fault diagnosis
5. Design an embedded application using different interfaces

1 **5 Hours**

EXPERIMENT 1

Configure FPGA architecture features (Clock Manager) using the Architecture Wizard
Interface DC , Stepper motor with FPGA

2 **5 Hours**

EXPERIMENT 2

Implement ALU using FPGA

3 **5 Hours**

EXPERIMENT 3

i. Implement BCD to 7 segments Decoder using FPGA
ii. Design a chess clock controller FSM using HDL

4 **5 Hours**

EXPERIMENT 4

Design and simulation sequential circuits using HDL

5 **5 Hours**

EXPERIMENT 5
Design of traffic controller using PIC Microcontroller

6 **5 Hours**

EXPERIMENT 6
Simulation of LED interfacing with PIC Microcontroller (For multiple LEDs use delay program)

7 **5 Hours**

EXPERIMENT 7
Implementation of LCD display with PIC Microcontroller

8 **5 Hours**

EXPERIMENT 8
Interface Analog to Digital converter with PIC Microcontroller

9 **5 Hours**

EXPERIMENT 9
Interface Temperature Sensor with PIC Microcontroller

10 **5 Hours**

EXPERIMENT 10
i. Built in self test and fault diagnosis
ii. RAM (16 x 4) - 74189 (Read and Write operations)

11 **10 Hours**

EXPERIMENT 11
Self-Learning Experiment

Total: 60 Hours

21ES21 REAL TIME OPERATING SYSTEMS 3 0 0 3

Course Objectives

- To introduce the principle of real-time operating systems, and their use in the development of embedded multitasking applications.
- To acquire knowledge about different types of scheduling algorithms
- To understand the various functions of RTOS

Programme Outcomes (POs)
a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Construct the general architecture of computers
2. Apply the memory management and memory allocation for embedded system
3. Analyze the theory and implementation processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files
4. Use the system software design for an embedded system
5. Design an embedded system with engineering consideration

UNIT I **9 Hours**

INTRODUCTION

Introduction to Operating System: Computer Hardware Organization, BIOS and Boot Process, Multithreading concepts, Processes, Threads, Scheduling

UNIT II **9 Hours**

BASICS OF REAL-TIME CONCEPTS

Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel

UNIT III **9 Hours**

PROCESS MANAGEMENT

Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting and prioritizing mutex

UNIT IV **9 Hours**

INTER-PROCESS COMMUNICATION AND MEMORY MANAGEMENT

Messages, Buffers, mailboxes, queues, semaphores, deadlock and priority inversion. Process stack management, run-time buffer size, swapping, overlays, block/page management and replacement algorithms

UNIT V **9 Hours**

RTOS APPLICATION DOMAINS

RTOS for Image Processing - Embedded RTOS for voice over IP - RTOS for fault Tolerant Applications - RTOS for Control Systems.

Total: 45 Hours

Reference(s)

1. Christos Koulamas, Mihai T. Lazarescu, Real-Time Embedded Systems, 2018, MDPI AG.
2. Jiacun Wang, Real-Time Embedded Systems, 2017,Wiley.
3. K.C. Wang, Embedded and Real-Time Operating Systems 2017,Springer International Publishing.
4. Xiaocong Fan, Real-Time Embedded Systems Design Principles and Engineering Practices, 2015, Elsevier Science.
5. C.M. Krishna, Kang, G.Shin, Real Time Systems, McGraw Hill, 2006.
6. Website:Using the FreeRTOS Real Time Kernel From FreeRTOS.

21ES22 SYSTEM ON CHIP 3 0 0 3

Course Objectives

- To design, optimize, and program a modern System-on-a-Chip
- To decompose the task into parallel components that co-operates to solve the problem.
- To familiarize students to characterize and develop real-time solutions.
- To implement both hardware and software solutions, formulate hardware/software tradeoffs, and perform hardware/software co design.

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Use co-simulation to validate system functionality.
2. Understand hardware, software, and interface synthesis.
3. Compare the different algorithms involved in methodologies for hardware and software partitioning
4. Analyze the functional and nonfunctional performance of the system early in the design process to support design decisions.
5. Analyze tradeoffs and explore architecture and mico-architecture design spaces to develop and synthesize custom hardware accelerators

UNIT I **9 Hours**

INTRODUCTION TO THE SYSTEM APPROACH

System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System-level interconnection, SOC Design, System Architecture and Complexity.

UNIT II **9 Hours**

PROCESSORS

Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, Robust Processors, Vector Processors and Vector Instructions extensions, Superscalar Processors.

UNIT III **9 Hours**

MEMORY DESIGN FOR SOC

Overview of SOC external memory, Internal Memory Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Virtual to real translation, SOC Memory System, Models of Simple Processor - memory interaction

UNIT IV **10 Hours**

INTERCONNECT CUSTOMIZATION AND CONFIGURATION

InterConnect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

UNIT V **8 Hours**

APPLICATION STUDIES / CASE STUDIES

SOC Design approach, AES algorithms, Design and evaluation, Image compression - JPEG compression.

Total: 45 Hours

Reference(s)

1. P. Marwedel, Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, Third Edition, Springer, 2018.
2. Ricardo Reis, Design of System on a Chip: Devices and Components, 1st Edition, 2004, Springer
3. D. C. Black, J. Donovan, B. Bunton, A. Keist, SystemC: From the Ground Up, Second Edition, Springer, 2010.
4. Prakash Rashinkar, Peter Paterson and Leena Singh L, System on Chip Verification - Methodologies and Techniques, 2001, Kluwer Academic Publishers.
5. Steve Furber, ARM System on Chip Architecture , 2nd Edition, 2000, Addison Wesley Professional.

21ES23 PROGRAMMING FOR EMBEDDED SYSTEM 3 0 2 4

Course Objectives

- To impart the knowledge on Embedded C Programming
- To provide a comprehensive background knowledge of OOPS concept in embedded C
- To impart embedded application using high level programming

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Analyze the difference between the C and Embedded C in terms of Structure
2. Construct the architecture and memory organization meeting the realtime constrains
3. Abstract the architectural support for high level languages
4. Apply Programming language by creating a class using inheritance.
5. Apply the high level language in designing embedded applications.

UNIT I **9 Hours**

INTRODUCTION TO EMBEDDED PROGRAMMING

C and Assembly- Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements -Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization - In-line Assembly.

UNIT II **9 Hours**

EMBEDDED C PROGRAMMING

Data types, Expression and control statements Iteration- Functions- Creating classes and Abstraction - Constructors and Destructors-Inheritance in C++ - Exception handling.

UNIT III **9 Hours**

C AND C PROGRAMMING USING DATA DATASTRUCTURE

Linear data structures - Implementation of stacks and Queues, Linked List - Implementation of linked list, Sorting, Searching, Insertion and Deletion, Nonlinear structures - Trees and Graphs Object-Oriented programming basics using C++ and its relevance in embedded systems.

UNIT IV **9 Hours**

EMBEDDED C WITH OOPS

Adding Structure to C Code: Object-oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays- Need for timeout mechanism-Creating loop timeouts-Creating hardware timeouts.

UNIT V **9 Hours**

MODELLING AND EMBEDDED PROGRAMMING ISSUES

Embedded programming issues - Re-entrancy, Portability, Optimizing and testing embedded C programs. Modelling and Analysis of Real-time and Embedded system.

1 **6 Hours**

EXPERIMENT 1

a) Write C program to count the number of lines, words and characters in a given text.
b) Write a C program to find the length of the string using Pointer.

2 **6 Hours**

EXPERIMENT 2

a) 2s complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2s complement of 11100 is 00100. Write a C program to find the 2s complement of a binary number.
b) Write a C program to convert a Roman numeral to its decimal equivalent.

3 **6 Hours**

EXPERIMENT 3

Implementation of types of Inheritance.

1. Write a program to generate employee payroll using inheritance.
2. Write a program to student details using multilevel inheritances.

Write a program to employee details using multilevel inheritances.

4 **6 Hours**

EXPERIMENT 4

Implementation of Class templates and Function templates.

1. Write a program to perform insertion sort using class template.
2. Write a program to perform quick sort using function template.
3. Write a program to perform merge sort using template.

5 **6 Hours**

EXPERIMENT 5

Implementation of file handling operations.

1. Write a program to reading and writing a file contents.
2. Write a program to open a file and append data to the end of file.
3. Write a program to write the class objects to a file.

Total: 75 Hours

Reference(s)

1. Kernighan, Brian W, Ritchie, Dennis M, C Programming language, 4th Edition, Addison Wesley,2013.
2. Michael J Pont, Embedded C, Pearson Education, 2007
3. Behrouz A. Forouzan and Richard F. Gilberg, Computer Science: Structured Programming Approach Using C, Third Edition, Course Technology Inc., 2006.
4. Kirk Zurellm, C Programming for Embedded Systems, CRC Press, 2000.
5. David E Simon, An Embedded Software Primer, Pearson Education Asia, 2005.

