ANNAMALAI UNIVERSITY

Annamalainagar

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL ENGINEERING

M.E. EMBEDDED SYSTEMS (Two-Year Full Time & Three-year Part Time) DEGREE PROGRAMME

Choice Based Credit System

HAND BOOK

2017

DEPARTMENT OF ELECTRICAL ENGINEERING

Vision - Mission Statement

Vision

Empowering the community of students of Department of Electrical Engineering with very high morals, values, ethics, skills and technical knowledge through a rich curriculum blending the equal proportions of theoretical and hands-on experience by a process of transformation via hard-work and perseverance, with a view to serving the society in the role of socially responsible engineers so as to look after the needs of the nation and to elevate the standard of living of the people by incorporating innovation and sustained research.

Mission

- To attract the students to pursue not only the under graduation, but also up to the research level, with the exquisite infrastructure, learned faculties, state-of-the-art laboratories etc., from the Indian and International diasporas.
- To foster the global standards in learning, teaching and research that owes to an overall development of the department, faculties and students within the university and from across the globe as well.
- To enhance the calibre of students to be the most sought for, by the industrial and research entities.
- To enable for a diversified and challenging career that is ensued by the highest degree of professionalism, entrepreneurship, managerial and administrative expertise.

M.E. (EMBEDDED SYSTEMS)

Programme Educational Objectives (PEO)

The core objectives of the M.E. programme in Embedded Systems are intended

PEO-1

To provide adequate opportunities for the students to gain knowledge in the area of embedded systems and the related disciplines and apply the same to do research to emulate new ideas.

PEO-2

To motivate the students to gain competency in the areas of modelling, design, programming and optimization to meet industrial challenges in the field of automotive electronics, robotics, communication, consumer electronics, and industrial process control.

PEO-3

To cultivate leadership qualities and communication skills in the students and make them competent to function effectively in multidisciplinary teams.

PEO-4

To inculcate in the minds of the students ethical responsibility towards serving the society and make them understand their role as engineers in improving the standard of life of the people

Programme Outcomes (PO)

PO-1

Ability to analyze the existing concepts and synthesize new concepts in the field of embedded systems and to integrate both for enrichment of knowledge.

PO-2

Ability to explore the area of embedded systems to arrive at critical decisions while carrying out research in appropriate domain.

PO-3

Ability to investigate complex embedded system application problems and arrive at feasible hardware and software models by applying the acquired knowledge

PO-4

Ability to employ state-of- the art techniques and research outcomes in the embedded systems learning process.

PO-5

Ability to integrate modern engineering tools for solution of embedded system problems with an understanding of the limitations.

PO-6

Ability to work as an effective team member in collaborative-multidisciplinary engineering tasks related to the field of embedded systems.

PO-7

Ability to efficiently manage embedded system applications after considering societal, environmental, economic and financial factors.

PO-8

Ability inculcate lifelong learning and research with a high level of enthusiasm and commitment to facilitate global competence.

PO-9

Ability to develop effective presentation and communication skills during preparation of technical reports and design documentation.

PO-10

Ability to be a responsible professional with intellectual integrity, code of conduct and ethics of research and contribute towards the sustainable development of the society

Mapping of PEO with PO									
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**
PEO 1	✔	✔	✔							
PEO 2		✔	✔	✔	✔					
PEO 3				✔	✔	✔			✔	
PEO 4							✔	✔		✔

M.E. / M. Tech (Two-Year Full Time & Three-year Part Time) DEGREE PROGRAMME

CHOICE BASED CREDIT SYSTEM (CBCS)
REGULATIONS

1. **Condition for Admission**

   Candidates for admission to the first year of the four-semester **M.E / M.Tech Degree programme in Engineering** shall be required to have passed B.E / B.Techdegree of Annamalai University or any other authority accepted by the syndicate of this University as equivalent thereto. They shall satisfy the condition regarding qualifying marks and physical fitness as may be prescribed by the syndicate of the Annamalai University from time to time. The admission for part time programme is restricted to those working or residing within a radius of **90 km** from Annamalainagar. The application should be sent through their employers.

2. **Branches of Study in M.E / M.Tech**

   The Branch and Eligibility criteria of programmes are given in **Annexure 1**

3. **Courses of study**

   The courses of study and the respective syllabi for each of the M.E / M. Tech programmes offered by the different Departments of study are given separately.

4. **Scheme of Examinations**

   The scheme of Examinations is given separately.

5. **Choice Based Credit System (CBCS)**

   The curriculum includes three components namely Professional Core, Professional Electives and Open Electives in addition toThesis. Each semester curriculum shall normally have a blend of theory and practical courses.

6. **Assignment of Credits for Courses**

   Each course is normally assigned one credit per hour of lecture / tutorial per week and one credit for two hours or part thereof for laboratory or practical per week. The total credits for the programme will be 65.

7. **Duration of the programme**

   A student of **M.E / M.Tech**programme is normally expected to complete in four semesters for full-time / six semesters for part-time but in any case not more than four years for full-time / six years for part-time from the date of admission.

8. **Registration for courses**

   A newly admitted student will automatically be registered for all the courses prescribed for the first semester, without any option. Every other student shall submit a completed registration form indicating the list of courses intended to be credited during the next semester. This registration will be done a week before the last working day of the current semester. Late registration with the approval of the Dean on the recommendation of the

Head of the Department along with a late fee will be done up to the last working day. Registration for the Thesis Phase - I and II shall be done at the appropriate semesters.

9. **Electives**

The student has to select two electives in first semester and another two electives in the second semester from the list of Professional Electives. The student has to select two electives in third semester from the list of Open Electives offered by the department/ allied department. A student may be allowed to take up the open elective courses of third semester (Full Time program) in the first and second semester, one course in each of the semesters to enable them to carry out thesis in an industry during the entire second year of study provided they should register those courses in the first semester itself. Such students should meet the teachers offering those elective courses themselvesfor clarifications. No specific slots will be allotted in the time table for such courses.

Further, the two open elective courses to be studied in III semester (Full Time programme) may also be credited through the SWAYAM portal of UGC with the approval of Head of the Department concerned. In such a case, the courses must be credited before the end of III Semester.

10. **Assessment**

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I)	:	10 marks
Second assessment (Mid-Semester Test-II)	:	10 marks
Third Assessment	:	5 marks
End Semester Examination	:	75 marks

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First assessment (Test-I)	:	15 marks
Second assessment (Test-II)	:	15 marks
Maintenance of record book	:	10 marks
End Semester Examination	:	60 marks

The thesis PhaseI will be assessed for 40 marks by a committee consisting of the Head of the Department, the guide and a minimum of two members nominated by the Head of the Department. The Head of the Department will be the chairman. The number of reviews must be a minimum of three per semester. 60 marks are allotted for the thesis work and viva voce examination at the end of the third semester. The same procedure will be adopted for thesis Phase II in the fourth semester.

11. **Student Counsellors (Mentors)**

To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during

each semester, monitor their progress in SWAYAM courses / open elective courses and obtain the final approval of the Head of the Department.

12. Class Committee

For each of the semesters of M.E / M.Techprogrammes, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from first to fourth semesters for Full time and first to sixth semesters for Part-time will be as follows:

- Teachers of the individual courses.
- A Thesis coordinator (for Thesis Phase I and II) shall be appointed by the Head of the Department from among the Thesis supervisors.
- A thesis review committee chairman shall be appointed by the Head of the Department
- One Professor or Associate Professor, preferably not teaching the   concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.
- All counselors of the class and the Head of the Department (if not already a member) or any staff member nominated by the Head of the Department may opt to be special invitees.

The class committee shall meet **three** times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all   the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement   of the examinations. During this meeting the assessment on a maximum of 25 marks for theory / 40 marks for practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department for approval and transmission to the Controller of Examinations.

13. Temporary Break of Study

A student can take a one-time temporary break of study covering the current semester and / or the next semester with the approval of the Dean on the recommendation of the Head of the Department, not later than seven days after the completion of the mid-semester test. However, the student must complete the entire programme within the maximum period of **four years for Full time / six years for Part time.**

14. Substitute Assessments

A student who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the end of semester examination may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Head of the Department within a week from the date of the missed assessment.

15. Attendance Requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

A student who withdraws from or does not meet the minimum attendance requirement in a semester must re-register and repeat the same semester in the subsequent academic years.

16. Passing and declaration of Examination Results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the controller of examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the grade point average (GPA) and cumulative grade point average (CGPA) and prepare the mark sheets.

90 to 100 marks	Grade 'S'
80 to 89 marks	Grade 'A'
70 to 79 marks	Grade 'B'
60 to 69 marks	Grade 'C'
55 to 59 marks	Grade 'D'
50 to 54 marks	Grade 'E'
Less than 50 marks	Grade 'RA'
Withdrawn from the Examination	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course is declared to have successfully completed that course and earned the credits for that course. Such a course cannot be repeated by the student.\

A student who obtains letter grade RA / W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-totaling of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of

the prescribed fee per paper. The application must be made to the   Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

17. Awarding Degree

After successful completion of the programme, the degree will be awarded with the following classifications based on CGPA.

For First Class with Distinction the student must earn a minimum of 65 credits within four semesters for full-time / six semesters for Part time from the time of admission, pass all the courses in the first attempt and obtain a CGPA of 8.25 or above.

For First Class, the student must earn a minimum of 65 credits within two years and six months for full-time / three years and six months for Part time from the time of admission and obtain a CGPA of 6.75 or above.

For Second class, the student must earn a minimum of 65 credits within four years for full-time / six years for Part time from the time of admission.

18. Ranking of Candidates

The candidates who are eligible to get the M.E /M.Tech degree in First Class with Distinction will be ranked on the basis of CGPA for all the courses of study from I to IV semester for M.E / M.Tech full-time / I to VI semester for M.E / M.Tech part-time.

The candidates passing with First Class and without failing in any subject from the time of admission will be ranked next to those with distinction on the basis of CGPA for all the courses of study from I to IV semester for full-time / I to VI semester for M.E / M.Tech part-time.

19. Transitory Regulations

If a candidate studying under the old regulations M.E. / M.Tech could not attend any of the courses in his/her courses, shall be permitted to attend equal number of courses, under the new regulation and will be examined on those subjects. The choice of courses will be decided by the concerned Head of the department. However he/she will be permitted to submit the thesis as per the old regulations. The results of such candidates will be passed as per old regulations.

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

	Department		Programme (Full Time & Part time)	Eligible B.E./B.Tech Programme *
1	**Civil Engineering**	i.	Environmental Engineering	B.E. / B.Tech – Civil Engg, Civil & Structural Engg, Environmental Engg, Mechanical Engg, Industrial Engg, Chemical Engg, BioChemicalEngg, Biotechnology, Industrial Biotechnology, Chemical and Environmental Engg.
		ii.	Environmental Engineering & Management	
		iii.	Water Resources Engineering & Management	B.E. / B.Tech – Civil Engg, Civil & Structural Engg, Environmental Engg, Mechanical Engg, Agricuturalanf irrigation Engg, Geo informatics, Energy and Environmental Engg.
2	**Civil & Structural Engineering**	i.	Structural Engineering	B.E. / B.Tech – Civil Engg, Civil & Structural Engg.
		ii.	Construction Engg. and Management	
		iii.	Geotechnical Engineering	
		iv.	Disaster Management &Engg.	
3	**Mechanical Engineering**	i.	Thermal Power	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Mechanical Engg (Manufacturing).
		ii.	Energy Engineering & Management	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Mechanical (Manufacturing) Engg, Chemical Engg
4	**Manufacturing Engineering**	i.	Manufacturing Engineering	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Manufacturing Engg, Production Engg, Marine Materials science Engg, Metallurgy Engg, Mechatronics Engg, Industrial Engg.
		ii.	Welding Engineering	
		iii.	Nano Materials and Surface Engineering	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Manufacturing Engg, Production Engg,MarineMaterialsscienceEngg,MetallurgyEngg,Chemical Engg
5	**Electrical Engineering**	i.	Embedded Systems	B.E./B.Tech–Electrical and Electronics Engg, Electronics and Instrumentation Engg,Control and Instrumentation Engg, Information technology, Electronics and communication Engg, Computer Science and Engg
		ii.	Smart Energy Systems	B.E./B.Tech – Electrical and Electronics Engg, Electronics and Instrumentation Engg, Control and Instrumentation Engg.
		iii.	Power Systems	B.E. / B.Tech – Electrical and Electronics Engg
	Electronics &	i.	Process Control & Instrumentation	B.E. / B.Tech – Electronics and Instrumentation Engg,

6	**Instrumentation Engineering**			Electrical and Electronics Engg, Control and Instrumentation Engg, Instrumentation Engg
		ii.	Rehabilitative Instrumentation	B.E. / B.Tech – Electronics and Instrumentation Engg, Electrical and ElectronicsEngg, Electronics and communication Engg, Control and Instrumentation Engg, Instrumentation Engg, Bio Medical Engg, Mechatronics.
		iii.	Micro Electronics and MEMS	B.E. / B.Tech – B.E. / B.Tech – Electronics and Instrumentation Engg, Electrical and ElectronicsEngg, Electronics and communication Engg, Control and Instrumentation Engg, Instrumentation Engg, Bio Medical Engg, Mechatronics, Telecommunication Engg
7	**Chemical Engineering**	i.	Chemical Engineering	B.E. / B.Tech – Chemical Engg, Petroleum Engg, Petrochemical Technology
		ii.	Food Processing Technology	B.E. / B.Tech - Chemical Engg, Food Technology, Biotechnology, Biochemical Engg, Agricultural Engg.
		iii.	Industrial Bio Technology	B.E. / B.Tech - Chemical Engg, Food Technology, Biotechnology, Leather Technology
		iv.	Industrial Safety Engineering	B.E. / B.Tech – Any Branch of Engineering
8	**Computer Science & Engineering**	i.	Computer Science & Engineering	B.E. / B.Tech - Computer Science and Engineering, Information Technology, Electronics and Communication Engg, Software Engineering
9	**Information Technology**	i	Information Technology	B.E. / B.Tech - Computer Science and Engineering, Information Technology, Electronics and Communication Engg, Software Engineering
10	**Electronics & Communication Engineering**	i.	Communication Systems	B.E. / B.Tech - Electronics and Communication Engg, Electronics Engg.

