ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

M.E. Embedded Systems

(Two-Year Full Time & Three-year Part Time)

DEGREE PROGRAM

Choice Based Credit System

Regulations & Curriculum – 2017

HAND BOOK

2017

DEPARTMENT OF ELECTRICAL ENGINEERING

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

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 Program 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 Program 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 Programs 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 Programs 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 Program will be 65.

7. Duration of the Program

A student of **M.E / M.Tech**Program 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 Program) 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 Program, 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.TechPrograms, 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 Program 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 Program, 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.

ANNEXURE 1

Synod.	Department		Program (Full Time & Part time)	Eligible B.E./B. TechProgram
1	**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
2	**Civil Engineering**	i.	Environmental Engineering	B.E. / B.Tech – Civil Engg, Civil & Structural Engg, Environmental Engg, Mechanical Engg, Industrial Engg, Chemical Engg, BioChemical Engg, 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, Agricutural and irrigation Engg, Geo informatics, Energy and Environmental Engg.
3	**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.	
4	**Computer Science & Engineering**	i.	Computer Science & Engineering	B.E. / B.Tech - Computer Science and Engineering, Information Technology, Electronics and Communication Engg, Software Engineering
5	**Electrical Engineering**	i.	Embedded Systems	B.E. / B.Tech – Electrical and Electronics Engg, Control and Instrumentation Engg, Information technology, Electronics and communication Engg, Computer Science and Engg
		ii.	Power System	B.E. / B.Tech – Electrical and Electronics Engg,
6	**Electronics & Communication Engineering**	i.	Communication Systems	B.E. / B.Tech -Electronics and Communication Engg, Electronics Engg.

S.No.	Department		Program (Full Time & Part time)	Eligible B.E./B.TechProgram
7	**Electronics & Instrumentation Engineering**	i.	Process Control & Instrumentation	B.E. / B.Tech – Electronics and Instrumentation Engg, Electrical and Electronics Engg, Control and Instrumentation Engg, Instrumentation Engg, , Electronics and Communication Engg,
		ii.	Rehabilitative Instrumentation	B.E. / B.Tech – Electronics and Instrumentation Engg, Electrical and Electronics Engg, 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 Electronics Engg, Electronics and communication Engg, Control and Instrumentation Engg, Instrumentation Engg, Bio Medical Engg, Mechatronics, Telecommunication Engg
8	**Information Technology**	i	Information Technology	B.E. / B.Tech - Computer Science and Engineering, Information Technology, Electronics and Communication Engg, Software Engineering
9	**Mechanical Engineering**	iii.	Thermal Power	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Mechanical Engg (Manufacturing).
		iv.	Energy Engineering & Management	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Mechanical (Manufacturing) Engg, Chemical Engg
10	**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 and Industrial Engg.
		ii.	Welding Engineering	
		iii.	Nano Materials and Surface Engineering	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Manufacturing Engg, Production Engg, Marine Materials science Engg, Metallurgy Engg, Chemical Engg

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL ENGINEERING

M.E., EMBEDDED SYSTEMS PROGRAM

VISION

To develop the Department into a "Centre of Excellence" with a perspective to provide quality education and skill-based training with state-of-the-art technologies to the students, thereby enabling them to become achievers and contributors to the industry, society and nation together with a sense of commitment to the profession.

MISSION

M1: To impart quality education in tune with emerging technological developments in the field of Electrical and Electronics Engineering.

M2: To provide practical hands-on-training with a view to understand the theoretical concepts and latest technological developments.

M3: To produce employable and self-employable graduates.

M4: To nurture the personality traits among the students in different dimensions emphasizing the ethical values and to address the diversified societal needs of the Nation

M5: To create futuristic ambience with the state-of-the-art facilities for pursuing research.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: Envisage a solid foundation in Basic Sciences, Electrical and Electronics Engineering for a successful career and Life-long Learning in the fields of having Societal Implications.

PEO2: Design and implement effective solutions for complex Electrical and Electronics Engineering problems using modern tools and techniques.

PEO3: Establish Professionalism, Good Communication skills and ethical attitude in multi-disciplinary team work.

PEO4: Apply creative thinking and critical reasoning skills in collaborative research.

PEO5: Contribute to the economic growth of the country by creating job opportunities through entrepreneurship.