21ES26 REAL TIME OPERATING SYSTEMS LABORATORY

0 0 4 2

Course Objectives

- To study about FreeRTOS
- To acquire knowledge about concepts related to OS such as Scheduling techniques, threads and memory management.
- To acquire knowledge about inter process communication
- To understand the various functions of RTOS

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems

b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems

c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Interpret the basic concepts of Free RTOS and to implement task management and delays
2. Implement mailbox, message queue and mutex in Free RTOS on ARM7
3. Apply the multitasking techniques in real-time systems
4. Implement the impact of real time operating systems on application area
5. Design and development of protocols related to real-time communication

1 **4 Hours**

EXPERIMENT 1
Getting started with Free RTOS

2 **4 Hours**

EXPERIMENT 2
Implementation of task management and delays in Free RTOS on ARM7

3 **4 Hours**

EXPERIMENT 3
Multitasking in Free RTOS using minimum 3 tasks on ARM7

4 **4 Hours**

EXPERIMENT 4
Implementation of Semaphore for signalling and synchronization in Free RTOS on ARM7

5 **4 Hours**

EXPERIMENT 5
Implementation of Mailbox in Free RTOS on ARM7

6 **4 Hours**

EXPERIMENT 6
Implementation of Message Queue in Free RTOS on ARM7

7 **4 Hours**

EXPERIMENT 7
Implementation of Mutex in Free RTOS

8 **4 Hours**

EXPERIMENT 8
I/O handling using Free RTOS on ARM7

9 **4 Hours**

EXPERIMENT 9
LCD interfacing using Free RTOS on ARM7

10 **4 Hours**

EXPERIMENT 10
MQ-06 sensor interfacing using Free RTOS on ARM7

11 **5 Hours**

EXPERIMENT 11
Traffic light implementation using Free RTOS on ARM7

12 **5 Hours**

EXPERIMENT 12
Drowsy driver detection using Free RTOS on ARM7

13 **10 Hours**

EXPERIMENT 13
Self-Learning Experiment

Total: 60 Hours

21ES27 MINI PROJECT 0 0 4 2

Course Objectives

- Speculate the problem identifying ability.
- Improve the analyzing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Formulate a real-world problem, identify the requirement, and develop the design solutions.
2. Identify technical ideas, strategies, and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.

4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations.

21ES33 DISSERTATION PHASE I 0 0 20 10

Course Objectives

- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
2. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
3. Ability to present the findings of their technical solution in a written report.
4. Presenting the work in International/ National conference or reputed journals.

21ES41 DISSERTATION PHASE II 0 0 28 14

Course Objectives

- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

Programme Outcomes (POs)
a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
2. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
3. Ability to present the findings of their technical solution in a written report.
4. Presenting the work in International/ National conference or reputed journals.

21ES51 STATISTICAL DIGITAL SIGNAL PROCESSING

3 0 0 3

Course Objectives

- To obtain the system parameters from the different modeling algorithms.
- To estimate the signal in the presence of noise using suitable algorithms.
- To design the filter for a certain application using adaptive and Kalman algorithms.
- To analyse the detection in statistical signal processing and implement the algorithms for a related application.

Programme Outcomes (POs)
a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Analyse the implications at system level of the use of statistical signal processing techniques.
2. Apply advanced mathematical methods for the resolution of problems related to statistical signal processing.

3. Develop and evaluate signal detection techniques with applications in positioning and radar systems.
4. Design the filters based on adaptive and Kalman filtering algorithms.
5. Develop statistical filtering systems aimed at synchronisation, equalisation and detection in communications receivers.

UNIT I **9 Hours**

PARAMETER ESTIMATION THEORY

Random signalmodelling: MA(q), AR(p),ARMA (p, q) models.Principle of estimation and applications, Properties of estimates, unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE), Cramer Rao bound, Efficient estimators; Criteria of estimation: the methods of maximum likelihood and its properties; Baysean estimation: Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation.

UNIT II **9 Hours**

ESTIMATION OF SIGNAL IN PRESENCE OF WHITE GAUSSIAN NOI

Linear Minimum Mean-Square Error (LMMSE) Filtering: Wiener Hoff Equation, FIR Wiener filter, Causal IIR Wiener filter, Non-causal IIR Wiener filter, Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters.

UNIT III **9 Hours**

ADAPTIVE AND KALMAN FILTERING

Principle and Application, Steepest Descent Algorithm Convergence characteristics; LMS algorithm, convergence, excess mean square error, Leaky LMS algorithm; Application of Adaptive filters; RLS algorithm, derivation, Matrix inversion Lemma, Initialization, tracking of non-stationarity. State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter extended Kalman filter.

UNIT IV **9 Hours**

DETECTION IN SIGNAL PROCESSING

Detection performance (error probabilities, ROC). Detection criteria for completely known statistics (Neyman-Pearson, Bayes risk). Detection criteria in the presence of unknown parameters (GLRT, Rao, Wald, LMP). Sequential detection (SPRT, CUSUM). Case of study: Radar signal detection.

UNIT V **9 Hours**

SPECTRAL ANALYSIS

Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Parametric method, AR(p) spectral estimation and detection of Harmonic signals, MUSIC algorithm, Digital SAR image processing.

Total: 45 Hours

Reference(s)

1. Steven M. Kay, Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory, Prentice-hall Signal Processing Series, 1st may 1993.
2. Swagata Nandi, DebasisKundu, Statistical Signal ProcessingFrequency Estimation, Springer Singapore, 21 August 2020.
3. Umberto Spagnolini, Statistical Signal Processing in Engineering, Wiley, 5 February 2018.

4. Mohinder S. Grewal, Angus P. Andrews, Kalman Filtering: Theory and Practice with MATLAB, 4th Edition, Wiley-IEEE Press, December 2014.
5. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley & Sons, Inc., April 1996.
6. D. G. Manolakis, V. K. Ingle and S. M. Kogon, Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing, McGrawHill, 2000.

21ES52 EMBEDDED LINUX 3 0 0 3

Course Objectives

- To understand the fundamentals of Embedded Linux
- To understand the basics of embedded operating systems
- To obtain basic knowledge on board support packages and device drivers
- To acquire the basic insights of Real Time Linux.

Programme Outcomes (POs)

b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications

Course Outcomes (COs)

1. Execute the Linux Files and storage of persistent information, types of files and file access
2. Attribute the basic architecture of embedded Linux
3. Acquire basic knowledge on board support packages
4. Apply the concept of embedded drivers in real time applications.
5. Interpret the significance of Real Time Linux.

UNIT I **9 Hours**

LINUX FUNDAMENTALS

Introduction to Linux, Basic Linux commands and concepts, Logging in, Shells, Basic text editing, advanced shells and shell scripting, Linux File System, Linux programming, Processes, and threads in Linux, Inter-process communication, Devices, Linux System calls.

UNIT II **9 Hours**

EMBEDDED LINUX

Embedded Linux-Introduction, Advantage, Embedded Linux Distributions, Architecture, Linux kernel architecture, User space, Linux start-up sequence, GNU cross-platform Tool chain.

UNIT III **9 Hours**

BOARD SUPPORT PACKAGE AND EMBEDDED STORAGE

Inclusion of BSP in kernel build procedure, Boot loader Interface, Memory Map, Interrupt Management, UART, Embedded Storage, Flash Map, Memory Technology Device (MTD) MTD Architecture, MTD Driver for NOR Flash.

UNIT IV **9 Hours**

EMBEDDED DRIVERS AND APPLICATION PORTING

Linux serial driver: TTY driver, Frame buffer - Ethernet driver, I2C subsystem, USB gadgets, Watchdog timer, Kernel Modules, Application porting roadmap, Programming with threads, Operating System Porting Layer, Kernel API Driver, Case studies - RT Linux.

UNIT V **9 Hours**

REAL-TIME LINUX

Real-time operating system- Linux and Real-time: Interrupt latency, ISR duration, Scheduler latency, Scheduler duration, User-space Real-time, process scheduling, Memory locking, Hard real-time Linux: Real-time application Interface.

Total: 45 Hours

Reference(s)

1. Paul Cobbaut, Fundamental of Linux, Netsec BVBA, Fifth Edition, 2015.
2. P.Raghavan, Embedded Linux System Design and Development, First Edition,Taylor & Francis, 2012.
3. Philippe Gerum, Karim Yaghmour , Building Embedded Linux Systems, Fourth Edition,2009
4. Craig Hollabaugh, Embedded Linux, Hardware, Software and Interfacing, Third Edition, Addison-Wesley Professional, 2003.
5. P. Raghavan, Amol Lad, Sriram Neelakandan, Embedded Linux System Design and Development, Auerbach Publications , 2006.
6. Doug Abbott, Linux for Embedded and Real time Applications, 4th edition, 2017.

21ES53 BUILDING AUTOMATION 3 0 0 3

Course Objectives

- To understand the principles and application of Building Automation system and building process control
- To study the dynamic performance of building processes/systems, control fundamentals and building process control
- To get knowledge in security systems

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Indicate the basic concept of Building Management System
2. Develop HVAC system for buildings with human comfort
3. Explain the concept of energy management and Building Management system
4. Infer principles of operation and illustrate the architecture of fire alarm system
5. Identify the appropriate control system design for different applications in security system aspects

UNIT I **9 Hours**

HVAC SYSTEM

Introduction to HVAC - Different components of HVAC system like heating, cooling system, chillers, AHUs, compressors and filter units and their types - Ventilation Process and Applications - Central Fan System - Exhaust Fans - Unitary Systems - VAV, FCU - Design issues in consideration with respect to efficiency and economics - Human comfort zones.

UNIT II **9 Hours**

BUILDING MANAGEMENT SYSTEM (BMS)

Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS, Input-Output summary and field device selection for BMS.

UNIT III **9 Hours**

ENERGY MANAGEMENT SYSTEM

Energy Saving concept & methods - Lighting control - Building efficiency improvement - Green Building - Leadership in Energy and Environmental Design (LEED) Certification concept and examples - Introduction to structural health monitoring and methods employed - BMS: Integrated Building Management Systems (HVAC, Fire, Security & Lighting Systems) project cycle, Project steps BMS - Verticals: Advantages & Applications of BMS.

UNIT IV **9 Hours**

FIRE ALARM SYSTEM (FAS)

Introduction to fire alarm system - Fire modes, History, Components, and Principles of operation FAS Components: Field Components, Panel Components and Applications. FAS Architectures: Types of Architectures, Examples. FAS loops: Classification of loops, Examples. Power Supply design for FAS. Cause & effect matrix: Examples. Fire Standards: FAS Design procedure in brief, NFPA 72A, BS 5839, Indian Standards.

UNIT V **9 Hours**

SECURITY SYSTEMS

Introduction to Security Systems, Concepts Access Control System: Access Components, Computer system access control- DAC, MAC, and RBAC - Access control system Design. CCTV: Camera: Operation & types, Camera Selection Criteria, DVR Based system, DVM, Network design, Storage design and CCTV Applications.