*AMIE in the relevant discipline is considered equivalent to B.E

Curriculum for M.E. Embedded Systems (Full-Time)

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits
			Semester - I							
1	PC-I	EMSC101	Applied Mathematics	4	-	-	25	75	100	3
2	PC-II	EMSC102	Microcontroller Based System Design	4	-	-	25	75	100	3
3	PC-III	EMSC103	Real Time Operating System	4	-	-	25	75	100	3
4	PC-IV	EMSC104	Wireless Sensor Networks	4	-	-	25	75	100	3
5	PE-I	EMSE105	Professional Elective-I	4	-	-	25	75	100	3
6	PE-II	EMSE106	Professional Elective-II	4	-	-	25	75	100	3
7	Lab-I	EMSP107	Microcontroller based System Design Lab	-	-	3	40	60	100	2
			Total	**24**		**3**	**190**	**510**	**700**	**20**

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits
			Semester - II							
1	PC-V	EMSC201	RISC and CISC Processors	4	-	-	25	75	100	3
2	PC-VI	EMSC202	Embedded Control Systems Design	4	-	-	25	75	100	3
3	PC-VII	EMSE203	Digital Instrumentation	4	-	-	25	75	100	3
4	PC-VIII	EMSC204	Advanced Digital System Design	4	-	-	25	75	100	3
5	PE-III	EMSE205	Professional Elective-III	4	-	-	25	75	100	3
6	PE-IV	EMSE206	Professional Elective-IV	4	-	-	25	75	100	3
7	Lab-II	EMSP207	ARM and DSP based System Design Lab	-	-	3	40	60	100	2
8	Semin	EMSS208	Seminar	-	-	2	100	-	100	1
			Total	**24**		**5**	**290**	**510**	**800**	**21**

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits
			Semester – III							
1	OE-I	EMSE301	Open Elective-I	4	-	-	25	75	100	3
2	OE-II	EMSE302	Open Elective-II	4	-	-	25	75	100	3
3	Thesis	EMST303	Thesis Phase-I	-	3	-	40	60	100	4
4	Ind Train	EMSI304	Industrial Training	-	*	-	100	-	100	2
			Total	**8**	**3**	**-**	**190**	**210**	**400**	**12**

*Note: * - Four weeks during the summer vacation at the end of IInd Semester.*

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits
			Semester – IV							
1	Thesis	EMST401	Thesis Phase-II	-	8	-	40	60	100	12
			Total	**-**	**8**	**-**	**40**	**60**	**100**	**12**

L- Lecture ;**P**-Practical ; **T**-Thesis ; **CA**-Continuous Assessment; **FE**-Final Exam

Curriculum for M.E. Embedded Systems (Part-Time)

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
			S e m e s t e r – I								
1	PC-I	PEMSC101	Applied Mathematics	4	-	-	25	75	100	3	EMSC101
2	PC-II	PEMSC102	Microcontroller Based System Design	4	-	-	25	75	100	3	EMSC102
3	PC-III	PEMSC103	Real Time Operating System	4	-	-	25	75	100	3	EMSC103
			Total	**12**	**-**	**-**	**75**	**225**	**300**	**09**	

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
			S e m e s t e r – II								
1	PC-IV	PEMSC201	RISC and CISC Processors	4	-	-	25	75	100	3	EMSC201
2	PC-V	PEMSC202	Embedded Control Systems Design	4	-	-	25	75	100	3	EMSC202
3	PC-VI	PEMSE203	Digital Instrumentation	4	-	-	25	75	100	3	EMSC203
			Total	**12**	**-**	**-**	**75**	**225**	**300**	**09**	

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
			S e m e s t e r – III								
1	PC-IV	PEMSC201	Wireless Sensor Networks	4	-	-	25	75	100	3	EMSC104
2	PE-I	PEMSE202	Professional Elective-I	4	-	-	25	75	100	3	EMSE105
3	PE-II	PEMSE203	Professional Elective-II	4	-	-	25	75	100	3	EMSE106
4	Lab-I	PEMSP204	Microcontroller based System Design Lab	-	-	3	40	60	100	2	EMSP107
			Total	**12**	**-**	**3**	**115**	**285**	**400**	**11**	

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
			S e m e s t e r – IV								
1	PC-VIII	PEMSC401	Advanced Digital System Design	4	-	-	25	75	100	3	EMSC204
2	PE-III	PEMSE402	Professional Elective-III	4	-	-	25	75	100	3	EMSE205
3	PE-IV	PEMSE403	Professional Elective-IV	4	-	-	25	75	100	3	EMSE206
4	Lab-II	PEMSP404	ARM and DSP based System Design Lab	-	-	3	40	60	100	2	EMSP207
5	Semin	PEMSS405	Seminar	-	-	2	100		100	1	EMSS208
			Total	**12**	**-**	**5**	**215**	**285**	**500**	**12**	

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
			S e m e s t e r – V								
1	OE-I	PEMSE501	Open Elective-I	4	-	-	25	75	100	3	EMSE301
2	OE-II	PEMSE502	Open Elective-II	4	-	-	25	75	100	3	EMSE302
3	Thesis	PEMST503	Thesis Phase-I	-	4	-	40	60	100	4	EMST303
4	Ind Train	PEMSI504	Industrial Training	-	*	-	100	-	100	2	EMSI304
			Total	**8**	**4**	**-**	**190**	**210**	**400**	**12**	

Note: * - Four weeks during the summer vacation at the end of IVth Semester.

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
			S e m e s t e r – VI								
1	Thesis	PEMST601	Thesis Phase-II	-	8	-	40	60	100	12	EMST401
			Total	**-**	**8**	**-**	**40**	**60**	**100**	**12**	

L- Lecture ;**P**-Practical ; **T**-Thesis ; **CA**-Continuous Assessment ;**FE**-Final Exam

PE – PROFESSIONAL ELECTIVES

1. **Advanced Digital Signal Processing**

2. **Digital Image Processing**

3. **Distributed Embedded Computing**

4. **Medical Instrumentation Systems**

5. **FPGA Based Embedded System Design**

6. **VLSI for Embedded Applications**

7. **Micro-Electro-Mechanical Systems**

8. **Software Technology for Embedded Systems**

9. **Robotics and Automation**

10. **Embedded Product Development Technologies**

11. **SCADA for Embedded Applications**

12. **Wireless and Mobile Communication**

OE-OPEN ELECTIVES

1. **Cloud Computing**

2. **Optimization Techniques**

3. **Scientific Research and Technical Communication**

4. **Soft Computing Techniques**

5. **Internet of Things**

6. **Intellectual Property Rights**

EMSC101	APPLIED MATHEMATICS	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To strengthen the mathematical background of the students
- To expose the students to the latest areas required in the field of study of power systems.
- to enable the student to build up his mathematical ability in Matrices
- To acquire the knowledge in Statistics to understand the concepts with a sense of applicability.
- To emphasize on the study of operations research with specified reference to quadratic programming.
- To exploit the use of PDE for design analysis and simulation of power systems.

Matrices

Computation of the greatest and the least eigen values of a matrix by power method - Modal matrix and spectral matrix - Hermitian form - Canonical form.

Operations Research

Linear programming - Graphical method - Simplex method - Nonlinear programming with special reference to quadratic programming - Kuhn Tucker conditions - Dynamic programming - Bellman's principle of optimality.

Statistics

Random variables -Distribution function - Density function - Variance and covariance - Stochastic process - Auto correlation and auto covariance - Cross correlation and

cross covariance - Stationary process - Auto correlation and cross   correlation functions - Power spectrum.

Boundary Value Problems

Special functions and multiple Fourier series: Orthogonal functions, Bessel functions and Legendre polynomials - Generalised Fourier series   expansions of an arbitrary function in terms of   orthogonal functions, Bessel functions of order   zero and Legendre polynomials - Fourier series   expansions of functions of two and three variables.

Partial Differential Equations

Solution of wave equation, diffusion equation,   Poisson equation and Laplace equation by the method   of separation of variables - Transverse vibration   of rectangular and circular membranes - Potentials   due to   charged circular rings, circular plates and spheres.

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3. Papoulis .A, "Probability, Random Variables and Stochastic Processes", McGraw Hill., 2002
4. Venkataraman. M.K, "Higher Mathematics for Engineering & Science", The National Publishing Co. 1992
5. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Eastern., 2015
6. Louis Pipes .A and Hartill, "Applied Mathematics for Engineers and Physicists", McGraw Hill., 2014

COURSE OUTCOMES:

1. Enhance skills in Matrix operation to apply in embedded system domain.
2. Familiarize with Linear and nonlinear programming methods.
3. Acquire knowledge in handling situations involving random variables, random processes.
4. Able to solve some boundary value problems.
5. Acquire basic understanding of the most common partial differential equations.

Mapping with Programme Outcomes									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1			✓							
CO2				✓						
CO3		✓					✓			
CO4	✓									
CO5				✓						

EMSC102	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To introduce the fundamentals of microcontroller based system design.
- To study the interfacing peripherals with microcontrollers.
- To learn the features, architecture and programming of PIC.
- To introduce PIC peripheral system design.
- To study on basic tool features for target configuration.
- To give case study experiences for microcontroller based applications.

Introduction

Need for Microcontroller based system design -Design   cycle - Design problem - Hardware and software considerations - System   integration/Structure and characteristics-Interrupt   structures-Programmable   timers- Latency-Interrupt density-Interval considerations.

89C51 Processor

Review   of architectures and instruction sets of 89C51 Processor - Coprocessor configuration - Closely coupled and loosely   coupled configurations - Architecture and instruction set of I/O processor -I/O control -I/O   timing - Data buffering with FIFO - Key boards and switches - Remote instrument control -Self test hardware - Key board parsing - Real time programming -Self test algorithm.

PIC Microcontroller

Architecture – memory organization – addressing modes – instruction set – PIC programming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, -Peripherals of PIC **-**Timers – Interrupts, I/O ports- I2C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories.

Trouble Shooting and Development Systems

Logic analyzers, logic state analyzers, logic timing analyzers -Display   modes -signature analysis - Error detection using signature analysis. Development systems -Basic features - Software development   aids -Mass storage devices - Development system architecture - Emulators -System software.

System Design Examples

LCR meter -True RMS meter -Temperature control -Thermistor   transducer linearization - PID controller - Digital Weighing machine -Controller for washing machine -Discrete state process control -Digital notch filter.

REFERENCES:

1. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson Education 2011.

2. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey 'PIC Microcontroller Embedded Systems using Assembly and C for PIC18', Pearson Education 2008.
3. Rajkamal,".Microcontrollers-Architecture, Programming, Interfacing & System Design", 2ed, Pearson, 2012.
4. Jonathan W.Valvano., "Embedded Microcomputer systems", Thomas Asia Pvt. Ltd, Singapore, 2001.
5. John Iovine, 'PIC Microcontroller Project Book ', McGraw Hill 2000.

COURSE OUTCOMES:

1. Understand the fundamentals of microcontroller systems and interface, and have the ability to apply them.
2. Understand the architecture and capabilities of PIC microcontroller.
3. Learn importance of PIC in designing embedded application.
4. Learn use of hardware and software tools.
5. Develop interfacing to real world devices.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓		✓					✓	✓	
CO2					✓					
CO3		✓	✓						✓	
CO4			✓				✓			
CO5	✓			✓		✓	✓			✓

EMSC103	REAL TIME OPERATING SYSTEM	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To impart students about the fundamentals of Real Time Systems and interaction with RTOS
- To teach the concepts of how process are created and controlled with RTOS.
- To study on programming logic of modeling and analyzing RTS
- To study about the services rendered by RTOS in an application.
- To acquire knowledge about the common problems in developing an RTOS.
- To discuss the application development using RTOS.