PROGRAM OUTCOMES (POs)

After the successful completion of B.E (Electrical and Electronics Engineering Engineering) Program the students will be able to:

PO1: Engineering Knowledge:

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2:Problem Analysis:

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/Development of Solutions:

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct Investigations of Complex Problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern Tool Usage:

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The Engineer and Society:

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and Sustainability:

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics:

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and Team Work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication:

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project Management and Finance:

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-Long Learning:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

At the time of graduation, the students will be able to:

PSO 1: Inculcate research attitude and develop innovative methodologies independently to solve Embedded System problems.

PSO 2: Inscribe and be exposed with significant technical reports / documents in the domain of Embedded System Engineering

PSO 3: Demonstrate an acceptable degree of mastery with an exposure to the state-of-the-art practices for employability / higher education.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
PEO 1	3	3	3	3		2					1	2	2	1	2
PEO 2	3	3	3	3	3					1			3	2	3
PEO 3	3	3	3	3	3							3	3		2
PEO 4						2	2	3	1	2	3				1
PEO 5					2	2	2	2	3	2	3			3	2

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**-FinalExam

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

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Codein M.E. FullTime
Semester – 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
	Semester – 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
	Semester – 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
	Semester – 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	Credit s	Equivalent Course Code in M.E. Full Time
	Semester – 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
	Semester – 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. **LSI 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 are as required in the field of study of powers ystems.
- 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 powe rsystems.

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' principle of optimality.

Statistics

Random variables-Distribution function-Density function - Variance and covariance-Stochastic process - Auto correlation and auto covariance – Cross correlation a n d 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 EngineeringMathematics", Wiley Eastern., 2015
6. Louis Pipes .Aand Hartill, "Applied Mathematics for Engineers and Physicists", McGraw Hill.,2014

COURSE OUTCOMES:

1. Enhance skills in Matrix operation to apply in embedded systemdomain.
2. Familiarize with Linear and nonlinear programmingmethods.
3. Acquire knowledge in handling situations involving random variables,random processes.
4. Able to solve some boundary valueproblems.
5. Acquire basic understanding of the most common partial differentialequations.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**1**										**3**		
CO2	**3**	**3**											**2**		
CO3	**2**	**3**	**2**	**3**	**2**								**3**	**2**	**1**
CO4	**2**	**3**	**2**	**2**	**1**								**3**	**1**	**2**
CO5	**2**	**3**	**2**	**2**	**1**								**3**	**1**	**1**

EMSC102	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To introduce the fundamentals of microcontroller-basedsystemdesign.
- To study the interfacing peripherals withmicrocontrollers.
- To learn the features, architecture and programming ofPIC.
- To introduce PIC peripheral systemdesign.
- To study on basic tool features for targetconfiguration.
- To give case study experiences for microcontroller-basedapplications.

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- Intervalconsiderations.

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 testalgorithm.

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-CCPmodules-ADC,DACandSensorInterfacing–FlashandEEPROMmemories.

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 notchfilter.

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 Education2011.
2. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ‘PIC Microcontroller Embedded Systems using Assembly and C for PIC18’, PearsonEducation 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 Hill2000.

COURSE OUTCOMES:

1. Understand the fundamentals of microcontroller systems and interface, and have the abilityto applythem.
2. Understand the architecture and capabilities of PICmicrocontroller.
3. Learn importance of PIC in designing embeddedapplication.
4. Learn use of hardware and software tools.
5. Develop interfacing to real world devices.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**										**2**		
CO2	**3**	**2**											**2**		
CO3	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**
CO4	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**
CO5	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**

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 is created and controlledwith RTOS.
- TostudyonprogramminglogicofmodelingandanalyzingRTS
- TostudyabouttheservicesrenderedbyRTOSinanapplication.
- To acquire knowledge about the common problems in developing anRTOS.
- To discuss the application development usingRTOS.

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, Synchronizationbetween 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 signaloperations.

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-Servicingthetimerinterruptinthetaskcontext-Timeouteventhandlers.

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, Managementunit.