Total: 45 Hours

Reference(s)

1. Albert Ting-Pat So, Intelligent Building Systems, WaiLok Chan, Kluwer Academic publisher, Third edition, 2012.
2. Robert Gagnon and Thomson Delmar Learning, Design of Special Hazards and Fire Alarm Systems, Second edition, 2008.

3. Smart Buildings by Jim Sinopoli, Butterworth-Heinemann imprint of Elsevier, Second Edition, 2010.
4. Levenhagen and John I.Spethmann, HVAC Controls and Systems, Donald H., McGraw-Hill Pub, Third Edition, 1998.
5. Reinhold A. Carlson, Robert A. Di Giandomenico, pub. by R.S. Means Company, Understanding Building Automation Systems, First Edition,1991.
6. Ajit Singh, Independently Published, Smart Home Automation Using IoT, 2019.

21ES54 IMAGE PROCESSING TECHNIQUES 3 0 0 3

Course Objectives

- To study about the fundamentals of digital images.
- To understand 1D and 2D image transforms.
- To gain sound knowledge about various image processing techniques.

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Interpret the image perception and relate it as a mathematical model
2. Analyze the image using various transformation techniques
3. Implement the image enhancement and restoration techniques
4. Determine the appropriate method for image segmentation and recognition
5. Implement the suitable image compression techniques

UNIT I **9 Hours**

FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

Elements of digital image processing systems - Elements of visual perception - Mach band effect -Image acquisition- Image sampling and Quantization -Basic relationships between pixels- Two-dimensional mathematical preliminaries.

UNIT II **9 Hours**

IMAGE TRANSFORMS

2D transforms - DFT - Discrete Cosine Transform - Walsh - Hadamard - Slant - Haar- KLT- SVD - Wavelet Transform

UNIT III **9 Hours**

IMAGE ENHANCEMENT AND RESTORATION

Basic Gray Level Transformations - Histogram Processing - Smoothing and Sharpening Spatial Filters1Smoothing and Sharpening Frequency Domain Filters - Homomorphic filtering - Image enhancement for remote sensing images and medical images. Image degradation/ restoration process model - Noise models - Restoration in the presence of noise only Spatial Filtering- Inverse filtering Geometric transformations.

UNIT IV **9 Hours**

IMAGE SEGMENTATION AND RECOGNITION

Edge detection - Detection of discontinuities - edge operators - edge linking and boundary detection, thresholding - feature analysis and extraction - region-based segmentation - Image Recognition - Patterns and pattern classes - Matching by minimum distance classifier - Number plate detection using segmentation algorithm.

UNIT V **9 Hours**

IMAGE COMPRESSION AND EMBEDDED IMAGE PROCESSING

Image Compression models - Huffman - Run Length Encoding - Arithmetic coding - Transform Coding - Wavelet coding-Image Compression Standards - Introduction to embedded image processing. Hardware implementation of image processing algorithms: Segmentation and compression

Total: 45 Hours

Reference(s)

1. C.Rafael Gonzalez and E. Richard Woods, Digital Image Processing, Pearson Education Inc., 2008.
2. David Salomon, Handbook of Data Compression - The Complete Reference, Springer, 2010.
3. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 2002.
4. MilmanSonka, Vaclav Hlavac and Roger Boyle, Image Processing, Analysis, and Machine Vision, Brooks/Cole, Vikas Publishing House, 2008.
5. Donald G. Bailey, Design for Embedded Image processing on FPGAs, John Wiley and Sons, 2011
6. S.Sridhar, Digital Image Processing, Oxford University Press, 2011

21ES55 EMBEDDED OPERATING SOFTWARE DESIGN

3 0 0 3

Course Objectives

- To understand the Embedded Communication protocols used in Internet of Things.
- To analyze the use of memory and time management for protocol libraries
- To design the communication protocol for multi board

Programme Outcomes (POs)

b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems

c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems

d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications

Course Outcomes (COs)

1. Interpret the significance of embedded communication protocols in IoT.
2. Identify the fundamentals of Software partitioning and explore the modules and task management types
3. Interpret the structures and tables used in Memory Management Unit
4. Analyze the device management schemes and understand the system architecture
5. Attribute the architecture, interfacing technique, test tools in the Multi-board systems.

UNIT I **9 Hours**

INTRODUCTION TO COMMUNICATION PROTOCOLS IN IOT

Introduction to IoT communication protocols, - Architecture and specifications: Bluetooth Low Energy (BLE), Z wave, Sigfox. Applications - Smart Accident detection and prevention system.

UNIT II **9 Hours**

SOFTWARE PARTITIONING

Software Partitioning - Limitation of strict Layering - Tasks & Modules - Modules and Task Management Types - Debugging Protocols

UNIT III **9 Hours**

TABLES

Partitioning of Structures and Tables - Implementation - Speeding Up access - Table Resizing - Table access routines - Buffer and Timer Management - Third Party Protocol Libraries

UNIT IV **9 Hours**

MANAGEMENT SOFTWARE

Device Management - Management Schemes - Router Management - management of Sub System Architecture - Device to manage configuration - System Start up and configuration.

UNIT V **9 Hours**

MULTI BOARD COMMUNICATION SOFTWARE DESIGN

Multi-Board Architecture - Single control Card and Multiple line Card Architecture - Interface for Multi-Board software - Failures and Fault - Tolerance in Multi-Board Systems - Hardware independent development - Using a COTS Board -Development Environment - Test Tools.

Total: 45 Hours

Text Book(s)

1. Sridhar T, Designing Embedded Communication Software, First Edition, CMP Books, 2004.

Reference(s)

1. Greg Utas, Robust Communication Software, First Edition, Wiley-Blackwell, 2004.
2. Peter Marwedel, Embedded System Design, Second Edition, paperback, 2013
3. Michael Barrs, Programming Embedded Systems in C and C++, Second Edition, Barr groups 2000.
4. Joel J. P. C. Rodrigues , Amjad Gawanmeh , Kashif Saleem, Sazia Parvin, Smart devices, Applications and Protocols for IoT, IGI Global; 1st edition, 2019.

21ES56 AUTOMOTIVE NETWORKING 3 0 0 3

Course Objectives

- To focus popular standards and future data communication
- To impart knowledge about different layers of In-vehicle protocols
- To study the challenges and latest research results related to the In-vehicle communication protocols

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Show a comprehensive theoretical and practical knowledge of the key elements and principles of operation of commonly used automotive networks
2. Apply the CAN concepts
3. Explain the concept of LIN
4. Critically analyze the suitability of different automotive networks and apply appropriate selection criteria when choosing a network technology for a particular application
5. Evaluate the requirements and critically analyse the suitability of new automotive network technologies to support advanced safety-critical systems deployment

UNIT I **9 Hours**

BASICS OF IN-VEHICLE NETWORKING

Over view of Data communication and networking - need for In-Vehicle networking - layers of OSI reference model - Overview of general-purpose networks and protocols - TCP, UDP, IP, ICMP, ARP, vehicle buses.

UNIT II **9 Hours**

OVERVIEW OF CAN

Overview of CAN - CAN Chip - fundamentals - selecting CAN controller - CAN application areas - message frame formats, bit encoding - bit-timing and synchronization - data rate and bus length - network topology - bus access - physical layer standards CAN higher layer protocol- Introduction to CAN open and application in transportation electronics.

UNIT III **9 Hours**

LIN STANDARD

LIN standard overview - applications - LIN communication- message frame formats - development flow - LIN Descriptor Files - LIN schedule.

UNIT IV **9 Hours**

MOST AND FLEXRAY

MOST overview - data rates -data types - topology -application areas - FlexRay introduction - network topology - ECUs and bus interfaces - controller host interface and protocol operation controls - media access control and frame and symbol processing - coding/decoding unit - FlexRay scheduling - message processing - wakeup/ startup applications.

UNIT V **9 Hours**

WIRELESS SYSTEMS

Introduction to wireless systems - GPS - Setting receivers - Positioning - activating the navigation function -Concept of latitude and longitude grid system - Mapping and location technologies - Application.

Total: 45 Hours

Reference(s)

1. B.Hoffman, Wellenhof, H.Lichtenegger and J.Collins,GPS Theory and practice, 4th revised edition, Springer, Wein, New York, 1997.
2. IndraWidjaja, Alberto Leon-Garcia, Communication Networks: Fundamental Concepts and Key Architectures, McGraw-Hill College 1st edition, January 15, 2000.
3. Konrad Etschberger, Controller Area Network, IXXAT Automation, August 22, 2001.
4. Olaf Pfeiffer, Andrew Ayre, Christian Keydel, Embedded Networking with CAN and CAN open, Anna books/Rtc Books, April 1, 2008
5. Ronald K Jurgen, Automotive Electronics Handbook, McGraw-Hill Inc., 1999.
6. Dennis Foy, Automotive Telematics, Red Hat, 2002.

21ES57 PRINCIPLES OF DEEP LEARNING 3 0 0 3

Course Objectives

- To impart basic knowledge on Deep Neural Networks
- To understand various methods and algorithms of Deep Learning
- To familiarize students with computer vision modules and Natural Language Processing

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Infer the basic concept of neural networks
2. Use the advanced methods of machine learning
3. Analyse and select suitable algorithms for Deep Learning
4. Apply their knowledge of CNN and RNN
5. Attribute the knowledge of various application of deep learning

UNIT I **9 Hours**

INTRODUCTION

Feed-forward Neural networks, Gradient descent and the back-propagation algorithm. Unit saturation, aka the vanishing gradient problem, and ways to mitigate it, RelU Heuristics for avoiding bad local minima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout.

UNIT II **9 Hours**

NEURAL NETWORKS

Architectures of Neural Network, convolution/pooling layers, Long Short-Term Memory (LSTM) networks, GRU, Comparison of LSTM and GRU, Encoder-Decoder architectures.

UNIT III **9 Hours**

DEEP UNSUPERVISED LEARNING

Auto-encoders (standard, sparse, de-noising, contractive, etc), Variational auto-encoders, Adversarial Generative Networks, Auto-encoder and DBM.