RTOS

Differences between General Purpose OS & RTOS, Real-time concepts, Hard Real time and Soft Real-time systems,Basic architecture of an RTOS, components in RTOS - kernel, objects, scheduler, Multitasking, context switch, Scheduling types - Preemptive priority based scheduling - Round-robin and preemptive scheduling - Task states - Task management.

Kernel Objects

Semaphores – Binary, counting, mutual exclusion (mutex) semaphores, Synchronization between two tasks and multiple tasks, Single shared-resource-access synchronization, Recursive shared- resource-

access synchronization - message queue- Sending messages in FIFO or LIFO order- broadcasting messages. Common pipe- pipe operation- Select operation on multiple pipes-Pipes for inter-task-Synchronization - Event register - control block- Signals- Catch operation- Execution sequence of wait and signal operations.

RTOS Services

Overview- TCP/IP protocol- Stack- File system- Remote procedure calls- RTOS command shell-Exceptions and Interrupts- Programmable interrupt controller-Priority scheme- Task and stack-Interrupt nesting- Interrupt processing in two contexts.Timer and Timer Services - Real-time clock-Soft-timer- Servicing the timer interrupt in the task context- Timeout event handlers.

I/O Subsystem and Memory Management

Port-mapped I/O- Memory-mapped I/O- Write operation for a block-mode device- I/O function mapping- Associating devices with drivers-Memory allocation map, fragmentation, free operation, Management unit.

Typical RTOS

Introduction to RT Linux, Real-Time Linux Applications in Embedded system, Common Design Problems - Deadlock, priority inversion problem, Embedded RTOS forfault-Tolerant applications

REFERENCES:

1. Qing Li and Caroline Yeo, "Real Time Concepts for Embedded Systems", Elsevier, 2011.
2. Krishna C.M and Kang G. Shin, "Real-time Systems" McGraw-Hill, new edition, 2009.
3. Stuart Bennett., "Real-time Computer Control: An Intoduction" Prentice - Hall, 2nd edition, 2011.
4. Laplante P.A. and Ovaska.S.J., "Real-time System Design and Analysis" IEEE Press, 4th edition, 2013.
5. Jim Cooling, "Real-time operating systems",   Lindentree Associates, First Edition, 2013.

COURSE OUTCOMES:

1. It acquires knowledge about Real Time Operating System.
2. It helps to understand the concept of real time programming.
3. It gives an idea about the services rented by an RTOS in a developed application.
4. It describes about I/O and memory management concepts
5. It provides a concept to design and develop application using RTOS.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✔	✔	✔		✔	✔	✔	✔		✔
CO2	✔	✔	✔					✔		✔
CO3	✔		✔	✔				✔		
CO4	✔							✔	✔	
CO5	✔	✔	✔		✔	✔	✔	✔		✔

EMSC104	WIRELESS SENSOR NETWORKS	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To introduce the basic concepts in communication networks and the protocols used in the networks.
- To give an exposure to sensor networks and different architectures of Wireless Sensor Networks.
- To familiarise the students about the various multiple access techniques available in the communication systems and introduce the different clustering algorithms for WSNs.
- To acquire knowledge on security management systems and security protocols for WSN and distributed sensor systems.
- To give an idea about power and energy level management techniques available for WSNs.

Networks Fundamentals

Introduction to wireless network and M computing – Fading and shadowing communication – Mobile IP – overview – Network elements - packet delivery – registration – Tunneling and encapsulation – optimization –Traditional TCP and inspection on Mobility – indirect and snooping TCP – 2G/3G networks – enhancing process.

Architecture

Introduction to sensor networks – Architectures – design factor – sensor network classifications - characteristics – Modeling of sensor network - WSN as Embedded system – Tiered architectures in sensor network – Forming of tiered network - Draw backs - Power efficient topology in WSN- Issues – Assumptions.

Protocols

MAC- Hidden/Exposed terminals – Near/Far terminals – SDMA, FDMA, TDMA and CDMA – infrared transmission – MAC Layer synchronization – power management – roaming – SMACS and EAR algorithm – CSMA –Hybrid TDMA/FDMA – Error control – Adhoc networks – Clustering Algorithm – Leach – Teen – Peach Technique.

Security System

Security Protocols –Authentication – Network layer – Security techniques – Security in WSN – Adhoc network – Search Technique – Security management technique - Reliability issues in WSN – Distributed sensor systems – Distributed services – Dynamic adaption – Fault tolerance - pre limiters – classic fault.

Energy Management

Introduction – Different power management technology – Design in EEMAC – Reduce communication – Node level energy management – Node Level Processor Oriented Energy Management – Node level I/O device oriented Energy Management – Energy aware routing.

REFERENCES:

1. Mohammed Ilyas and Imadmahgoub, "Handbook of sensor networks, compact wireless and wired sensing systems", CRC press, 2005.
2. KazemSohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Networks: Technology, Protocols, and Applications", John Wiley & Sons Publications,2007.
3. WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", John Wiley & Sons Publications, 2010.
4. Rappaport T.S, "Wireless Communication Principles and Practice", Prentice Hall, Second Edition, 2014.
5. Taub H. and Schilling D.L, "Principle of Communication" Tata McGraw-Hill Education, 2008.

COURSE OUTCOMES:

1. Describe and explain the working of communication protocols and the evolution of 2G/3G networks.
2. Understand the characteristics, architectures and modeling of WSNs.
3. Explain the concepts of multiple access techniques and the working of various clustering algorithms and their usefulness for routing in WSNs.
4. Describe the different security management techniques and security protocols defined for WSNs.
5. Elucidate the design issues related to the energy and power management techniques for WSNs.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Mapping with Programme Outcomes										
CO1	✓							✓		
CO2				✓	✓	✓				
CO3	✓			✓		✓		✓		
CO4		✓		✓	✓		✓			
CO5		✓		✓	✓	✓	✓			

		L	T	P
EMSP107	**MICROCONTROLLER BASED SYSTEM DESIGN LAB**	0	0	3

COURSE OBJECTIVES:

- To learn the working principles of 89C51 microcontroller, PIC and ARM Processor.
- To understand the characteristics of real time systems.
- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To instruct the concepts of algorithm development & programming on software tools and micro Controllers with peripheral interfaces.

- To practice through atleast one of the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

List of Experiments

1. Study of Microcontroller
   (i) 89C51 Microcontroller
   (ii) PIC Microcontroller
   (iii) Spartan-6 FPGA Processor
   (iv) ARM Processor and
   (v)ARM CORTEX-M4 Processor
2. Applications of 89C51 Microcontroller
   (i) Frequency Measurement
   (ii)Stepper Motor Control
3. Interfacing with PIC 16F877 Microcontroller
   (i)I^{2}C Logic Based Character Display
   (ii)Realization Of Real Time Clock
4. Applications of Spartan-6 FPGA Processor
   (i)Seven Segment LED Display
   (ii)Character LCD Display
5. Seven Segment LED Display using ARM Processor
6. Analog to Digital Converter using ARM Processor
7. Realization of Real Time Clock using ARM Processor
8. Applications of ARM CORTEX-M4 Processor
   (i)Seven Segment LED Display
   (ii)Character LCD Display

COURSE OUTCOMES:

Upon completion of the course the student will be able to
1. Explain the architecture and operation of Microcontroller, PIC and ARM Processors.
2. Identify and explain the operations of peripherals and memories typically interfaced with Processors.
3. Analyze instruction sets ofMicrocontroller, PIC and ARM Processors.
4. Gain hands-on experience in doing experiments on Microcontroller, PIC and ARM Processors by using hardware kit in the laboratory and present the report.
5. Students should understand the hardware/software tradeoffs involved in the design of DSP Processors.

Mapping with Programme Outcomes									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✔	✔	✔							
CO2	✔		✔	✔						
CO3			✔	✔						
CO4		✔	✔	✔			✔			
CO5			✔	✔	✔					

C201	RISC AND CISC PROCESSORS	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To acquire knowledge about the features of advanced processors.
- To study the architectures of CISC processor.
- To discuss on memory management, application development of CISC processors.
- To discuss the architecture and instruction set of ARM processor.
- To learn the programming concept in ARM processor
- To study about ARM application.

Features of Advanced Processors

Instruction set - Data formats - Instruction formats - Addressing modes - Memory Hierarchy - register file - Cache - Virtual memory and paging - Segmentation - Pipelining : The instruction pipeline - pipeline hazards - Instruction level parallelism - reduced instruction set - Computer principles - RISC versus CISC - RISC properties - RISC evaluation - On-chip register files versus cache evaluation.

Architecture of CISC Processors

PENTIUM: The software model - functional description - CPU pin descriptions - CISC concepts - bus operations - Super scalar architecture - pipe lining - Branch prediction instruction and caches - Floating point unit - protected mode operation - Segmentation - paging -Protection – Multi-tasking - Exception and interrupts - Input/Output - Virtual 8086 model -Interrupt processing - Instruction types - Addressing modes - Processor flags - Instruction set - Basic programs.

ARM Architecture

ARM: architecture - organization and implementation - instruction set - The thumb instruction set -Arcon RISC Machine – Architectural Inheritance – Core & Architectures - CPU cores.

ARM Programming

Basic Assembly language program -The ARM Programmer's model -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors.– Instruction cycle timings

ARM Application Development

Handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Example: Standalone - Embedded Operating Systems – Fundamental Components – Memory protection and management-Protected Regions-Initializing MPU, Cache and Write Buffer-MPU to MMU-Virtual Memory-Page Tables-TLB-Domain and Memory Access Permission-Fast Context Switch Extension.

REFERENCES:

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley, 2nd edition, 2000.

2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier, 2007.
3. Trevor Martin,'The Insider's Guide To The Philips ARM7-Based Microcontrollers, An Engineer's Introduction To The LPC2100 Series' Hitex (UK) Ltd., 2005.
4. Gene. H. Miller, "Micro Computer Engineering", Pearson Education, 2003.

COURSE OUTCOMES:

1. Delivers insight into various embedded processors of RISC and CISC architecture with improved design strategies.
2. Introduces the recent advanced features in RISC and CISC processors.
3. Gives an idea about the instruction set in ARM processor
4. Explains the programming model in the processors.
5. Develops an overview about the application of the advanced processors.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✔		✔		✔					
CO2				✔		✔				
CO3				✔		✔				
CO4			✔		✔	✔				
CO5							✔	✔		✔

EMSC202	EMBEDDED CONTROL SYSTEMS DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To provide a clear understanding on the basic concept of embedded control system.
- To know the fundamentals of Real time operating system.
- To study the software and hardware design interface, SPI, RTC interfacing and programming.
- To teach the basic concepts of developing device driver-software –interfacing and porting using C & C++.
- To teach the application development on embedded controller.

Embedded System Organization

Embedded computing – characteristics of embedded computing applications – embedded system design challenges; Build process of Real-time Embedded system – Selection of processor; Memory; I/O devices-Rs-485, MODEM, Bus Communication system using I2C, CAN, USB buses, 8 bit –ISA, EISA bus;

Real-Time Operating System

Introduction to RTOS; RTOS- Inter Process communication, Interrupt driven Input and Output -Nonmaskable interrupt, Software interrupt; Thread – Single, Multithread concept; Multitasking Semaphores.

Interface with Communication Protocol

Design methodologies and tools – design flows – designing hardware and software Interface. –system integration; SPI, High speed data acquisition and interface-SPI read/write protocol, RTC interfacing and programming.

Design of Software for Embedded Control

Software abstraction using Mealy-Moore FSM controller - Layered software development - Basic concepts of developing device driver – SCI – Software - interfacing & porting using standard C & C++ ; Functional and performance Debugging with benchmarking Real-time system software – Survey on basics of contemporary RTOS – VXWorks, UC/OS-II.

CASE Studies with Embedded Controller

Programmable interface with A/D & D/A interface; Digital voltmeter, control- Robot system; -PWM motor speed controller, serial communication interface.

REFERENCES:

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", Morgan Kaufmann Publishers, Second Edition, 2008.
2. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGrawHill, 2006.
3. Arnold S.Berger, "Embedded Systems Design: An Introduction to Processes, Tools, and Techniques", CMP Books, 2002.
4. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, "PIC Microcontroller and Embedded Systems- Using Assembly and C for PIC18", Pearson Education, 2008.
5. Daniel W. Lewis, "Fundamentals of Embedded Software", Prentice Hall India, 2004.

COURSE OUTCOMES:

1. Understand the basic concept of embedded system such as memory, I/O devices, and bus communication system.
2. Design real time embedded systems using the concepts of RTOS.
3. Explain and design of software for embedded control.
4. Implement the real-time operating system principle.
5. Design simple A/D and D/A interface circuits.