UNIT IV **9 Hours**

CONVOLUTIONAL AND RECURRENT NEURAL NETWORK

Introduction to CNN and RNN, Kernel filter, Principles behind CNNs, Multiple Filters, Unfolded RNNs, Seq2Seq RNNs, LSTM

UNIT V **9 Hours**

DEEP LEARNING APPLICATIONS

Deep Learning on Embedded devices, Image Processing, Natural Language Processing, Speech Recognition, Video Analytics

Total: 45 Hours

Reference(s)

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville, Deep learning, Fourth Edition, An MIT Press book, 2015.
2. Bengio, Yoshua. Learning deep architectures for AI, Foundations and trends in Machine Learning, Second Edition, Pearson,2009.
3. Jason Bell, Machine learning : Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014.
4. Theodoridis, S. and Koutroumbas, K., Pattern Recognition, Fourth Edition, Academic Press, 2008.
5. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach, Second Edition, Prentice Hall Series in Artificial Intelligence, 2003.
6. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification, Second Edition, Wiley1Interscience., 2001.

21ES58 WIRELESS AND MOBILE COMUNICATION 3 0 0 3

Course Objectives

- To understand the concept of Cellular Mobile Networks
- To provide a comprehensive background knowledge of Wireless Communication
- To study the various broadband technologies

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Explain the basic concepts of wireless transmission and overview of networks
2. Apply the cellular radio concepts such as frequency reuse, handoff and how interference between mobiles and base stations affects the capacity of cellular systems
3. Deduce the concept of basic wireless networks
4. Interpret the routing protocols and concepts
5. Exemplify the architecture and programming model for application layer protocols

UNIT I **9 Hours**

OVERVIEW OF NETWORKS

Wireless Transmission- signal propagation-spread spectrum-Satellite Networks - Capacity Allocation1FAMA-DAMA-MAC

UNIT II **9 Hours**

MOBILE NETWORKS

Cellular Wireless Networks - GSM - Architecture - Protocols - Connection Establishment - Frequently Allocation-Routing - Handover - Security - GPRA.

UNIT III **9 Hours**

WIRELESS NETWORKS

WirelessLAN-IEEE802.11 Standard -Architecture of Wireless Networks-Services of Wireless Networking - Introduction to Wireless sensor networks - LoRA - Wi-Fi - UAVs Protocol

UNIT IV **9 Hours**

ROUTING

Mobile IP-DHCP- AdHoc Networks - LEU420 / DIT421 Routing and switching technology - Proactive and Reactive Routing Protocols - Multicast Routing.

UNIT V **9 Hours**

TRANSPORT AND APPLICATION LAYERS

TCP over AdHoc Networks - WAP Architecture - WWW Programming Model - Wireless transaction protocol (WTP) - Wireless Session Protocol (WSP) - Wireless Application Environment (WAE) - Wireless Telephony Application (WTA) - WML scripts.

Total: 45 Hours

Reference(s)

1. KavehPahlavan, Prasanth Krishnamoorthy, Principles of Wireless Networks, Fourth Edition, PHI/Pearson Education, 2014.
2. Samson Colon, Wireless Networks and Communications, Willford Press, 2019
3. Cory Beard and William Stalings, Wireless Communication Networks and Systems, Global Edition, Pearson Education, 2015
4. UweHansmann, LotharMerk, Martin S.Nicklons and Thomas Stober, Principles of Mobile computing, Second Edition, Springer, Newyork, 2010.
5. Jochen Schiller, Mobile communications, PHI/Pearson Education, Second Edition, 2012.
6. C.K.Toh, AdHoc mobile wireless networks, Second Edition, Prentice Hall Inc, 2011.

21ES59 VIRTUAL INSTRUMENTATION IN EMBEDDED SYSTEMS

3 0 0 3

Course Objectives

- To learn the concepts towards measurement and automation with LabVIEW.
- To get the knowledge about how to control an external measuring device by interfacing a computer.
- To become competent in data acquisition and instrument control.

Programme Outcomes (POs)

b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications

Course Outcomes (COs)

1. Build a virtual instrument using good coding practices
2. Infer the programming structure used in system design.
3. Analyse working of A/D and D/A converters, use display devices for digital circuits, use digital meters for measurements.
4. Identify the instrument used for interfacing with LabVIEW.
5. Understand current technology and to adapt to new devices and technologies.

UNIT I **9 Hours**

GRAPHICAL PROGRAMMING ENVIRONMENT

Introduction, History of Virtual Instrumentation, Lab View and VI, Conventional and Graphical Programming, Future Perspective. Introduction, Components of LabView, Owned and Free Labels, Tools and Other Palettes, Arranging Objects, Pop-up menus, Color Coding, Code Debugging, Context Sensitive Help, Types of VI"s, Creating Sub-VIs. Concepts of graphical programming Lab-view software.

UNIT II **9 Hours**

PROGRAMMING STRUCTURE

FOR loops, WHILE loop, CASE structure, formula node, Sequence structures - Arrays and Clusters - Array operations - Bundle - Bundle/Unbundle by name, graphs and charts - String and file I/O - High level and Low-level file I/Os - Attribute modes Local and Global variables.

UNIT III **9 Hours**

HARDWARE ASPECTS

Installing hardware, installing drivers - Configuring the hardware - Addressing the hardware in LabVIEW - Digital and Analog I/O function - Data Acquisition - Buffered I/O - Real-time Data Acquisition.

UNIT IV **9 Hours**

INSTRUMENT COMMUNICATION

Introduction, Modem standards, Data transmission systems - Time Division Multiplexing (TDM) - Digital Modulation Basic requirements of Instrument Bus Communications standards, interrupt and data handshaking, serial bus- basics, Message transfer - RS-232, USB, RS-422, Ethernet Bus- CAN standards interfaces. General considerations - advantages and disadvantages-Instrumentation network design, advantages and limitations, general considerations, architecture, model and system configuration of : HART network, Mod Bus, Fieldbus

UNIT V **9 Hours**

CONFIGURING PROGRAMMABLE INSTRUMENTATION

Microprocessor-based system design-Peripheral Interfaces systems and instrument communication standards-Data acquisition with the processor and with VI-Virtual Instrumentation Software and hardware simulation of I/O communication blocks. Processor-based DAS, Data loggers, VI based process measurements like temperature, pressure and level development system- DSO interface - digital controller for colour video display.

Total: 45 Hours

Reference(s)

1. Jerome Jovitha, Virtual Instrumentation Using Labview, PHI Learning Pvt. Ltd., 2012.
2. Mathivanan, PC based Instrumentation Concepts and practice, Prentice-Hall India, 2009.
3. Krishna Kant, Computer Based Industrial Control, Prentice Hall India Ltd., 2004.
4. Bouwens, A.J., Digital Instrumentation, McGraw Hill, Reprint 2007.
5. Garry W Johnson, LabView Graphical Programming, Tata McGraw Hill, 5th Edition,2019.
6. Jonathan W Valvano, Embedded Microcomputer systems, Brooks/Cole, Thomson, 2010.

21ES60 DESIGN OF EMBEDDED COMPUTING SYSTEM

3 0 0 3

Course Objectives

- To provide the insight of design metrics of an Embedded System
- To focus on distributed Embedded Architecture and its accessing protocols
- To understand about the design methodologies in hardware and software design

Programme Outcomes (POs)

b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications

Course Outcomes (COs)

1. Illustrate the design challenges in designing an embedded system
2. Exemplify the different type of processor technology and computing platforms
3. Construct embedded system hardware with suitable memory
4. Develop software programs to control embedded system
5. Generate product specification for embedded system.

UNIT I **9 Hours**

EMBEDDED COMPUTING SYSTEM DESIGN

Embedded systems design metrics: optimizing metrics-processor technology- automation-synthesis1verification: hardware/software co-simulation - Embedded computing systems: Design challenges, Functionality, performance, Design methodology, process requirements and specifications.

UNIT II **9 Hours**

PROCESSING ELEMENTS AND COMPUTING PLATFORMS

Custom single-purpose processor design-RT level custom single-purpose processor design - optimizing custom single-purpose processors-General purpose processor"s software: architecture, operation, programmer"s view and development environment - ASIPs - selecting a microprocessor - general-purpose processor design -Basic computing platforms - Designing with computing platforms - Design example: Audio Player.

UNIT III **9 Hours**

MEMORY

Introduction-memory write ability and storage Permanence-common memory types-composing memory1memory hierarchy and caches-advanced RAM

UNIT IV **9 Hours**

INTERFACING

Introduction-communication basics-microprocessor interfacing: I/O addressing, interrupts, DMA1Arbitration-multilevel bus architectures-advanced communication principles-serial protocols-parallel protocols-wireless protocols.

UNIT V **9 Hours**

APPLICATIONS

Digital camera-washing machine-cell phones-home security systems-fingerprint identifiers-cruise control1printers-Automated teller match

Total: 45 Hours

Reference(s)

1. Frank Vahid and Tony Givargis, Embedded system design: A unified hardware/Software introduction, Third edition, John Wiley & sons, 2010.
2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Second Edition, Morgan Kaufman Publishers, 2008.
3. Jonathan.W.Valvano, Embedded Microcomputer systems: Real Time Interfacing, Third edition, cengage learning, 2012.
4. Santanuchattopadhyay, Embedded system Design, First Edition, PHI Learning Pvt. Ltd., 2010.
5. Daniel D. Gajski, Samar. Abdi, Andreas. Gerstlauer Embedded system design: Modeling, synthesis and verification, Second Edition,Springer, 2009.
6. Steave Heath, Embedded system Design, Second edition, 2003.

21ES61 DATA ANALYTICS FOR AUTOMATION INDUSTRIES

3 0 0 3

Course Objectives

- To understand the importance of data visualization to help make more effective business decisions
- To identify upcoming trends in data analytics field
- To create an analytics frame work

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications

Course Outcomes (COs)

1. Understand the concepts needed for data science, even with Python and R
2. Analyze the Hadoop and Map Reduce framework associated with big data.
3. Master the concepts of data blending, create data extracts and organize and format data
4. Build machine learning models using scikit-learn
5. Understand and use the various graphics in R for data visualization

UNIT I **9 Hours**

STATISTICS ESSENTIALS

Introduction - Sample or population data - Fundamentals of Descriptive Statistics - Practical Example of descriptive statistics- Distributions, Estimators and Estimates - Practical Example: Inferential Statistics- Hypothesis testing - Fundamentals of regression analysis - dealing with categorical data - practical example of regression analysis

UNIT II **8 Hours**

HADOOP

The Hadoop distributed file system -Hadoop I/O- Developing a map-reduce application-How map-reduce work - Setting up a Hadoop cluster - Cluster specification - Cluster setup and installation - Hadoop configuration

UNIT III **10 Hours**

TABLEAU

Getting started with Tableau - creating charts - working with metadata - filters and applying analytics to the worksheet - Modifications to data connections - Introduction to Level of details in Tableau (LODS)

UNIT IV **9 Hours**

PROGRAMMING BASICS AND DATA ANALYTICS WITH PYTHON

Introduction - Python environment setup and essentials -Python programming fundamentals - data analytics - statistical computing - mathematical computing using NumPy - Data manipulation with Pandas - Data visualization- Introduction to model building.

UNIT V **9 Hours**

R PROGRAMMING FOR DATA SCIENCE

R Basics - Data structures in R - R programming fundamentals - working with data in R - Strings and dates in R - Data visualization - Regression analysis - Classification - Clustering - Association

Total: 45 Hours

Reference(s)

1. James D Miller, Statistics for Data Science: Leverage the Power of Statistics for Data Analysis, Classification, Regression, Machine Learning, and Neural Networks, Packt publishing, 2017
2. Wes McKinney, Python for Data Analysis, 2nd edition O Reilly Media, USA, 2018
3. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, O Reilly Media, USA, 2017
4. Brett Lantz , Machine learning with R - Expert techniques for predictive learning, 3rd edition, Packt publishing, 2019
5. JD long and Paul Teetor, R Cookbook: Proven Recipes for Data Analysis, Statistics, and Graphics, 2nd edition, O Reilly Media, USA, 2019
6. Tom White Hadoop: The Definitive Guide, O Reilly Media, 2012.

21ES62 ROBOTICS AND AUTOMATION 3 0 0 3

Course Objectives

- To know about the origin and types of robotics and its stabilization
- To develop a clear idea about hydraulic, pneumatic and electric drives
- To develop an optimal knowledge about machine interface in applications

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Use the history of industrial robots
2. Explain the concepts anatomy, features and applications of a typical robot
3. Identify the actuator, sensor, control scheme and gripper of a typical robot application
4. Apply homogenous transformation to obtain the forward and inverse kinematics of simple robot manipulators
5. Apply the robotics concept to different case studies

UNIT I **9 Hours**

BASIC CONCEPTS

Brief history - types of robot -robot classifications and specifications - design and control issues1various manipulators - sensors - work cell - programming languages - Robotic Operating Systems (RoS) - Internet of Robotic Things (IoRT).

UNIT II **9 Hours**

ACTUATORS AND SENSORS

Hydraulic, pneumatic and electric drives - determination of HP of motor and gearing ratio - servo motor - variable speed arrangements - machine vision - ranging sensors: acoustic, magnetic, eddy current type - laser and fiber optic sensor - tactile sensors.

UNIT III **9 Hours**

GRIPPERS AND MATHEMATICAL REPRESENTATION OF ROBOT

Various types of grippers - design considerations of grippers - end effectors - mathematical representation of Robots - Position and orientation.

UNIT IV **9 Hours**

KINEMATICS AND PATH PLANNING

Homogeneous transformation - various joints - representation using the Denavit Hattenberg parameters - degrees of freedom - direct kinematics - inverse kinematics.

UNIT V **9 Hours**

CASE STUDIES

PID control scheme - selection of a robot - robots in manufacturing and non-manufacturing application - PUMA 560 & SCARA robots.

Total: 45 Hours

Reference(s)

1. R. K. Mittal, I. J. Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 2017.
2. R.D. Klafter, T.A. Chimielewski, M. Negin, Robotic Engineering : An integrated approach, Prentice Hall of India New Delhi, 2011.
3. John J. Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2010.
4. S.R. Deb, Robotics technology and flexible Automation, Tata McGraw Hill, 2011
5. P.J .Mc Kerrow , Introduction to Robotics, Addison Wesley, USA, 2011.
6. Thomas.R.Kurfess, Robotics and Automation Handbook, CRC Press, October 2004.

21ES63 FAULT TOLERANT CONTROL SYSTEM 3 0 0 3

Course Objectives

- To familiarize the students for the fault detection and isolation of industrial processes and Systems, additionally to fault-tolerant control with a special emphasis to model based techniques (analytical redundancy)
- To review the basic concept of fault detection systems

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations
f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Design and implementation of fault tolerant controllers for industrial systems and processes
2. Design decision logic description using languages
3. Design fault propagation analysis
4. Design and implement fault-tolerant control systems
5. Detect and quantify and compensate stiction in Control valves

UNIT I **9 Hours**

INTRODUCTION

Introduction - Types of faults and different tasks of Fault Diagnosis and Implementation - Different Approaches to FDD: Model-free and Model-based approaches-Introduction- Mathematical Representation of Faults and Disturbances: Additive and Multiplicative types - Residual Generation: Detection, Isolation, Computational and stability properties - Design of Residual generator - Residual specification and Implementation.

UNIT II **9 Hours**

DESIGN OF STRUCTURED RESIDUALS

Introduction- Residual structure of single fault Isolation: Structural and Canonical structures-Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts - Introduction to parity equation implementation of residual generator and alternative representation - Directional Specifications: Directional specification with and without disturbances - Parity Equation Implementation - Linearly dependent column.

UNIT III **9 Hours**

FAULT DIAGNOSIS USING STATE ESTIMATORS

Introduction - Review of State Estimators - Fault Detection and Diagnosis using Generalized Likelihood Ratio Approach and Marginalized Likelihood Ratio Approach.

UNIT IV **9 Hours**

FAULT TOLERANT CONTROL

Introduction-Passive Fault-tolerant Control- Active Fault tolerant Control - Eigen structure assignment - Actuator and Sensor Fault tolerance Principles: Compensation for actuator - Sensor Fault-tolerant Control Design - Fault-tolerant Control Architecture - Fault-tolerant Control design against major actuator failures.

UNIT V **9 Hours**

CASE STUDIES

Aircraft fault detection - Fault detection and diagnosis of DC Motor Drives - Fault detection and diagnosis of a Centrifugal pump pipe system - Fault-tolerant Control of Three-tank System - Diagnosis and Fault-tolerant control of chemical process - supervision of steam generator - Different types of faults in Control valves.

Total: 45 Hours

Reference(s)

1. Rolf Isermann, Fault-Diagnosis Systems: An Introduction from Fault Detection to Fault Tolerance, Springer Verlag, 2011.
2. Steven X. Ding, Model based Fault Diagnosis Techniques: Schemes, Algorithms, and Tools, Springer Publication, 2012.
3. Hassan Noura, Didier Theilliol, Jean-Christophe Ponsart, Abbas Chamseddine, Fault1Tolerant Control Systems: Design and Practical Appl
4. Mogens Blanke, Michel Kinnaert, Jan Lunze, Marcel Staroswiecki, Diagnosis and Fault1Tolerant Control, Sprin
5. Prashant Mhaskar, Jinfeng Liu, Panagiotis D. Christofides , Fault-Tolerant Process Control: Methods and Applications, Springer, 2014.
6. Ali Ahammad Shoukat Choudhury, Sirish L. Shah, Nina F. Thornhill, Diagnosis of Process Nonlinearities and Valve Stiction: Data Driven Approaches, Springer Berlin Heidelberg, 2010.

21ES64 OPTIMAL CONTROL SYSTEM 3 0 0 3

Course Objectives

- To impart knowledge about optimal control systems and its approach for formulation of the system
- To familiarize the characteristics of linear quadratic systems of optimal control
- To improve the skill in dynamic programming of various control system

Programme Outcomes (POs)

b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications

Course Outcomes (COs)

1. Infer state space equation and calculus of variations.
2. Formulate performance measures for optimal control problem.
3. Design optimal controller using linear quadratic regulator concepts.
4. Compute optimal control solution for discrete systems using dynamic programming.
5. Differentiate the relation between dynamic programming and Pontryagins minimum principle

UNIT I **9 Hours**

INTRODUCTION

Static optimization with and without constraints - Matrix properties and definitions - Quadratic forms and definiteness - state-space form for continuous systems and discrete systems. Calculus of variations: functionals of a single function, necessary and sufficient conditions: fixed initial and final boundary conditions

UNIT II **9 Hours**

OPTIMAL CONTROL FORMULATION

The Performance measure: performance measures for optimal control problems, selecting a performance measure, constraints - Variational approach to optimal control problems: necessary conditions for optimal control

UNIT III **9 Hours**

LINEAR QUADRATIC OPTIMAL CONTROL SYSTEMS

Problem formulation - Linear regulator problem - Infinite time linear quadratic regulator - meaningful interpretation of Riccati coefficient - analytical solution of algebraic Riccati equation - equivalence of open loop and closed loop. Design of LQR: inverted pendulum, DC motor speed control

UNIT IV **9 Hours**

DYNAMIC PROGRAMMING

The Optimal control law -Principle of optimality - dynamic programming applied to routing problem - an optimal control system -recurrence relation of dynamic programming - computational procedure for solving control problems- characteristics of dynamic programming solutions.