Mapping with Programme Outcomes									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✔					✔				
CO2	✔	✔	✔		✔		✔		✔	
CO3			✔							✔
CO4	✔	✔		✔		✔		✔		✔
CO5							✔		✔	

EMSC203	DIGITAL INSTRMENTATION	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To obtain the subject knowledge and ability to use basic Data acquisition system concepts.
- To familiarize the students the functioning of different types of instrument communication, interfacing and data transmission.
- To provide opportunity for students to work as part of teams on multi-disciplinary projects.
- To provide the P.G students with a sound foundation in the mathematical, scientific and engineering instruments to formulate, solve and analyze engineering problems and to prepare them for employability and higher studies.
- To promote student awareness of the lifelong learning and to introduce them to professional ethics and codes of professional practice.
- To prepare students for successful careers in industry that meets the needs of latest developments in industriesas employable professionals.

Introduction

Data acquisition systems – Overview of A/D converter, types and characteristics – Sampling, Errors - Objective – Data acquisition interface requirements – Counters – Modes of operation – Frequency, Period, Time interval measurements, Prescaler, Heterodyne converter for frequency measurement, Single and Multi channel Data Acquisition systems.

Interfacing and Data Transmission

Microprocessor based system design – Peripheral Interfaces – Data transmission systems – Time Division Multiplexing (TDM) – Digital Modulation – Pulse Modulation – Pulse Code Format – Interface systems and standards, Instrument Drivers.

Instrument Communication

Introduction, Modern standards, Basic requirements of Instrument Bus Communications standards, interrupt and data handshaking, serial bus – Basics, Message transfer, Fault confinement – RS-232, USB, RS-422, RS-485, Ethernet Bus – CAN standards interfaces – Field bus: general considerations, network design with Use of field buses in industrial plants, functions, international standards, performance – use of Ethernet networks, field bus advantages and disadvantages – Instrumentation network design, advantages and limitations of open networks, HART network and Foundation field bus network general considerations, network design – Mod bus, PROFIBUS-PA: Basics, architecture, model, network design and system configuration.

Visual Instrumentation

Block diagram and Architecture – Data flow techniques – Graphical programming using GUI – Real time Embedded system – Intelligent controller – Software and hardware simulation of I/O communication blocks – peripheral interface – ADC/DAC – Digital I/O – Counter, Timer.

Case Studies

PC based DAS, Data loggers, PC based process measurements like flow, temperature, pressure and level development system, Programmable Logic Controllers, CRT interface and controller with monochrome and colour video display.

REFERENCES:

1. Mathivanan, "PC based Instrumentation Concepts and Practice", Prentice-Hall India, 2015.
2. H. S. Kalsi, "Electronic Instrumentation", Third Edition, Tata McGraw-Hill, 2010.
3. Joseph J. Carr, "Elements of Electronic Instrumentation and Measurement", Pearson Education, 2010
4. K. Padmanabhan, S. Ananthi, "A Treatise on Instrumentation Engineering', I K Publish, 2011.

COURSE OUTCOMES:

1. To enhance teaching & research contributions in Embedded System Technology particularly for PC based Instrumentation concepts.
2. An ability to design and conduct experiments as well as to organize, analyze and interpret data on multidisciplinary domains.
3. Be able to identify problems in major issues of Instrument Communication Systems, analyze problems & solve them using the base of Embedded Technology.
4. To provide guidance and to develop inter-process communication techniques based on hardware– software approaches for real time process automations.
5. An ability to effectively communicate technical information in speech, presentation, and in writing.

		Mapping with Programme Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✔	✔		✔						✔
CO2		✔	✔						✔	
CO3			✔		✔					
CO4		✔					✔	✔	✔	
CO5								✔	✔	

		L	T	P
EMSC204	**ADVANCED DIGITAL SYSTEM DESIGN**	4	0	0

COURSE OBJECTIVES:

- Review the analysis and design of combinational logic circuits.
- Establish the methods for the analysis, modeling and design of synchronous sequential circuits.
- Incorporate the analysis and design of asynchronous circuit and obtain the hazard free circuits.
- Implement the digital systems on reconfigurable programmable logic devices.

- Study the different fault diagnosis and test methods.

Introduction

Review of Combinational circuit analysis – Minimization and design – Top-down modular design – Decoders, Encoders – Multiplexer and Demultiplexer – Incompletely specified functions – Circuit design.

Sequential Circuit Design

Analysis of Clocked Synchronous Sequential Circuits – Modeling of Clocked Synchronous Sequential Circuits – State Assignment and Reduction – Design of Clocked Synchronous Sequential circuits – ASM chart – ASM realization – Incompletely specified functions – State Assignment and Reduction – Circuit realization.

Asynchronous Sequential Circuit Design

Analysis of Asynchronous Sequential Circuit – Flow table reduction – Races in Asynchronous Sequential Circuit – State Assignment. Problem and Transition table- Design of Asynchronous Sequential Circuit – Static and Dynamic hazards. Essential Hazards – Mixed operating mode – Pulse mode circuits.

Synchronous Design Using Programmable Devices

Programmable Logic Devices- Design of sequential circuit using EPROM, GAL Devices – Programmable gate arrays – State machine using PLDs – PLD timing specifications.

Fault Analysis

Fault models for basic gates – Methods for test pattern generation – Boolean Difference method – Path sensitization method – Fault table method – Design for testability – Fault injection methods – Sequential circuit testing – Built in Self-Test, Built in Logic Block Observer.

REFERENCES:

1. John F.Wakerly, "Digital Design principles and practices", *Prentice Hall*, Fourth Edition, 2005.
2. William I.Fletcher, "An Engineering approach to Digital Design" *PHI Learning* (2009)
3. Nripendra N Biswas, "Logic Design Theory" *Prentice Hall of India*, Digitized (2007).
4. Parag K Lala, "Digital System design using PLD" *BS Publications*, 2008.
5. M.Morris Mano & Michael D.Ciletti, " Digital Design" , *Pearson*, Fifth Edition, 2013
6. Parag K Lala, "Fault tolerant and fault testable hardware design" *BS Publications*, 2002.

COURSE OUTCOMES:

1. Gather a review of combinational circuit and analysis.
2. Develop the ability to analyze and design synchronous sequential circuits.
3. Equip the capability to design Asynchronous sequential circuits and realize hazard free circuit.
4. Gain knowledge on implementation of sequential circuits using PLDs.
5. Understand the concepts fault diagnosis and testability.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✔	✔	✔			✔		✔	✔	
CO2	✔	✔		✔	✔	✔		✔	✔	✔
CO3	✔	✔		✔	✔	✔		✔	✔	✔
CO4	✔		✔	✔	✔	✔		✔	✔	✔
CO5		✔	✔	✔	✔	✔		✔	✔	

EMSP207	ARM AND DSP BASED SYSTEM DESIGN LAB	L	T	P
		0	0	3

COURSE OBJECTIVES:

This lab introduces
- To provide a theoretical and practical introduction to DSP Processor.
- To explain embedded C language programming techniques.
- To explain the design of hardware interfacing circuits, Microcontroller and DSP Processor system design considerations.

List of Experiments

1. Study of DSP Processors
   (i) TMS320F2812 Processor
   (ii)TMS320VC5416 Processor
   (iii)TMS320C6713 Processor
2. Linear and Circular Convolution using DSP TMS320C6713 Processor
3. Analog to Digital Conversion using DSP TMS320C6713 Processor
4. Digital to Analog Conversion using DSP TMS320C6713 Processor
5. Applications of DSP TMS320C6713 Processor
   (i) Low Pass Filter
   (ii) High Pass Filter
   (iii) Band Pass Filter
   (iv) Band Rejection Filter
6. Seven Segment LED Display using DSP TMS320F2812 Processor
7. Applications of DSP TMS320F2812 Processor
8. (i) Character LCD Display
9. (ii) Pulse Width Modulator
10. Temperature analysis using ARM Processor

COURSE OUTCOMES:

Upon completion of the course the student will be able to
1. Explain the architecture and operation of DSP Processors.
2. Identify and explain the operations of peripherals and memories typically interfaced with DSP Processors.
3. Analyze instruction sets of TMS320F2812, TMS320VC5416 and TMS320C6713 Processor.

4. Gain hands-on experience in doing experiments on TMS320F2812, TMS320VC5416 and TMS320C6713 Processor by using hardware kit in the laboratory and present the report.
5. Students should understand the hardware/software trade-offs involved in the design of DSP Processors.

	Mapping with Programme Outcomes									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✔	✔	✔							
CO2	✔		✔	✔						
CO3			✔	✔						
CO4		✔	✔	✔			✔			
CO5			✔	✔	✔					

EMSS208	**SEMINAR**	**L**	**T**	**P**
		0	**0**	**2**

OBJECTIVES:

- To work on a technical topic related to Embedded Systems and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student's choice related to Embedded Systems and to engage in discussion with audience. They will defend their presentation. A brief copy of their presentation also should be submitted. Evaluation will be done by the student counsellor based on the technical presentation and the report and also on the interaction shown during the seminar.

OUTCOMES:

1. The students will be getting the training to face the audience andto interact with the audience with confidence.
2. To tackle any problem during group discussion in the corporate interviews.

	Mapping with Programme Outcomes									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✔		✔		✔				✔	
CO2	✔	✔	✔		✔		✔	✔	✔	

EMST303	THESIS PHASE-I	L	T	P
		0	4	0

COURSE OBJECTIVES:

- To undergo literature survey and identify the topic of thesis and finalize in consultation with Guide/Supervisor
- To carry out Thesis work Phase – I which is an integral part of the thesis consisting of problem statement, literature review, thesis overview and scheme of implementation
- To attempt the solution to the problem by analytical/simulation/experimental methods and validate with proper justification.
- To prepare and deliver presentation on the selected thesis topic of research.
- To submit the duly certified progress report of Thesis work Phase – I in standard format for satisfactory completion of the work.

COURSE OUTCOMES:

1. Ability to analyse various aspects of topics, review quality of literature survey, synthesise knowledge and Novelty in the problem.
2. Assess clarity of Problem definition and Feasibility of problem solution
3. Validate the relevance to the specialization
4. Acquire Knowledge on the clarity of objective and scope
5. Develop effective communication skills to present and defend their research work to a panel of experts.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✔		✔		✔					
CO2	✔	✔	✔		✔	✔				
CO3	✔	✔			✔					
CO4	✔	✔	✔		✔		✔	✔		✔
CO5	✔	✔	✔		✔			✔		

EMSI304	INDUSTRIAL TRAINING	L	T	P
		0	*	0

OBJECTIVES:

- To train the students in the field work related the Embedded Systems and to have a practical knowledge in carrying out Embedded Systems field related works.

- To train and develop skills in solving problems during execution of certain works related to Embedded Systems.

The students individually undergo a training program in reputed concerns in the field of Embedded Systems during the summer vacation (at the end of second semester for full – time / fourth semester for part – time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he had,within ten days from the commencement of the third semester for Full-time / fifth semester for part-time. The students will be evaluated, by a team of staff members nominated by Head of the department, through a viva-voce examination.

OUTCOMES:

1. The students can face the challenges in the field with confidence.
2. The students will be benefited by the training with managing the situation that arises during the execution of works related to Embedded Systems.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✔		✔		✔	✔	✔			
CO2	✔	✔	✔		✔	✔	✔			

		L	T	P
EMST401	**THESIS PHASE-II**	**0**	**8**	**0**

COURSE OBJECTIVES:

- To carry out Thesis work Phase – II which the remaining part of the thesis.
- To attempt the solution to the problem by analytical/simulation/experimental methods and validate with proper justification.
- To deliver a presentation on the advancement in Technology pertaining to the selected thesis topic.
- To submit the duly certified progress report of Thesis work Phase – II in standard format for satisfactory completion of the work.

COURSE OUTCOMES:

1. Identify the real time applications in embedded system problems.
2. Analyze, design, component, or process to meet desired needs within realistic constraints and implement solution methodologies.
3. Apply modern engineering tools for solution.
4. Write technical reports following professional ethics.
5. Develop effective communication skills to present and defend their research work to a panel of experts.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓		✓		✓					
CO2	✓	✓	✓		✓	✓				
CO3	✓	✓			✓					
CO4	✓	✓	✓		✓		✓	✓		✓
CO5	✓	✓	✓		✓			✓		

		L	T	P
EMSEX0X	ADVANCED DIGITAL SIGNAL PROCESSING	4	0	0

COURSE OBJECTIVES:

- To study the analysis of discrete random signals.
- To study the digital filter design.
- To study the applications of adaptive filtering.
- To study the analysis of speech signals.
- To study the multi-rate signal processing fundamentals
- To introduce the various types of transforms.

Discrete Random Signal Processing

Power spectral density – filtering random process, special types of random process – Signal modelling - Least Squares method - Prony's method, iterative Prefiltering - Finite Data records - Stochastic Models.

Adaptive Signal Processing

FIR adaptive filters – Newton's steepest descent adaptive filter – Adaptive filters based on steepest descent method - WidrowHoffLMS Adaptive algorithm – Adaptive channel equalization - Adaptive echo canceller - convergence of LMS algorithms – Application: noise cancellation –adaptive recursive filters – recursive least squares.

Speech Signal Processing

Digital models for speech signal - Mechanism of speech production – time domain processing of speech signal - Pitch period estimation - Linear predictive Coding – autocorrelation method – Durbin recursive solution.

Multirate Signal Processing

Mathematical representation of change of the sampling rate - Interpolation and Decimation - Decimation by integer factor – Interpolation by an integer factor - Direct form FIR filter

structures – Single and multistage realization - Poly-phase realization – Application to sub band coding.

Types of Transform

Fourier Transform – Short Time Fourier Transform (STFT) - Discrete Time Fourier Transform (DTFT) – Continuous Wavelet Transform (CWT) – Wavelet Transform (WT) – Recursive multi-resolution decomposition – Hilbert transform - applications and its limitations

REFERENCES:

1. John G.Proakis, DimitrisG.Manobakis, "Digital Signal Processing", Prentice Hall of India, Third edition, 2000.
2. Raghuveer. M. Rao, AjitS.Bopardikar, "Wavelet Transforms, Introduction to Theory and applications", Pearson Education, Asia, 2000.
3. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", Wiley, 2002
4. Roberto Crist, "Modern Digital Signal Processing",, Thomson Brooks/Cole 2004.

COURSE OUTCOMES:

Students should be able to:
1. To understand advanced digital signal processing algorithms
2. To design adaptive filters for a given application
3. To design multi-rate DSP systems.
4. To understand decimation and interpolation of discrete-time signals.
5. To understand advanced digital signal transforms and their algorithms

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1			✔							
CO2					✔				✔	
CO3			✔	✔	✔					
CO4			✔							
CO5					✔				✔	✔

EMSEX0X	DIGITAL IMAGE PROCESSING	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To understand the image fundamentals and mathematical transforms necessary for image processing.
- To understand about Sampling Techniques.
- To know different transform and various algorithms to evaluate them
- To know the design of Digital filters

- To know different coding methods
- To understand the image segmentation techniques.

Digital Image Fundamentals and Image Transforms

Digital Image Fundamentals - Elements of digital image processing systems - Elements of visual perception –Image Sampling and Quantizations - Neighbours of a pixel - Distance measures - Color image fundamentals. Image Transforms Analysis of 1D DFT - 2D transforms – DFT – Discrete Cosine Transform – Walsh – Hadamard – SVD - Wavelet Transform.

Image Enhancement and Restoration

Basic Gray Level Transformations - Histogram Processing - Smoothing and Sharpening Spatial Filters- Smoothing and Sharpening -Frequency Domain Filters - Homomorphicfiltering- Image degradation/ restoration process model – Noise models- Restoration in the presence of noise only Spatial Filtering- Inverse filtering –Wiener filtering - Geometric transformations.

Image Compression

Need for data compression- Objective and subjective fidelity criteria – Image Compression models- Huffman - Run Length Encoding - Arithmetic coding - Vector Quantization - LZW coding - Error free compression – Lossy Compression- Transform Coding –Wavelet coding- Image Compression Standards – Introduction to fractal image compression.

Image Segmentation

Detection of Discontinuities – Point detection, Line detection, - Edge detection – Edge linking and Boundary Detection –Thresholding – Basic global and adaptive thresholding - Image segmentation by region growing - region splitting and merging -Basic formulation of Region oriented segmentation – Morphological operations - Clustering methods

Application of Image Processing

Image classification – Image understanding- Image recognition – Patterns and pattern classes - Matching by minimum distance classifier - Neural Network applications in image processing –Image fusion – Steganography - Digital image watermarking

REFERENCES:

1. Gonzalez R. C. and Woods R.E., "Digital Image Processing", Prentice- Hall, 3rd Edition, 2008.
2. Anil K.Jain, "Fundamentals of Digital Image Processing", Pearson Education, 2003.
3. Jayaraman,Esakirajan,Veerakumar, "Digital Image Processing"; McGrawHill, 2013.
4. J.W. Woods, "Multidimensional Signal, Image, Video Processing and Coding", Academic Press, 2nd Edition, 2012.
5. Milan Sonka, Vaclav Hlavav, Roger Boyle, "Image Processing, Analysis and Machine Vision", Thomson Learning, 2nd Edition ,2001
6. William K. Pratt, "Digital Image Processing", John Wiley, 4th Edition, 2007.

COURSE OUTCOMES:

1. Explain different transform and various algorithms to evaluate them
2. Implement the design of Digital filters
3. Implement the different coding methods
4. Apply the basic concepts of Image segmentation,
5. Explain image recognitions and the applications

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Mapping with Programme Outcomes										
CO1	✔	✔			✔					
CO2					✔	✔	✔			
CO3	✔		✔	✔				✔		
CO4		✔		✔		✔	✔			
CO5			✔				✔		✔	✔

EMSEX0X	DISTRIBUTED EMBEDDED COMPUTING	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To expose the students to the fundamentals of Network Management, Security and Communication Technologies.
- To understand the basics of internet with knowledge of internet server interfacing.
- To study Java based Networking.
- To get introduced to Embedded Network Routing Agents
- To study the Networking on-chip real time multiprocessor embedded systems.

Internet Hardware Infrastructure

Broad Band Transmission facilities – Open Interconnection standards – Local Area Networks – Wide Area Networks – Network management – Network Security – Cluster computers.

Internet Concepts

Capabilities and limitations of the internet – Interfacing Internet server applications to corporate databases HTML and XML Web page design and the use of active components.

Distributed Computing Using Embedded Java

Introduction to Embedded Java and its concepts - J2Micro Edition (J2ME) - IO streaming – Object serialization – Networking – Threading – RMI – multicasting – distributed databases – embedded java concepts – Wireless Java - case studies.

Embedded Agent

Introduction to the embedded agents – Embedded agent design criteria – Behaviour based, Functionality based embedded agents – Agent co-ordination mechanisms and benchmarks embedded - agent. Case study: Mobile robots.

Embedded Computing Architecture

Synthesis of the information technologies of distributed embedded systems – analog/digital co-design – optimizing functional distribution in complex system design – validation and fast prototyping of multiprocessor system-on-chip – a new dynamic scheduling algorithm for real-time multiprocessor systems.

REFERENCES:

1. Dietel&Dietel, "JAVA how to program", Prentice Hall, 1999.
2. SapeMullender, "Distributed Systems", Addison-Wesley, 1993.
3. George Coulouris, Jean Dollimore, "Distributed Systems – Concepts and Design", Wesley, 1988.
4. "Architecture and Design of Distributed Embedded Systems", edited by Bernd Kleinjohann C-lab, Universitat Paderborn, Germany, Kluwer Academic Publishers, Boston, April 2001, pp. 248.
5. David Reilly,MichaelReily, "Java Network Programming And Distributed Computing", Addison-Wesley Professional,2002.
6. Mclaughlin, "Java & XML", O'reilly Media, 3rd edition, 2006.

COURSE OUTCOMES:

1. Explains various network (hardware and security.
2. Explains basic concepts of internet database and webpage design.
3. Explains the distributed database computing using embedded Java.
4. Describes the embedded agent design and operation mechanism.
5. Explains the real time multiprocessor distributed embedded systems

					Mapping with Programme Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1			✓		✓					
CO2									✓	
CO3	✓			✓	✓	✓	✓			
CO4		✓				✓				✓
CO5	✓			✓	✓					

EMSEX0X	MEDICAL INSTRUMENTATION SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To understand basics of measurement system.
- To understand the concept of various biomedical instruments and technologies.
- To acquire knowledge about sensing devices used in biomedical instruments.
- To understand the biomedical instruments used in hospitals.
- To discuss about the reduction of noise in biomedical instruments.
- To obtain basic knowledge on medical imaging systems.

Medical Instrumentation Basics

Basic Medical Instrumentation system, General Constraints in design of medical instrumentation system, Classification of Biomedical Instruments, Biomedical Simulators, Sources of Bioelectric Potential and Electrodes- Resting and Action potential, Propagation of action potential, The bioelectric potentials: ECG, EEG, EMG, ERG, EOG, EGG; Digital Biosignals, Equipment standards and patient safety.

Sensing Devices for Biomedical Instruments

Resistive, Capacitive, Inductive, Piezoelectric, Thermocouple, Thermistors, Fiber, Optic Sensors, Radiation Sensors, Smart Sensors, Electro Chemical Sensors, Electrical Fibrosensors, Blood-Glucose Sensors.Operational Amplifiers, Inverting, Noninverting, Differential, Instrumentation Amplifiers, Pre amplifiers, Isolation Amplifiers, Active Filters.

Measurement Systems

Patient Monitoring Systems, Measurement of Blood Pressure, Heart Rate, Pulse Rate, Temperature, Heart Sounds, Blood Flow and Volume, Respiratory Systems, Cardiac Output Measurement, Blood pH, pO2 Measurement, Oximeters, Audiometers, Spectrophotometers. Introduction to telemetry & Telemedicine.

Artifacts and Noise In Medical Instrumentation

Examples of noise in medical instrumentation and biomedical signals – baseline wander, power line interference, electrode motion artifacts, Noise reduction with digital signal processing; QRS complex detection in ECG- Pan Tompkins Algorithm

Modern Medical Imaging Systems

Ultrasound and Ultrasonic imaging system – Ultrasound Doppler and flow detector, Echocardiogram; Physics of X-rays and X-ray machines, Information content of an Image, Radiography, Computed Radiography, Computer Tomography (CT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET).

REFERENCES:

1. John G.Webster, "Medical Instrumentation Application and Design", John Wiley &Sons,Inc Noida. 4[th]edition, 2010.
2. R.S.Khandpur, "Handbook of Biomedical Instrumentation", McGraw Hill Education,3rd edition, 2014.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 4[th]edition, 2001.
4. Leslie Cromwell, Fred J. Weibell , Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall India Learning Private Limited, 2nd edition, 2015.

COURSE OUTCOMES:
1. Helps to learn about Biomedical Instruments.
2. Acquires knowledge about Electrodes, Sensors and Transducers for biomedical signal acquisition
3. Gives an idea about ECG, EEG and EMG recording techniques and their instrumentation
4. Helps to know about signal processing and filtering techniques for noise and artifact removal.
5. Describes the modern medical imaging modalities and instruments

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✔	✔	✔	✔	✔			✔		✔
CO2	✔	✔	✔	✔	✔					
CO3	✔	✔		✔	✔				✔	
CO4	✔						✔	✔		
CO5	✔	✔	✔	✔	✔		✔	✔	✔	✔

		L	T	P
EMSEX0X	FPGA BASED EMBEDDED SYSTEM DESIGN	4	0	0

COURSE OBJECTIVES:

- Gain knowledge on various processors
- Acquire an exposure on system development.
- Understand the architecture of latest processors.
- Design different application circuits using a single FPGA chip.
- Program the FPGA to do specific work.
- Create embedded systems using FPGA.

ASICS, CMOS Logic and ASIC Library Design

Types of ASICs – Design Flow – CMOS transistors, CMOS design rules – Combinational Logic Cell – Sequential logic cell – Data path logic cell – Transistors as Resistors – Transistor Parasitic Capacitance – Logical effort – Library cell design –Library architecture.

Programmable Logic Cells and I/O Cells

Digital clock Managers-Clock management- Regional clocks- Block RAM – Distributed RAM-Configurable Logic Blocks-LUT based structures – Phase locked loops- Select I/O resources –Anti fuse - static RAM - EPROM and EEPROM technology – PREP bench marks – Actel ACT – Xilinx LCA – Altera FLEX – Altera MAX DC & AC inputs and outputs – Clock and power inputs – Xilinx I/O blocks.

Architectures

Architecture - FPGAs, Xilinx XC4000 - ALTERA's FLEX 8000/10000, ACTEL's ACT-1,2,3 and their speed performance - Apex, Cyclone FPGAs and Quartus architectures - case studies: Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs.

Design Entry and Testing

Verilog and VHDL - logic synthesis - Types of simulation – Faults - Fault simulation - Boundary scan test - Automatic test pattern generation. Built-in self test – scan test.

Partitioning and Routing

Embedded system partition - FPGA partition - partition methods - floor plan - placement - physical design flow - global routing - detailed routing - special routing - circuit extraction –

Design Rule Checking (DRC) - Embedded System Design Examples using ALTERA FPGAs – Traffic light Controller, Real Time Clock.

REFERENCES:

1. Wolf Wayne, "FPGA Based System Design", Pearson Education India, 2004.
2. M.J.S. SMITH, "Application Specific Integrated Circuits", Addison Wesley Longman Inc., 2001.
3. Mohammed Ismail, Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw Hill, 1994.
4. N.H.E.Westeetal, "CMOS VLSI Design" Pearson, Third Edition, 2005.
5. N. Jha, S.D. Gupta, "Testing of Digital Systems", Cambridge, 2003.
6. Design manuals of Altera, Xilinx and Actel. (From the web).