UNIT V **9 Hours**

PONTRYAGINS MINIMUM PRINCIPLE

Minimum time problems - relation between dynamic programming and the minimum principle - two point boundary value problems - quasi linearization

Total: 45 Hours

Reference(s)

1. Kirk, Donald E., Optimal Control Theory: An Introduction, Dover publications, 2012.
2. DesineniSubburam Naidu, Optimal Control Systems, CRC Press, 2018
3. ZdzislawBubnicki, Modern Control System, Springer, 2005
4. Anderson B.D.O. and Moore J.B., Optimal Control: Linear Quadratic Methods, Dover Publications, 2014.
5. I. Michael Ross., A Primer on Pontryagin"s Principle in Optimal Control, Collegiate Publishers, Second Edition, 2015
6. Suresh P. Sethi, Optimal Control Theory,Springer International Publishing, 2018.

21ES65 SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

3 0 0 3

Course Objectives

- To analyse the mathematical model of a system using non parametric, parametric and recursive identification methods.
- To get adequate knowledge about adaptive control methodology and its various schemes
- To design adaptive control scheme for real time systems and analyse its stability behavior

Programme Outcomes (POs)

b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems

c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems

d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications

Course Outcomes (COs)

1. Analyse the mathematical representation of a system using transient and frequency response methods
2. Analyse the mathematical representation of a system using regression, prediction and estimation methods
3. Analyse the mathematical representation of a system using recursive least square, direct and indirect methods
4. Interpret the concept of adaptive control and analyse its schemes
5. Apply Adaptive control concept to industrial processes and analyse the stability and robustness of the process

UNIT I **9 Hours**

SYSTEM IDENTIFICATION USING NON PARAMETRIC METHODS

Non-parametric methods: Transient analysis-frequency analysis-Correlation analysis- Spectral analysis.

UNIT II **9 Hours**

SYSTEM IDENTIFICATION USING PARAMETRIC METHODS

Linear Regression: The Lease square estimate-best linear unbiased estimation under linear constraints1updating the Parameter estimates for linear regression models-Prediction error methods: Description of Prediction error methods-Optimal Prediction - Instrumental variable methods: description of Instrumental variable methods

UNIT III **9 Hours**

RECURSIVE IDENTIFICATION METHODS

The recursive lest squares method-the recursive Instrument variable method-the recursive prediction error method-model validation and model structure determination. identification of systems operating in closed loop: Direct identification- Indirect identification-joint input-output identification.

UNIT IV **9 Hours**

ADAPTIVE CONTROL SCHEMES

Introduction - users- Definitions-auto tuning-types of adaptive control-gain scheduling controller Model Reference Adaptive Control schemes - self-tuning controller. MRAC and STC: Approaches - The Gradient approach - Lyapunov functions - Passivity theory - pole placement method Minimum variance control - Predictive control.

UNIT V **9 Hours**

APPLICATION OF ADAPTIVE CONTROL AND ANALYSIS

Application of adaptive control: Distillation column control, Continuous Stirred Tank Reactor Control. Analysis: Stability - Convergence - Robustness

Total: 45 Hours

Reference(s)

1. Torsten Soderstrom, Errors-in-Variables Methods in System Identification (Sweden), Springer, ISBN:9783319750019, 3319750011, 2018.
2. Nhan T. Nguyen Model-Reference Adaptive Control (NASA-USA), Springer, ISBN: 9783319563930, 3319563939, 2018.
3. Yiannis Boutalis, Dimitrios Theodoridis , Theodore Kottas, Manolis A. Christodoulou, System Identification and Adaptive Control: Theory and Applications of the Neurofuzzy and Fuzzy Cognitive Network Models (Advances in Industrial Control) Hardcover Springer, ISBN: ISBN-13 : 978-3319063638, 2014.
4. Karl J.Astrom and Bjorn Wittenmark, Adaptive Control, Pearson Education, 2nd Editon, 2013.
5. Sastry S. and Bodson M., Adaptive control stability, Convergence and Robustness, Prentice Hall inc., New Jersey, 2011.
6. Ljung,L., System Identification: Theory for the user, Pretice Hall, Englewood cliffs, 1999.

21ES66 WIRELESS SENSOR NETWORKS 3 0 0 3

Course Objectives

- To obtain a broad understanding of the technologies and applications for the emerging and exciting domain of wireless sensor networks
- To study the challenges and latest research results related to the design and management of wireless sensor networks
- To focus on network architectures and security

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Formulate the basics of wireless sensor networks and its applications in enabling technologies
2. Indicate the architecture and elements of wireless sensor networks
3. Identify the performance of MAC and routing protocols
4. Implement the localization techniques for detection WSN
5. Demonstrate the tools and platforms needed to establish sensor networks

UNIT I **9 Hours**

OVERVIEW OF WIRELESS SENSOR NETWORKS

Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Applications of sensor networks- Enabling Technologies for Wireless Sensor Networks.

UNIT II **9 Hours**

ARCHITECTURES

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts, Case study: Structural Health Monitoring-Environmental Sensor Networks.

UNIT III **9 Hours**

NETWORKING OF SENSORS

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Case study: MAC for Underwater Acoustic Sensor Networks, Routing Protocols- Energy- Efficient Routing, Geographic Routing.

UNIT IV **9 Hours**

INFRASTRUCTURE ESTABLISHMENT

Topology Control, Clustering, Time Synchronization, Localization and Positioning-case study: Shooter Localization in Urban Terrain, Sensor Tasking and Control-Case study: Large Scale Habitat Monitoring. Security and privacy protection, Heterogeneous fault detection, Discrepancy based fault detection and correction, Case study: Secure Routing in Wireless Sensor Networks: Attacks and Countermeasures

UNIT V **9 Hours**

SENSOR NETWORK PLATFORMS AND TOOLS

Operating Systems for Wireless Sensor Networks, Sensor Node Hardware Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming, Case study: Qualnet Simulation of Military application.

Total: 45 Hours

Reference(s)

1. C. D. Johnson, Process Control Instrumentation Technology, 8th Edition, Prentice Hall, 2015
2. Fisher Controls International, Control Valve Handbook, 4th Edition, Emerson Process Management, 2013.
3. R.W. Miller, Flow Measurement Engineering Handbook, Mc-Graw Hill, New York 2011.
4. Bela G. Liptak, Instrument Engineers Handbook - Process Control and Optimization, 4th Edition, Vol.2, CRC Press, 2018.
5. K. Martinez, J. Hart and R. Ong, Environmental Sensor Networks IEEE Computer Magazine, August 2004.
6. M. Maroti, G. Simon, A Ledeczi and J. Sztipanovits, Shooter Localization in Urban Terrain, IEEE Computer Magazine, August 2004.

21ES67 MACHINE VISION 3 0 0 3

Course Objectives

- Familiarize the concepts of machine vision
- Study the importance of optics shading
- Understand the algorithms of computational learning

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems

d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications

f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Explain the concepts of machine vision.
2. Outline the concepts of image optics
3. Analyse the various machine learning methods.
4. Apply Bayesian and Computational Learning methods.
5. Compare the different algorithms using advanced learning concepts.

UNIT I **9 Hours**

MACHINE VISION

Introduction Machine vision Relationship to other fields Image definitions levels of computation- Binary image processing Thresholding - Geometric properties position orientation Run-length encoding - Binary algorithms Definitions - Component labeling Size filter Euler number -Region boundary Area perimeter compact Distance measures- Distance transforms Medial axis Thinning expanding and shrinking morphological operators.

UNIT II **9 Hours**

OPTICS SHADING

Optics lens equation Image resolution Depth of Field view volume Exposure- shading Image Inductance Illumination Reflector Surface orientation shape from shading depth Stereo imaging Cameras in arbitrary position and orientation Stereo matching Edge matching Region correlation shape from X Range imaging structural lighting Imaging Radar- Active vision.

UNIT III **9 Hours**

INTRODUCTION TO LEARNING

Learning Problems Perspectives and Issues Concept Learning Version Spaces and Candidate Eliminations Inductive bias Decision Tree learning Representation Algorithm Heuristic Space Search. K- Nearest Neighbour Learning Locally weighted Regression

UNIT IV **9 Hours**

BAYESIAN AND COMPUTATIONAL LEARNING

Bayes Theorem Concept Learning Maximum Likelihood Minimum Description Length Principle Bayes Optimal Classifier Gibbs Algorithm Naive Bayes Classifier bayesian Belief Network EM Algorithm Probability Learning

UNIT V **9 Hours**

ADVANCED LEARNING

Learning Sets of Rules Sequential Covering Algorithm Learning Rule Set First Order Rules Sets of First Order Rules Induction on Inverted Deduction Inverting Resolution Analytical Learning Perfect Domain Theories Explanation Base Learning FOCL Algorithm Reinforcement Learning

Total: 45 Hours

Reference(s)

1. Ramesh Jain, Rangachar Kasturi and Brian G. Schunck, Machine Vision, McGraw Hill International Edition, 2006.
2. Fabio Solari, Manuela Chessa, Silvio P. Sabatini, Machine Vision: Applications and Systems, Intech Pulications 2012

3. Carsten Steger, Markus Ulrich, Christian Wiedemann, Machine Vision Algorithms and Applications, Wiley, 2018
4. Gregory A Baxes, Digital Image Processing, John Wiley & Sons, 1994.
5. W.K. Pratt, Digital Image Processing, 4th edition, John Wiley and Sons, 2010.
6. Tom M. Mitchell, Machine Learning, New Delhi: McGraw-Hill Science/Engineering/Math, 2012

21ES68 SOFT COMPUTING TECHNIQUES 3 0 0 3

Course Objectives

- To expose the students to the concepts of neural networks and applications
- To provide adequate knowledge about fuzzy and neuro-fuuzy systems
- To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Implement the concept of machine learning through neural networks
2. Infer different learning methods in artificial neural networks
3. Develop a fuzzy expert system for designing intelligent systems
4. Implement Neuro-Fuzzy and Neuro-Fuzz-GA expert system
5. Design Genetic algorithm to solve optimization problems

UNIT I **9 Hours**

INTRODUCTION TO SOFT COMPUTING

Evolution of Computing - Soft Computing Constituents - From Conventional AI to Computational Intelligence - Machine learning Basics.