COURSE OUTCOMES:

1. Underlying fundamental concepts of VLSI have been brought out.
2. Memory management and input/output technology of various processors have been pointed out.
3. Architecture of various processors have been understood.
4. Softwares for the processors have been learnt.
5. Some basic design examples using VLSI processors have been described.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Mapping with Programme Outcomes										
CO1	✔									
CO2		✔								
CO3				✔						
CO4			✔							
CO5						✔	✔			✔

EMSEX0X	VLSI FOR EMBEDDED APPLICATION	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To enlighten the student with the growth of integrated circuits and develop procedure for their design, simulation and implementation.
- The evolution and growth of integrated circuit, the methods of layout and the different approaches for their design are to be discussed.
- A detailed study of the fabrication techniques is to be made. Analysis of analog and digital VLSI circuits is to be carried out. The need for application of specific devices and their features along with examples are to be dealt.

- The course will refurbish the student to realign his ideas on a different plane. It will help the student to develop newer control strategies that can meet the desired performance more precisely.

VLSI Design Concepts

Evolution of VLSI - VLSI design process - Architectural design - Logical design - Physical design - Lay-out styles - Full custom - Semi custom approaches - Need for design rules - Types of design rules - Design for MOS & CMOS circuits - Simple layout examples - Sheet resistance, area capacitance, wiring capacitance - Dry capacitive loads.

VLSI Fabrication Techniques

Wafer fabrication - Wafer processing - Oxidation - Patterning - Silicon gate NMOS process - CMOS process - Nwell - Pwell - Twin tub - Silicon on insulator - CMOS Process enhancements - Analytical techniques - Ion beam techniques - Chemical methods - Package Fabrication technology - Reliability requirements - Field loss - Failure mechanism - Design automation.

Analog VLSI

Introduction to analog VLSI - Analog circuit building blocks - Switches, active resistors - Current sources and sinks - Current mirrors/amplifiers - MOS & BJT, inverting amplifiers - CMOS and BJT two stage op-amp - Analog signal processing circuits - Sensors - D/A and A/D converters.

Digital VLSI

Logic design - Switch logic - Gate logic - Dynamic CMOS logic - Structured design - Simple combinational logic design - Clocked sequential design - Sub-system design - Design of shifters - Arithmetic processors - ALU - Serial, Parallel and pipelined multiplier arrays.

FPGA Based Embedded Processor

FPGAs - Xilinx family. LCA - I/O block - programmable interconnect - Configuration memory. Hardware software task partitioning – FPGA fabric Immersed Processors – Soft Processors and Hard Processors – Tool flow for Hardware/Software Co-design –Interfacing Processor with memory and peripherals – Types of On-chip interfaces – Wishbone interface, Avalon Switch Matrix, OPB Bus Interface, Creating a Customized Microcontroller - FPGA-based Signal Interfacing and Conditioning.

REFERENCES:

1. Pucknell D.A and Kamran Eshranghiaon., "Basic VLSI Design" Prentice Hall of India, New Delhi,3'rd Edition, 1994.
2. Bhaskar.J. "A VHDL Primer", PHI, 1999.
3. Rahul Dubey, "Introduction to Embedded System Design Using Field Programmable Gate Arrays", Springer Verlag London Ltd., 2009
4. Fabricus E.D., "Introduction to VLSI Design" McGraw Hill International Edition,1990.
5. Haskard M.R, May L.C., "Analog VLSI design -NMOS and CMOS "Prentice Hall,1988.
6. C.Mead&L.Conway, "Introduction to VLSI systems", Addison-Wesley, USA, 1980.

7. PalmorJ.E,Perlman D.E., "Introduction to Digital systems" Tata McGraw Hill,1996.

8. Kevin skahill., "VHDL for programmable logic device" Addison Wesley,1996.

9. Smith., "Application specific Integrated circuits" Addison-Wesley, 2nd reprint, 2000.

10. David Pellaris, Douglas Taylor., "VHDL Made easy", PHI Inc, 1997.

11. AMAR Mukherjee., "Introduction to NMOS and CMOS VLSI system Design" Prentice Hall, USA, 1986.

COURSE OUTCOMES:

1.Obtain the knowledge of basic fundamentals of VLSI design concepts

2. Understand various fabrication process technologies used in VLSI devices.

3.Be able to analyze and design CMOS analog IC building blocks like MOS amplifiers,

4.Current mirrors and multistage differential amplifiers

5. Be able to analyze and design CMOS digital IC building blocks

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Mapping with Programme Outcomes											
CO1		✔		✔						✔	
CO2		✔				✔			✔		✔
CO3		✔	✔	✔		✔		✔			
CO4		✔	✔	✔		✔			✔		✔
CO5		✔	✔	✔	✔			✔			✔

EMSEX0X	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES:

- This course intends to provide a conceptual understanding of micro fabrication techniques and the issues surrounding them.

- To know the major classes, components and applications of MEMS devices/systems and to demonstrate an understanding of the fundamental principles behind the operation of these devices/systems.

- To learn Bulk micromachining process and to understand the concept of different etching process and etching materials in fabrication process.

- To impart knowledge about surface micromachining process and to understand the types and concept of bonding process.

- To study and design of different types of MEMS actuators, Micro grippers, MEMS resonators and their applications.

Introduction To Micro Machined Devices

Microsystems vs. MEMS - Markets for Microsystems and MEMS, Scaling Principles-Materials for micromachining, Micromachining terms- mechanical properties of silicon-native oxides of silicon and other semiconductors-typical silicon wafer types.

Bulk Micro Machining

Wet etching of silicon-Isotropic etching-anisotropic etching, alkali hydroxide etchants-ammonium hydroxide- tetramethyl ammonium hydroxide (TMAH)-ethylene diaminepyrochatechol (EDP)-ultrasonic agitation in wet etching stop layers for dopant elective etchants. Porous-silicon formation – anistrophic wet etching of porous aluminum-anistrophic wet etching- quartz- vapour phase etches. RIE laser driven bulk processing.

Surface Micromachining

Thin film processes-nonmetallic thin film for micromachining –silicon dioxide – silicon nitride - silicon carbide – polycrystalline diamond - polysilicon and other semiconductors and thin film transition – wet etching of non-metallic thin film-metallic thin film for micromachining - Resistive evaporation – E-beam evaporation-sputter deposition-comparison of evaporation and sputtering – CVD of metals - adhesion layer for metals - electro deposition (E plating) – Electro deposition mechanism: - DC electroplating-pulsed electroplating-Agitation for electroplating-black metal film-electro less plating.

Bonding Processes

Anodic Bonding-Anodic bonding using deposited glass-silicon fusion bonding-other bonding and techniques - compound processes using bonding. Sacrificial Processes and other Techniques: Sticking problem during wet releasing prevention of sticking-phase change release methods-geometry-examples of sacrificial processes.

Mems Actuators And Their Applications

Actuation mechanisms–Electrostatic actuation–Electrostatic cantilever actuators–Torsional electrostatic actuators–Electrostatic comb drives–Feedback stabilization of electrostatic actuators -Electrostatic rotary micro motors - Electrostatic linear micro motors – Electrostatic micro grippers–Electrostatic relays and switches - Thermal actuation – Thermal expansion of solids – Thermal array actuators –Piezoelectric actuation–Cantilever resonators.

REFERENCES:

1. Chang Liu, Foundations of MEMS, Pearson Education,2nd edition, 2014.
2. Muhammad H. Rashid, Micro Electronic Circuits: Analysis and Design, Cenage Learning,2nd edition 2012.
3. Reza Ghodssi, Pinyen Lin, MEMS materials and processes Handbook, Springer science business media, 2011
4. Chang Liu, Foundations of MEMS, (ILLINOIS ECE Series), Pearson Education International, 2006.
5. Tai-Ran-Hsu, MEMS & Microsystems Design and Manufacture, Tata McGrawHill, New Delhi, 2002
6. Stephen D. Senturia, Microsystems Design, Springer International Edition, 2001.
7. Gregory T.A. Kovacs, Micro machined Transducers, WCB McGraw Hill, 1998.

COURSE OUTCOMES:

1. Understanding the concept of scaling laws that are used extensively in the design of micro devices and systems.
2. Analyze the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching.
3. Provide impart knowledge about thin film process and etchants used for isotropic and anisotropic etching.
4. Analyze semiconductor materials for common micro components and devices.
5. Understanding the types of bonding process and the techniques used for sacrificial process.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✔	✔								
CO2	✔	✔			✔	✔				
CO3	✔		✔	✔			✔	✔		
CO4	✔	✔		✔			✔			
CO5		✔	✔		✔	✔		✔		

Mapping with Programme Outcomes

		L	**T**	**P**
EMSEX0X	**SOFTWARE TECHNOLOGY FOR EMBEDDED SYSTEMS**	4	0	0

COURSE OBJECTIVES:

- To expose the students to the fundamentals of embedded Programming.
- It aims at familiarizing the students in embedded concepts and programming in 'C'.
- This module covers the advanced topics in 'C'
- To learn Memory management and Data structures which are of high relevance in embedded software is considered in depth.
- The syllabus also covers the topic 'scripting languages for embedded systems'.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

Programming Embedded Systems

Embedded Program – Role of Infinite loop – Compiling, Linking and locating – downloading and debugging – Emulators and simulators processor – External peripherals – Toper of memory – Memory testing – Flash Memory.

Embedded C Programming

Review of data types – scalar types - Primitive types - Enumerated types - Subranges, Structure types - character strings – arrays – Functions. Introduction to Embedded C - Introduction, Data types Bit manipulation, Interfacing C with Assembly. Embedded programming issues - Reentrancy, Portability, Optimizing and testing embedded C

programs.Modelling Language for Embedded Systems: Modeling and Analysis of Real-Time and Embedded systems.

Embedded Applications Using Data Structures

Linear data structures – Stacks and Queues 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.

Scripting Languages for Embedded Systems

Basics of PYTHON Programming Syntax and Style – Python Objects – Dictionaries – comparison with C programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution Environment.

Embedded Software Development Tools

Host and target machines – Linkers / Locators for Embedded Software – Debugging techniques – Instruction set simulators Laboratory tools – Practical example – Source code.

REFERENCES:

1. David E.Simon, "An Embedded Software Primer", Pearson Education, 2003.
2. Michael Bass, "Programming Embedded Systems in C and C++", Oreilly, 2003.
3. Michael J Pont, "Embedded C", Pearson Education, 2007.
4. Mark Lutz,"LearningPython,PowerfulOOPs,O'reilly, 2011.
5. Robert Lafore, "Object_Oriented programming in C++", Galgotia publications, 2002.
6. Daniel W. Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education, 2002.

COURSE OUTCOMES:

1. The learning process delivers insight into various programming languages / softwares compatible to embedded process development with improved design & programming skills.
2. Develop advanced programs in Embedded C.
3. Get knowledge in data structure and OOP.
4. Develop programs using scripting languages.
5. Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✔			✔						
CO2	✔		✔							
CO3	✔				✔					
CO4	✔			✔						
CO5					✔		✔			

EMSEX0X	ROBOTICS AND AUTOMATION	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot.
- To learn manipulators and their applications in robots and programming of robots.
- To discuss about the various applications of robots, justification and implementation of robot.
- To know about the electronic systems in automation of mechanical operations.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

Introduction

Specifications of Robots - Classifications of robots – Work envelope - Flexible automation versus Robotic technology – Applications of Robots. Robot KineMaticsAnd Dynamics - Positions, Orientations and frames, Mappings: Changing descriptions from frame to frame, Operators: Translations, Rotations and Transformations – Transformation Arithmetic - D-H Representation - Forward and inverse Kinematics Of Six Degree of Freedom Robot Arm – Robot Arm dynamics.

Robot Drives and Power Transmission Systems

Robot drive mechanisms, hydraulic – electric – servomotor - stepper motor - pneumatic drives, Mechanical transmission method - Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems – Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws.

Manipulators

Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and Pneumatic manipulators.

Industrial Automation

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating.Types of production and types of automation, automation strategies, levels of automation.

Programmable Automation

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.

REFERENCES:

1. Deb S. R. and Deb S., "Robotics Technology and Flexible Automation", Tata McGraw Hill Education Pvt. Ltd, 2010.
2. John J.Craig, "Introduction to Robotics", Pearson, 2009.

3. Mikell P Groover, "Automation Production Systems and Computer - Integrated Manufacturing" Pearson Education, New Delhi, 2001.
4. WemerDepper and Kurt Stoll, "Pneumatic Application", KemprathReihe, Vogel BuchVerlagWurzbutg, 1987.
5. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
6. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press, 2001.

COURSE OUTCOMES:

1. Explain the basic concepts of working of robot.
2. Analyze the function of manipulators in the robot.
3. Use robots in different applications.
4. Knowledge of industrial automation by transfer lines and automated assembly lines.
5. Ability to understand the electronic control systems in metal machining and other manufacturing processes.

					Mapping with Programme Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✔			✔						
CO2		✔	✔							
CO3						✔	✔			
CO4			✔			✔				
CO5						✔	✔			

		L	**T**	**P**
EMSEX0X	**EMBEDDED PRODUCT DEVELOPMENT TECHNOLOGY**	**4**	**0**	**0**

COURSE OBJECTIVES:

- To understand basics of product design and development.
- To acquire knowledge about testing methodologies.
- To understand the basic concepts of product development based on its reliability, cost, robustness
- To discuss about the need for CAE, CAD, CAM, IDE tools in product design.
- To obtain basic knowledge on industrial design.
- To understand the concept of developing products in an embedded system.

Concepts of Product Development

Need for PD - Product Development Process Phases - Product Development organization structures - Strategic importance of Product Planning process – Product Specifications-Target Specifications-Plan and establish product specifications - Understanding customer and behavior analysis. Concept Generation, Five Step Method-Basics of Concept selection-Creative thinking –creativity and problem solving- creative thinking methods generating design concepts-systematic methods for designing –functional decomposition – physical decomposition – Product Architecture - component Standardization.

Product Design Phase

System design – design phases – design styles – design of safety critical systems – design diversity – design for maintainability. System engineering – architecturing and engineering judgment – documentation – human interface – packaging and enclosures – grounding and shielding - circuit design – circuit layout – power – cooling – product integration, production and logistics.

Approaches in Product Development

Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems -architecture of the chunks - creating detailed interface specifications - Portfolio Architecture- competitive benchmarking- Approach – Support tools for the benchmarking process, trend analysis- Setting product specifications-product performance analysis -Industrial Design- Robust Design – Testing Methodologies.

Industrial Design

Integrate process design - Managing costs - Robust design –need for Involving CAE, CAD, CAM, IDE tools - Prototype basics - Principles of prototyping - Planning for prototypes-Economic & Cost Analysis - Understanding and representing tasks-baseline project planning -accelerating the project execution.

Developing Embedded Product Design

Discussions on Creating Embedded System Architecture - Mobile Phone -Adaptive Cruise Controller, Architectural Structures- Criteria in selection of Hardware & Software Components, product design by Performance Testing, Costing, Benchmarking, specific product design.

REFERENCES :

1. Karl T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw – Hill International Edns., 5th edition, 2011.
2. Tim Williams, "EMC for product designers", Elsevier, 4th edition, 2007.
3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th Edition, 2009.
4. Kevin Otto & Kristin Wood, "Product Design Techniques in Reverse Engineering and New Product Development", Pearson Education (LPE), 2001.
5. YousefHaik, T. M. M. Shahin, "Engineering Design Process", Cengage Learning, 2nd Edition, 2010.

COURSE OUTCOMES:

1. Gives an idea about an approach to concept creativity, selection and testing.
2. Provides an idea for designing a consumer specific product.
3. Gives knowledge up gradation on recent trends in embedded systems design.
4. Describes the economic analysis and the consideration while designing a product.
5. Helps to improve the integration of customer requirements in product design.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1			✔					✔		✔
CO2				✔				✔	✔	✔
CO3				✔		✔	✔			
CO4							✔			✔
CO5					✔			✔		✔

		L	T	P
EMSEX0X	**SCADA FOR EMBEDDED APPLICATIONS**	4	0	0

COURSE OBJECTIVES:

- To understand basics of SCADA.
- To understand the concept of various components involved with SCADA.
- To acquire knowledge about SCADA communication protocols.
- To study about monitoring and control techniques related to SCADA.
- To obtain basic knowledge implementation of SCADA in embedded systems.
- To learn about the application of SCADA in Embedded system.

Introduction to SCADA

Introduction to SCADA, Data acquisition systems, Evolution of SCADA, SCADA definitions, Communication technologies, Elements of a SCADA system, SCADA Functional requirements, SCADA Hierarchical concept, SCADA architecture, General features of SCADA.

SCADA System Components

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels.

SCADA Communication

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC 61850 based communication architecture, Communication media like Fiber optic, PLCC, Interface provisions and communication extensions, synchronization with NCC, DCC.

SCADA Monitoring and Control

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording, Control function - Station control, bay control, breaker control and disconnector control.

SCADA Applications

Utility applications in Embedded systems, monitoring, analysis and improvement. SCADA applications in Utility Automation and Industries-Case studies, Implementation, Simulation Exercises

REFERENCES:

1. Stuart A. Boyer, "SCADA-Supervisory Control and Data Acquisition", ISA: Instrumentation, Systems, and Automation Society, 4th edition, 2009.
2. Gordon Clarke and Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cyber security for SCADA systems", PennWell Books, 2006.
4. David Bailey and Edwin Wright, "Practical SCADA for industry", Newnes, 2003
5. Stuart G. Mccrady, "Designing SCADA application software: A practical approach", Elsevier, 1st edition, 2013.

COURSE OUTCOMES:

1. Understanding the concept of SCADA.
2. Analyse various system components involved in SCADA system.
3. Acquires knowledge about monitoring and control methods in SCADA.
4. Helps to know about communication protocols in SCADA system.
5. Describes about application of SCADA in Embedded system.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Mapping with Programme Outcomes										
CO1			✓	✓						
CO2	✓		✓					✓	✓	
CO3		✓	✓							
CO4					✓					
CO5									✓	✓

EMSEX0X	WIRELESS MOBILE COMMUNICATION	L	T	P
		4	0	0

COURSE OBJECTIVES:
- Expose the students to the fundamentals of wireless communication technologies.
- Teach the fundamentals of cellular concepts.
- Study the concepts of mobile radio propagation.
- Explore various modulation techniques used.
- Introduce network routing protocols.
- Study the various multiple access techniques.

Introduction

Brief history of wireless communication - elements of wireless communication systems-radio frequency spectrum and bandwidth requirements - Universal Mobile Communication

Systems- Personal Communication systems- emerging trends in wireless communications Wireless systems and standards: AMPS and ATACS systems- 2G, 2.5G, 3G and B3G systems and standards.

Cellular Concept

Frequency Reuse – Channel Assignment and Handoff Strategies – Interference and System Capacity – Trunking and Grade of Service – Improving Coverage and Capacity in cellular Systems – Radio wave Propagation: Basic Propagation Mechanisms – Reflection – Diffraction - Scattering – Free Space Propagation Model - Outdoor and Indoor Propagation Models – Signal Penetration in Buildings – Ray Tracing and Site Specific Model - Practical Link Budget Design.

Mobile Radio Propagation

Small Scale Multipath Propagation – Impulse Response Model of a Multi Path Signal - Parameters of Mobile Multi Path Channels – Types of Small Scale Fading – Statistical model for Multi Path Channels – Multi Path Shape Factors for Small Scale Fading Wireless Channels.

Modulation Technique for Mobile Radio

Amplitude Modulation – Angle Modulation – Digital Modulation - Line Coding – Pulse Shaping Techniques – Geometric Representation of Modulation Signals – Linear Modulation Techniques – Constant Envelope Modulation – Combined Linear and Constant Modulation Techniques – Spread Spectrum Modulation – Modulation Performance in Fading and Multi Path Channels.

Multiple Access Techniques

Fundamentals of Equalization – Equalizers in Communication Receiver – Linear Equalizer, Non Linear Equalisation – Algorithm for Adaptive Equalisation – Training a Generic Adaptive Equalizer – Fractional Equalizer – Diversity Techniques- Rake Receiver – Interleaving - Frequency Division Multiple Access (FDMA), Spread Spectrum Multiple Access – Space Division Multiple Access (SDMA) - Packet Radio.

REFERENCES:

1. Rappaport T.S., Wireless Communications Principles and Practices, Second Edition, Pearson Education, Asia, 2002
2. John G. Proakis, Digital Communication, McGraw Hill International, Fourth edition. 2000.
3. Simon Haykin, Communication systemsThird Edition, John wiley, 2002
4. Edware Lee and David Messerschmitt, Digital Communication, Kluwer Academic Publications, 2012.
5. T. G. Palanivelu, Wireless and Mobile Communication, PHI Learning, Pvt. Ltd., 2008
6. EzioBiglieri, Katie Wilson and Stephen Wilson,Academic Press Library in Mobile and Wireless Communications, Academic Press, Elsevier, 2016

COURSE OUTCOMES:

1. Fundamental concepts of wireless communication and its standards have been brought out.
2. Cellular concepts and various radio propagation models have been pointed out.
3. Architecture of various mobile radio models have been understood.
4. Various mobile radio modulation techniques have been described.
5. Different access techniques have been learnt.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓			✓					✓	
CO2		✓			✓				✓	✓
CO3	✓	✓	✓							✓
CO4	✓			✓		✓	✓			
CO5			✓		✓				✓	

EMSEX0X	CLOUD COMPUTING	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To know the principles of cloud computing.
- To study the various cloud service models
- To understand the basics of virtualization
- To familiarize with the programming models available in cloud
- To get an insight on some applications and prospects of cloud computing

An Overview

Cloud Computing- Definition-motivation-characteristics- Past, Present, and Future-Cloud Computing Methodologies-The Cloud Architecture-Cloud Deployment Techniques-Cloud Services-Cloud Applications-Issues with Cloud Computing-comparison between Cloud Computing and Grid Computing-Benefits, Limitations, and Concerns associated with Cloud Computing-prospects and implications

Cloud Services

Cloud services-classification- software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS)- data storage as a service- other services- security as a service (SeaaS), knowledge as a service, and analytics as a service (AaaS)-service providers-Cloud Deployment Models- Private Cloud-Public Cloud-Community Cloud-Hybrid Cloud

Virtualization

Introduction- Virtualization Opportunities- Processor Virtualization- Memory Virtualization Storage Virtualization - Network Virtualization - Data Virtualization Application

Virtualization -Approaches to Virtualization- Full Virtualization – Para virtualization - Hardware-Assisted Virtualization -Types of Hypervisors- From Virtualization to Cloud Computing- IaaS- PaaS- SaaS

Programming Models for Cloud Computing

Existing and Extended Programming Models for Cloud- BSP Model- Map Reduce Model- Map Reduce --Model- Cloud Haskell- Multi MLton- Erlang- SORCER: Object-Oriented Programming- Programming Models in Aneka- New Programming Models Proposed for Cloud- Orleans- BOOM and Bloom- Grid Batch- Simple API for grid applications

Applications and Prospects

Cloud Applications- Engineering Applications- Educational Applications- Personal Applications- Cloud Gaming- Cloud Prospects- Impact of the Cloud on IT Professionals and the IT Industry- Cloud Computing in Emerging Markets- Research Topics in Cloud Computing- The Future of the Clouds.

REFERENCES:

1. K. Chandrasekaran, "Essentials of Cloud Computing", CRC press, 2015
2. RajkumarBuyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2011.
3. Dan C. Marinescu, "Cloud Computing: Theory and Practice", Morgan Kaufmann, 2013
4. San Murugesan, Irena Bojanova, "Encyclopedia of Cloud Computing", Wiley-IEEE Press, 2016
5. Derrick Rountree, Ileana Castrillo,"The Basics of Cloud Computing: Understanding the fundamentals of Cloud Computing in Theory and Practice", Syngress, 2013

COURSE OUTCOMES:

1. Conceptualize the basic ideas and motivation for cloud computing
2. Familiarize with thecloud services offered by the companies
3. Understand the concept of Virtualization.
4. Discuss the suitability of each programming model to different kinds of application
5. Identify the areas of application and explore future prospects.

EMSEX0X	OPTIMIZATION TECHNIQUES	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To introduce the fundamental concepts of optimization techniques.
- To acquire sound knowledge of obtaining optimal solutions to the power system problems with the help of different mathematical techniques.
- To understand various algorithms with their comparative study for the utilization of optimization problem solution.
- To analyse the concepts of various classical and modern methods for constrained and unconstrained problems.
- To gain in-depth knowledge about variety of performance measures for optimization problems applied in the engineering fields.

Introduction to Optimization

Engineering applications – Classification of optimization problems – Classical optimization techniques – Single and multivariable optimization – multivariable optimization with and without constraints – Saddle point – Solution by the method of Lagrange multipliers – Kuhn tucker conditions.

Linear Programming

Applications – Standard form of LPP – definitions and Theorems – Solution of a system of Linear simultaneous equations – Pivotal reduction – Simplex algorithm – Revised simplex method. Duality in linear programming – Dual simplex method – Decomposition principle - Transportation problem – Northwest corner rule – Least cost method.