UNIT II **9 Hours**

NEURAL NETWORKS

Machine Learning using Neural Network, Adaptive Networks - Feed Forward Networks - Supervised Learning Neural Networks - Radial Basis Function Networks - Reinforcement Learning - Unsupervised Learning Neural Networks - Adaptive Resonance Architectures - Advances in Neural Networks.

UNIT III **9 Hours**

FUZZY LOGIC

Fuzzy sets - Operations on Fuzzy Sets - Fuzzy Relations - Membership Functions - Fuzzy Rules and Fuzzy Reasoning - Fuzzy Inference Systems - Fuzzy Expert Systems - Fuzzy Decision Making.

UNIT IV **9 Hours**

NEURO - FUZZY MODELING

Adaptive Neuro - Fuzzy Inference systems - Coactive Neuro-Fuzzy Modeling - Classification and Regression Tress - Data Clustering Algorithms - Rule base structure Identification - Neuro-Fuzzy Control

UNIT V **9 Hours**

GENETIC ALGORITHMS

Introduction - Gradient Search - Non-gradient search - Genetic Algorithms: binary and real representation schemes, selection methods, crossover and mutation operators for binary and real coding.

Total: 45 Hours

Reference(s)

1. R. Rajasekaran and G. A and Vijayalakshmi Pa, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, Prentice Hall of India, 2019
2. Hagan, Demuth, Beale, Neural Network Design, Cengage Learning, 2014
3. N.P.Padhy, Artificial Intelligence and Intelligent Systems, Oxford, 2013
4. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, 2nd Edition, Wiley India Edition, 2013
5. Timothy J. Ross, Fuzzy Logic with Engineering Applications, 3rd Edition, Wiley India Edition, 2011
6. David E. Goldberg, Genetic Algorithms in search, optimization and machine learning, Addison Welsey, 2010

21ES69 MEDICAL IMAGE PROCESSING 3 0 0 3

Course Objectives

- To learn the basic fundamentals of medical imaging systems
- To provide information about classification and image visualization in medical image processing
- To have an understanding on the application of digital image processing techniques on medical images

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Interpret the image perception model and image transforms
2. Analyze the enhancement and restoration techniques for preprocessing of medical images
3. Implement the medical image reconstruction methods
4. Implement the classification methods in medical image processing
5. Analyze the medical image visualization methods

UNIT I **9 Hours**

FUNDAMENTALS OF IMAGE PROCESSING

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image Acquisition Strategies, Image sampling and quantization - two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms - 2D-DFT, DCT, KLT, SVD and Wavelet.

UNIT II **9 Hours**

BIO-MEDICAL IMAGE PREPROCESSING

Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fMRI, Ultrasound imaging., 3D Ultrasound imaging Nuclear, Medical Imaging modalities - SPECT,PET, Molecular Imaging.

UNIT III **9 Hours**

MEDICAL IMAGE RECONSTRUCTION

Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fMRI, Ultrasound imaging., 3D Ultrasound imaging Nuclear, Medical Imaging modalities - SPECT,PET, Molecular Imaging.

UNIT IV **9 Hours**

IMAGE ANALYSIS AND CLASSIFICATION

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification - Statistical, Rule based, Neural Network approaches.

UNIT V **9 Hours**

IMAGE REGISTRATIONS AND VISUALIZATION

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization - 2D display methods, 3D display methods, virtual reality based interactive visualization.

Total: 45 Hours

Reference(s)

1. Atam P.Dhawan,- Medical Image Analysis, Wiley Interscience Publication, NJ S.Sridhar, Digital Image Processing, Oxford University Press, 2011, New Delhi.
2. Rafael C.Gonzalez and Richard E.Woods,- Digital Image Processing, Third Edition, Pearson Education, 2008, New Delhi
3. Geoff Dougherty,- Digital Image Processing for Medical Applications, Cambridge University Press, 2010.

4. John L.Semmlow,- Biosignal and Biomedical Image Processing Matlab Based applications, Marcel Dekker Inc., New York,2004
5. Sinha G. R, Patel, B. C., Medical Image Processing: Concepts And Applications, Prentice Hall, 2014.
6. Jack L. Lancaster and Bruce Hasegawa, Fundamental Mathematics and Physics of Medical Imaging, CRC Press, 2016.

21ES70 BIO SIGNAL PROCESSING 3 0 0 3

Course Objectives

- To study the characteristics of different bio signals
- To learn linear and non-linear filtering Techniques to extract valuable information
- To understand various techniques for automated classification and decision making to aid diagnosis

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

Course Outcomes (COs)

1. Understand the basics of bio signals and its characteristics
2. Understand the pre-processing of Bio signals
3. Analyze Bio signals in time domain & to estimate the spectrum
4. Apply wavelet detection techniques for Biosignals processing
5. Classify Biosignals using neural networks and statistical classifiers

UNIT I **9 Hours**

INTRODUCTION TO BIOMEDICAL SIGNALS

Introduction to Biomedical signals: Bio-signal Characteristics of Electro Cardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Objectives of Biomedical signal analysis, Difficulties in Biomedical signal analysis, Computer-aided diagnosis.

UNIT II **9 Hours**

BIOSIGNAL AND SPECTRAL CHARACTERISTICS

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

UNIT III **9 Hours**

TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION

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

UNIT IV **9 Hours**

REMOVAL OF ARTIFACTS AND WAVELET DETECTION

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

UNIT V **9 Hours**

BIOSIGNAL CLASSIFICATION AND RECOGNITION

Signal classification and recognition - Statistical signal classification, linear discriminant function, direct feature selection and ordering, Backpropagation neural network-based classification. Application in Normal versus Ectopic ECG beats.

Total: 45 Hours

Reference(s)

1. SerigoCerutti, Carlo Marchesi, Advanced Methods of Biomedical Signal Processing- IEEE, April 2011
2. Rangaraj M Rangayyan ,Biomedical Signal Analysis , IEEE Press, 2001
3. Biomedical Digital Signal Processing - Willis J Tomkins, PHI, 1993.
4. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida, 1999.
5. Rangaraj M. Rangayyan, Biomedical Signal Analysis-A case study approach, Wiley, 2nd Edition, 2016.
6. KatarzynaJ.Blinowska, JaroslawZygierewicz Practical Biomedical Signal Analysis Using MATLAB, CRC Press, October 2011

21ES71 ELECTRO MEDICAL INSTRUMENTATION 3 0 0 3

Course Objectives

- To understand the role of instrumentation in biomedical engineering field
- To get ample knowledge on Electro-physiological and non-electric parameter measurement
- To analyze parameters of medical imaging and its measurements

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems

b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems

c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Analyze the human physiology and characterize the different transducers to measure its parameters
2. Classify the various Electro physiological and blood flow measurements
3. Identify the techniques for heart and blood pressure measurements
4. Construct the techniques used in medical image analysis
5. Choose the appropriate assistive and Therapeutic devices for Illness

UNIT I **10 Hours**

HUMAN PHYSIOLOGY AND BIO POTENTIAL ELECTRODES

Cell and their structures - action and resting potential - nervous system: functional organization of the nervous system, structure of nervous system, neurons, synapse - transmitters and neural communication - cardiovascular system - Embedded System components of a biomedical system - different types of electrodes - electrical safety - grounding and isolation

UNIT II **9 Hours**

ELECTRO - PHYSIOLOGICAL AND BLOOD FLOW MEASUREMENT

ECG - EEG - lead system and recording methods - typical waveforms - Blood flow and cardiac output measurement, Electromagnetic and ultrasound blood flow measurement using Embedded Systems.

UNIT III **9 Hours**

NON - ELECTRICAL PARAMETER MEASUREMENT

Measurement of blood pressure - Heart rate - Heart sound - Pulmonary function measurements - spirometer - Body Plethysmograph - Blood Gas analyzers: pH of blood - measurement of blood pCO2, pO2, Embedded System based pulse oximeter

UNIT IV **9 Hours**

MEDICAL IMAGING PARAMETER MEASUREMENTS

X-RAY machine - Computer Tomography - Magnetic Resonance Imaging system - ultra sonography - Endoscopy - Embedded System based bio-telemetry

UNIT V **8 Hours**

ASSISTING AND THERAPEUTIC DEVICES

Embedded System based Cardiac pacemakers - defibrillators - ventilators - heart-lung machine - dialyzers - elements of audio and visual aids; Case Study

Total: 45 Hours

Reference(s)

1. R.S.Khandpur, Hand Book of Bio-Medical instrumentation, Tata McGraw Hill publishing company Ltd., 2014.
2. J.G. Webster, Medical Instrumentation: Application and Design, John Wiley and Sons, New York, 2014.

3. Leslie Cromwell, Biomedical Instrumentation and measurement, Tata McGraw Hill, 2012.
4. G. Well, Biomedical Instrumentation and Measurements, Prentice Hall of India, New Delhi, 2012.
5. Jog Nandini.K, Electronics in Medicine and Biomedical Instrumentation, Prentice Hall India, January, 2006

21ES72 INDUSTRIAL CONTROL AND AUTOMATION

3 0 0 3

Course Objectives

- To study the concepts of Advanced Industrial Process Controllers and Assembly language programming of PLC, SCADA and DCS.
- To study the concepts of Architectural Support for High level language and memory hierarchy.
- To study the concepts of Architectural support for system Development and memory management.

Programme Outcomes (POs)

a. Imparting domain knowledge in Electric equipment, information technology and communication engineering to develop a cyber physical approaches for real time systems
b. Design and conduct experiments to analyze and interpret data on multidisciplinary domains in the field of embedded systems
c. Analyse the complex problems in electrical and electronics systems and solve them using the knowledge of embedded systems
d. Apply appropriate techniques, resources, and modern IT tools with the latest developments and Industry requirements for embedded applications
f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Analyse the hardware design and development tools of ARM microcontroller
2. Understanding the process of conversion of digital data to analog and analog data to digital data for automation and gain adequate programming skills using PLC, DCS and SCADA.
3. Abstract the architectural support for high level language and memory hierarchy
4. Design microcontroller bus architecture and interfacing techniques
5. Apply the architecture and memory organization of PLC with AI techniques.