Non Linear Programming

One dimensional minimization methods – unrestricted search – Exhaustive search – Interpolation methods – Quadratic and cubic interpolation methods. Unconstrained optimization techniques – Direct search methods – Simplex method – Indirect search (descent) methods – Gradient of a function – Steepest Descent method. Constrained optimization techniques – Transformation techniques – penalty function methods or sequential unconstrained minimization techniques (SUMT) – Interior and exterior penalty function method - Extrapolation technique – Augmented Lagrange multiplier method – Checking the convergence of constrained optimization problems – Perturbing the design vector – Kuhn-Tucker conditions.

Geometric Programming and Integer Programming

Geometric programming - Polynomial – Unconstrained minimization problem – Constrained minimization problem – Primal and Dual programs – Geometric programming with mixed inequality constraints – Complementary geometric programming. Integer linear programming – Mixed integer programming – Integer non linear programming – Sequential linear discrete programming.

Dynamic Programming

Multistage decision processes – Concept of sub optimization – Principle of optimality – Computational procedure in dynamic programming - Conversion of a final value problem into an initial value problem – Linear programming as a case of dynamic programming – Continuous dynamic programming.

REFERENCES:

1. R. L. Rardin, "Optimization in Operation Research", Pearson Education Private Ltd., Second Edition, 2016.
2. S. S. Rao, "Engineering Optimization: Theory and Practice", John Wiley & Sons, Fourth Edition, 2009.
3. F. S. Hiller and G. J. Lieberman, "Introduction to Operations Research", Tata McGraw Hill, Ninth Edition, 2010.
4. C. B. Gupta, "Optimization Techniques in Operations Research", I. K. International Publishing House Private Ltd., Second Edition, 2012.
5. H. A.Taha, "Operations Research-An Introduction", Prentice Hall, Eighth Edition, 2008.

6. S. S. Rao, "Optimization: Theory and Applications", New Age International (P) Ltd., Third Edition, 2004.

COURSE OUTCOMES:

1. Apply concepts of mathematics to formulate an optimization problem.
2. Understand and apply the concept of optimality criteria for various types of optimization problems.
3. Solve various constrained and unconstrained problems in single variable and multivariable domains.
4. Apply the methods of optimization in practical conditions.
5. Analyze a research problem having requirement of optimization techniques.

EMSEX0X	SCIENTIFIC RESEARCH AND TECHNICAL COMMUNICATION	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To gain a sound knowledge of scientific research for undertaking a valid study
- To explore the techniques of defining a research problem and investigate the various research designs, highlighting their main characteristics
- To familiarize with the art of Technical Communication
- To study the different types of Listening and Speech Techniques
- To realize the art of writing technical reports and proposals
- To understand the ethical issues of writing technical papers

Scientific Research

Research-Definition-Objectives and Motivation - Characteristics of scientific research activity - Means and methods of scientific research - Criteria of Good Research-Limitations-Components of a research problem-selecting the problem-necessity of defining the problem-technique involved in defining a problem---Importance of literature review in defining a problem –Identifying gap areas from literature review-Research design-need for research design-features of a good design-important concepts relating to research design-different research designs

Technical Communication

Importance of Technical Communication-Salient features of Technical Communication - Technical communication Vs. General communication-Objectives and characteristics of Technical Communication-Levels of communication-Flow of communication-Visual Aids in Technical Communication-Types of Barriers to communication

Listening and Speech Techniques

Types of listening, listening with a purpose, barriers to listening, listening comprehension, effective listening strategies, listening in conversational interaction, team listening-Speech techniques-Conversation and oral skills, strategies for good conversation, techniques to develop effective word accent, word stress, primary and secondary stress, use of correct stress pattern, developing voice quality, developing correct tone.

Technical Reports and Proposals

Technical Reports- Importance of Reports- Objectives of Reports- characteristics of a report- categories of reports- formats- structure of reports- writing the report- first draft- revising, editing, and proofreading-Technical proposals- definition and purpose- types- sales proposals and research proposals- characteristics- structure of proposals- preparation, budgeting, presentation, funding agencies for engineering research- evaluation of proposals

Technical Papers and Descriptions

Types of technical papers - Journal papers, Conference papers, Survey papers, Poster papers, Review papers- Research Paper- Characteristics- Components- Technical Description- Guidelines for Writing Good Descriptions- Writing Technical Descriptions- Ethical Issues in Writing- Moral and Social Responsibilities- Responsibilities to Coauthors- Citations and Plagiarism- Copyright Issues- Permissions for Tables and Figures- Introduction to LATEX

REFERENCES:

1. Meenakshi Raman, Sangeeta Sharma, "Technical Communication-Principles and Practice", Oxford University Press, 2015
2. Kothari, C.R., "Research Methodology: Methods and Techniques". New Age International, 2014.
3. Alexander M. Novikov and Dmitry A. Novikov, "Research Methodology, From Philosophy of Science to Research Design", CRC Press, 2013
4. Raymond Greenlaw, "Technical Writing, Presentational Skills, and Online Communication: Professional Tools and Insights", IGI Global, 2012
5. Mike Markel, "Technical Communication", Bedford St. Martin's, 2016

COURSE OUTCOMES:

1. Understand the concept of Research Methodology and develop a preliminary research design for projects in the field of expertise
2. Know the significance of Technical communication
3. Familiarize with thedifferent types of Listening and Speech Techniques
4. Prepare technical reports and proposals as per guidelines
5. Implement the acquired knowledge in preparation of technical papers.

EMSEX0X	SOFT COMPUTING TECHNIQUES	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To give an insight to the students about the significance of soft computing techniques and artificial neural networks.
- To teach the importance, architecture, algorithm and application of artificial neural networks.
- To impart knowledge on fuzzy logic systems.
- To give exposure to genetic algorithm and swarm optimization methods.

Introduction and Artificial Neural Networks

Introduction of soft computing – Comparison of soft computing and hard computing – types and applications of soft computing techniques - Biological neural networks – Evolution of Neural Networks – Basic Models of Artificial Neural Networks –Terminologies of ANNs – Learning and Training the neural network – McCulloch-Pitts neuron model- Perceptron Model – Back propagation network.

Associative Memory and Unsupervisied Neural Networks

Auto associative and hetero associative memory in neural network - Discrete Hopfield network. Fixed weight competitive network – Self organizing network – Adaptive Resonance Theory- Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox.

Fuzzy Logic System

Introduction to Classical Sets and Fuzzy sets – Fuzzy set operation - approximate reasoning – extension principle - Fuzzy statements - Decomposition of compound rules. Fuzzification - Membership value assignments using intuition - Membership functions- Defuzzification - Fuzzy rule and knowledge bases - fuzzy logic controller - Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox.

Genetic Algorithm

Optimization – Traditional optimization methods – Concept of Evolutionary Algorithm – Genetic Algorithm – encoding and decoding of variables – GA operators – fitness function – fitness scaling - procedures of GA - flow chart of GA. Implementation of GA to power system optimization problem.

Swarm Optimization

Basic concept of Swarm intelligence - Ant colony optimization (ACO) - Particle swarm optimization (PSO) and Artificial Bee colony algorithm (ABC).Application of above algorithms in power system optimization problems.

REFERENCES:

1. LawreneFaussett, "Fundamental of neural networks", Prentice Hall, 2004.
2. Rajasekaran and VilyalakshmiPai G.A, "Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications", Prentice Hall, 2015
3. DorigoMarco Stützle Thomas, "Ant Colony Optimization", Prentice Hall India Learning Private Limited , 2004.
4. Russell C. Eberhart ,Yuhui Shi and James Kennedy, "Swarm Intelligence", Morgan Kaufmann, 1st edition, 2001.
5. Jesse Russell, Ronald Cohn, "Artificial Bee Colony Algorithm", Book on Demand Ltd., 2012

COURSE OUTCOMES:

1. Understand the concept, architecture, algorithm and application of various artificial neural networks.
2. Understand the process of the neural network training.
3. Acquire knowledge about fuzzy logic systems.
4. Able to implement genetic algorithm and swarm optimization methods for various embedded system optimization problems.
5. Able to use the MATLAB based fuzzy logic and neural network toolboxes.

EMSEX0X	INTERNET OF THINGS	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To understand the concepts of Internet of Things
- To conceptualize Cloud computing and Fog computing
- To familiarize with the IOT Services and protocols
- To gain knowledge on the Security and privacy in IoT
- To explore the application areas where IoT can be applied

Introduction

Definition-benefits-IoT architectures- a reference architecture-service-oriented architecture-API-oriented architecture-taxonomy of resource management activities in IoT-various protocols in IoT communication layers-IoT applications-challenges and research domains

IoT Services

Open IoT architecture and functionalities-scheduling process and IoT services lifecycle-workflow associated with the service registration process-update resources service-process of unregistering a service-scheduling and resource management

IoT Protocols

Standardization of protocol for IoT – efforts – M2M and WSN protocols – SCADA and RFID protocols – issues with IoT standardization – unified data standards – protocols -IEEE 802.15.4 – BACNet protocol – modbus – KNX – Zigbee architecture – network layer– APS layer – security

Programming Frameworks, Cloud and Fog Computing

Minimal features to be fulfilled-IoT programming approaches-existing IoT frameworks-highlights of various IoT programming frameworks-Cloud Computing and Fog computing-Principle of Cloud computing- Architecture-cloud computing Vs fog computing-definitions and characteristics of Fog Computing-reference architecture for fog computing-applications

Security and Privacy in IoT

IoT reference model-IoT security threats-IoT security requirements-taxonomy of security attacks, threats, and security mechanisms-network and transport layer challenges-IoT gateways and security-IoT routing attacks-bootstrapping and authentication-authorization mechanisms-security frameworks for IoT-privacy in IoT networks

REFERENCES:

1. RajkumarBuyya Amir VahidDastjerdi, *Internet of Things: Principles and Paradigms,* Morgan Kaufmann, 2016
2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer, 2011.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012
5. HakimaChaouchi, The Internet of Things- Connecting Objects to the Web, Wiley, 2010

COURSE OUTCOMES:

1. Acquire knowledge on IoT
2. Familiarize with IoT services
3. Analyze various protocols for IoT
4. Distinguish between cloud and Fog computing
5. Learn about the Security and privacy in IoT

EMSEX0X	INTELLECTUAL PROPERTY RIGHTS	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To provide an insight into the laws related to intellectual property
- To familiarize with the steps required for protecting, managing and enforcing intellectual property rights
- To study each field within the umbrella of intellectual property, namely, trademarks, copyright, patents, trade secrets and unfair competition.
- To address new and international developments for each of the fields of intellectual property.
- To encourage students at all levels to develop patentable technologies

Introduction to Intellectual Property Rights

Definition- Intellectual property vs. physical property-importance of Intellectual property - Types - International Organizations, Agencies and Treaties - History of Intellectual property rights(IPR) in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India

Copyright

Meaning of copyright- Classes of works for which copyright protection is available- The Rights Affordedby Copyright Law - Copyright Ownership,Transfers, and Duration- Copyright Registration- Copyright Infringement- powers of Copyright Board- The Copyright (Amendment) Bill, 2012- The Information Technology Act, 2000.-Internet and Copyright issues-Authorship under Copyright-Plagiarism-Detection and Consequences-Plagiarism policy and regulations

Patents and Designs

Definition- patentable and non-patentable inventions- Foundations of Patent Law- Patent Searches, Applications, and Post-IssuanceProceedings- Patent Ownership and Transfer- Patent Infringement- New Developments and International Patent Law- Patent System in India-Design-Need for registration of design-Essential requirements for registration of Design-Remedies against infringement-Design law in India

Trademark

Definition-Types-Functions- Trademark Selection and Searching- The Trademark Registration Process- Post registration – Maintenance and Transfer of Rights to Marks- Infringement- New Developments in Trademark Law- International Trademark Law-Trade Marks law of India-Trade Secrets law-Factors indetermination of trade secret status-remedies forMisappropriation

Intellectual Property Management

Definition-Need and importance- Overall management of IPRs - Generation of new inventions - Patent protection - Market watch - Management of non-registerable rights - Software - Other technical rights - Trade mark policy - IPR trading - Collaborations - Valuation - Encouraging innovation -Major IP Management Activities-5Cs model of managing IP

REFERENCES:

1. Deborah. E. Bouchoux, "Intellectual Property: The Law of Trademarks,Copyrights,Patents, andTrade Secrets", Cengage learning, 2013.
2. NeerajPandey and KhushdeepDhami, "Intellectual property rights", Prentice-Hall Inc., 2014.
3. N.S. Gopalakrishnan& T.G. Agitha, "Principles of Intellectual Property", Eastern Book Company, Lucknow, 2009.
4. Vivien Irish, "Intellectual Property Rights for Engineers", The Institution of Engineering and Technology, 2008.
5. S.R.A. Rosedar," Intellectual property rights",LexisNexis, 2016

COURSE OUTCOMES:

1. Understand the concept of Intellectual property rights.
2. Familiarize with the copyright laws.
3. Acquire knowledge on Patenting and Design.
4. Learn about Trademark and Trade secrets law.
5. Focus on Intellectual Property Management.