UNIT I **9 Hours**

INTRODUCTION TO INDUSTRIAL CONTROL AND AUTOMATION

Introduction to Multivariable Control - Multivariable PID Controller - Multivariable IMC - Multivariable Dynamic Matrix Controller - Multiple Model-based Predictive Controller - Predictive PID Control - Control Schemes for Distillation Column, CSTR, Bioreactor, Four-tank system, pH, and polymerization reactor.

UNIT II **9 Hours**

AN OVERVIEW OF PROGRAMMABLE LOGIC CONTROLLERS AND SCADA

Programmable logic controllers- Organisation- - Hardware details- I/O- Power supply- - Programming aspects- Ladder programming- Sequential function charts- SCADA: Introduction, SCADA Architecture, Different Communication Protocols- Supervision and Control, HMI, RTU and Supervisory Stations.

UNIT III **9 Hours**

INTRODUCTION TO DCS AND ITS APPLICATIONS

DCS: Introduction, DCS Architecture, Local Control (LCU) architecture, LCU languages. LCU - Process interfacing issues, communication facilities, configuration of DCS, displays, redundancy concept - case studies in DCS

UNIT IV **9 Hours**

SEQUENCE CONTROL

Scan Cycle, RLL Syntax- Structured Design Approach- Advanced RLL Programming - The Hardware environment. Control of Machine tools: Introduction to CNC Machines- Analysis of a control loop.

UNIT V **9 Hours**

ARTIFICIAL INTELLIGENCE IN INDUSTRIAL AUTOMATION

Introduction to Artificial Intelligence - Applications of Industrial AI in Monitoring, optimization and control.AI applications in Industry Automation using -natural language processing-computer vision1speech recognition

Total: 45 Hours

Reference(s)

1. Process Dynamics and Control, 4th Edition Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Francis J. Doyle III, September 2016
2. Dorf, R.C. and Bishop R. T., Modern Control Systems, Addison Wesley Longman Inc., 2019.
3. Laplante P.A., Real Time Systems: An Engineers Handbook, Prentice Hall of India Pvt. Ltd., New Delhi, 2020.
4. Constantin H. Houpis and Gary B. Lamont, Digital Control Systems, McGraw Hill Book Company, Singapore, 2016.
5. Douglas E. Comer, Computer Networks and Internets, Sixth Edition, Prentice Hall, New Delhi, 2015
6. M. P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Fourth Edition, Pearson Education, UK, 2019

21XE01 ENGLISH FOR RESEARCH PAPER WRITING

2 0 0 0

Course Objectives

- Illustrate that how to improve your writing skills and level of readability.
- Learn about what to write in each section.
- Recognize the skills needed when writing a Title.
- Ensure the good quality of paper at very first-time submission.

Programme Outcomes (POs)

e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Illustrate the research ideas and writing journal papers
2. Creating research paper writing

UNIT I **5 Hours**

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

UNIT II **5 Hours**

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

UNIT III **5 Hours**

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

UNIT IV **5 Hours**

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

UNIT V **5 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

UNIT VI **5 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Total: 30 Hours

Reference(s)

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highmans book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

21XE02 COST MANAGEMENT OF ENGINEERING PROJECTS

2 0 0 0

Course Objectives

- To understand the cost concepts and different stages of project execution and its activities.
- To understand cost behavior, management and its quantitative techniques.

Programme Outcomes (POs)

e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Apply the cost concepts in decision making.
2. Analyze the various stages of project execution and its activities.
3. Analyze the cost behavior and various types of costing.
4. Analyze the cost management and budget related decisions.
5. Analyze the quantitative techniques for cost management.

UNIT I **6 Hours**

COST CONCEPTS IN DECISION-MAKING

Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT II **6 Hours**

PROJECT

Meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT III **6 Hours**

COST BEHAVIOR AND PROFIT PLANNING MARGINAL COSTING

Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning.

UNIT IV **6 Hours**

TOTAL QUALITY MANAGEMENT AND THEORY OF CONSTRAINTS

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V **6 Hours**

QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total: 30 Hours

Reference(s)

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

21XE03 STRESS MANAGEMENT 2 0 0 0

Course Objectives

- To achieve overall health of body and mind.
- To overcome stress by practicing yoga.

Programme Outcomes (POs)

e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Develop healthy mind in a healthy body thus improving social health also.
2. Improve Efficiency of the body by practicing breathing exercises and yoga.

UNIT I **10 Hours**

Definitions of Eight parts of yog. (Ashtanga)

UNIT II **10 Hours**

Yam and Niyam. Dos and Donts in life.i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

UNIT III **10 Hours**

Asan and Pranayam, i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam.

Total: 30 Hours

Reference(s)

1. Yogic Asanas for Group Training-Part-I Janardan Swami Yogabhyasi Mandal, Nagpur. Model Curriculum of Engineering & Technology PG Courses [Volume-I][47].
2. Rajayoga or conquering the Internal Nature by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

21XE04 DISASTER MANAGEMENT 2 0 0 0

Course Objectives

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Programme Outcomes (POs)

e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Illustrate the key concepts in disaster risk reduction and humanitarian response
2. Interpret the strengths and weaknesses of disaster management approaches, planning and programming

UNIT I **5 Hours**

INTRODUCTION

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II **5 Hours**

REPERCUSSIONS OF DISASTERS AND HAZARDS

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms and Cyclones, Tsunamis and Floods, Droughts and Famines, Landslides and Avalanches Man-made disaster Nuclear Reactor Meltdown, Industrial Accidents and Oil Slicks and Spills Outbreaks of Disease and Epidemics War and Conflicts.

UNIT III **5 Hours**

DISASTER PRONE AREAS IN INDIA

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT IV **5 Hours**

DISASTER PREPAREDNESS AND MANAGEMENT

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V **5 Hours**

RISK ASSESSMENT

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People"s Participation In Risk Assessment. Strategies for Survival.

UNIT VI **5 Hours**

DISASTER MITIGATION

Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Total: 30 Hours

Reference(s)

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies “, New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi
3. Goel S. L. "Disaster Administration And Management Text And Case Studies”, Deep &Deep Publication Pvt. Ltd., New Delhi.
4. Model Curriculum of Engineering & Technology PG Courses [Volume-I][42]

21XE05 VALUE EDUCATION 2 0 0 0

Course Objectives

- Interpret value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Programme Outcomes (POs)

e. Communicate the technical information effectively with the engineering community to make effective reports and presentations
f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

UNIT I **8 Hours**

Values and self-development- Social values and individual attitudes-Work ethics- Indian vision of humanism- Moral and non- moral valuation-Standards and principles-Value judgements.

UNIT II **7 Hours**

Importance of cultivation of values- Sense of duty Devotion- Self-reliance- Confidence-Concentration-Truthfulness- Cleanliness-Honesty- Humanity- Power of faith- National Unity- Patriotism- Love for nature-Discipline.

UNIT III **8 Hours**

Personality and Behavior Development - Soul and Scientific attitude- Positive Thinking- Integrity and discipline-Punctuality- Love and Kindness- Avoid fault Thinking- Free from anger- Dignity of labour-Universal brotherhood and religious tolerance-True friendship-Happiness Vs suffering- love for truth-Aware of self-destructive habits-Association and Cooperation-Doing best for saving nature.

UNIT IV **7 Hours**

Character and Competence -Holy books vs Blind faith, Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message, Mind your Mind, Self-control. Honesty, Studying effectively.

Total: 30 Hours

Reference(s)

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi.

21XE06 PEDAGOGY STUDIES 2 0 0 0

Course Objectives

- Review existing evidence on the review topic to inform programmer design and policy making undertaken by the DfID, other agencies and researchers
- Identify critical evidence gaps to guide the development.

Programme Outcomes (POs)

e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Overall personality

UNIT I **8 Hours**

INTRODUCTION AND METHODOLOGY

Aims and rationale- Policy background- Conceptual framework and terminology-Theories of learning-Curriculum- Teacher education-Conceptual framework- Research questions-Overview of methodology and Searching

UNIT II **7 Hours**

THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

UNIT III **8 Hours**

EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school, curriculum and guidance materials best support effective pedagogy. Theory of change, Strength and nature of the body of evidence for effective pedagogical,

practices, Pedagogic theory and pedagogical approaches, Teachers" attitudes and beliefs and Pedagogic strategies

UNIT IV **7 Hours**

PROFESSIONAL DEVELOPMENT

Alignment with classroom practices and follow up, Support Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Total: 30 Hours

Reference(s)

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379
3. Akyeampong K (2003) Teacher training in Ghana - does it count. Multi-site teacher education research project (MUSTER) country report 1. London: DFID
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, "learning to read" campaign

21XE07 BUSINESS ANALYTICS 2 0 0 0

Course Objectives

- Illustrate the role of business analytics within an organization
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making
- To become familiar with processes needed to develop, report, and analyze business data
- Use decision-making tools/Operations research techniques and Manage business process using analytical and management tools

Programme Outcomes (POs)

e. Communicate the technical information effectively with the engineering community to make effective reports and presentations

f. Apply legal and ethical issues in engineering profession through life-long learning to meet the changes in embedded technologies

Course Outcomes (COs)

1. Implement the knowledge of data analytics
2. Apply the ability of think critically in making decisions based on data and deep analytics.

3. Analyze the ability to use technical skills in predicative and prescriptive modeling to support business decision-making
4. Determine the ability to translate data into clear, actionable insights
5. Analyze the decision problems in business analytics

UNIT I **6 Hours**

BUSINESS ANALYTICS AND STATISTICAL TOOLS

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics-Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview

UNIT II **6 Hours**

TRENDINESS AND REGRESSION ANALYSIS

Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology

UNIT III **6 Hours**

ORGANIZATION STRUCTURES OF BUSINESS ANALYTICS

Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization

UNIT IV **6 Hours**

FORECATING TECHNIQUES

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models

UNIT V **6 Hours**

DECISION ANALYSIS

Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making

Total: 30 Hours

Reference(s)

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics by James Evans, persons Education