Typical RTOS

Introduction to RT Linux, Real-Time Linux Applications in Embedded system, Common Design Problems - Deadlock, priority inversion problem, Embedded RTOS for fault-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 Introduction" 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 OperatingSystem.
2. It helps to understand the concept of real timeprogramming.
3. It gives an idea about the services rented by an RTOS in a developedapplication.
4. It describes about I/O and memory managementconcepts
5. It provides a concept to design and develop application usingRTOS.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2									2		
CO2	3	3	2	1									2		
CO3	3	3	2	2	2								2	3	3
CO4	3	3	2	2	2								2	2	1
CO5	3	3	2	2	1								3	2	1

		L	T	P
EMSC104	WIRELESS SENSOR NETWORKS	4	0	0

COURSE OBJECTIVES:

- To introduce the basic concepts in communication networksand the protocols used in thenetworks.
- To give an exposure to sensor networks and different architectures of Wireless Sensor Networks.
- To familiarize the students about the various multiple access techniques available in the communicationsystemsandintroducethedifferentclusteringalgorithmsforWSNs.
- To acquire knowledge on security management systems and security protocols for WSN and distributed sensorsystems.
- 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 – Ashconetworks – Clustering Algorithm – Leach – Teen –Peach Technique.

Security System

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

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 Madamhood, "Handbook of sensor networks, compact wireless andwired sensing systems", CRC press,2005.
2. KazemSohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Networks: Technology, Protocols, and Applications", John Wiley & SonsPublications,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/3Gnetworks.
2. Understand the characteristics, architectures and modeling ofWSNs.
3. Explain the concepts of multiple access techniques and the working of various clustering algorithms and their usefulness for routing inWSNs.
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.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											1		
CO2	3	2											1		
CO3	3	3	2	2	2								3	2	2
CO4	3	3	2	2	1								3	1	1
CO5	3	3	3	2	1								3	1	1

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

COURSE OBJECTIVES:

- To learn the working principles of 89C51 microcontroller, PIC and ARMProcessor.
- To understand the characteristics of real timesystems.
- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supportingPeripherals.
- To instruct the concepts of algorithm development & programming on software tools and micro Controllers with peripheralinterfaces.
- To practice through at least one of the subdivisions covered within experiments listed belowtoexposethestudentsintotherevisingtheconceptsacquiredfromtheorysubjects.

LIST OF EXPERIMENTS

1. Study ofMicrocontroller
   i. 89C51Microcontroller
   ii. PICMicrocontroller
   iii. Spartan-6 FPGAProcessor
   iv. ARM Processorand
   v. RM CORTEX-M4Processor

2. Applications of 89C51Microcontroller
   i. Frequency Measurement (ii)Stepper MotorControl

3. Interfacing with PIC 16F877 Microcontroller (i)I^2C Logic Based Character Display (ii)Realization of Real TimeClock

4. Applications of Spartan-6 FPGA Processor (i)Seven Segment LED Display (ii)Character LCDDisplay

5. Seven Segment LED Display using ARMProcessor

6. Analog to Digital Converter using ARMProcessor

7. Realization of Real Time Clock using ARMProcessor

8. Applications of ARM CORTEX-M4 Processor (i)Seven Segment LEDDisplay
(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 andARM Processors.
2. Identify and explain the operations of peripherals and memories typically interfaced with Processors.
3. Analyze instruction sets ofMicrocontroller, PIC and ARMProcessors.
4. Gain hands-on experience in doing experiments on Microcontroller, PIC and ARM Processors by using hardware kit in the laboratory and present thereport.
5. Students should understand the hardware/software tradeoffs involved in the design ofDSPProcessors.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2		2								3		3
CO2	2		2		3								3		3
CO3	3	2	2		3								2		3
CO4	3	2	2						1		1		2		3
CO5	2		2		3								3	2	2

		L	T	P
C201	RISC AND CISC PROCESSORS	4	0	0

COURSE OBJECTIVES:

- To acquire knowledge about the features of advancedprocessors.
- To study the architectures of CISCprocessor.
- To discuss on memory management, application development ofCISC processors.
- To discuss the architecture and instruction set of ARMprocessor.
- To learn the programming concept in ARMprocessor
- To study about ARMapplication.

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 cacheevaluation.

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 - Basicprograms.

ARM Architecture

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

ARM Programming

Basic Assembly language program -The ARM Programr'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 SwitchExtension.

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 designstrategies.
2. Introduces the recent advanced features in RISC and CISCprocessors.
3. Gives an idea about the instruction set in ARMprocessor
4. Explains the programming model in theprocessors.
5. Develops an overview about the application of the advancedprocessors.

1. Mapping with Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			1									2		
CO2	3		2										2		
CO3	3	3	2	2									3	2	2
CO4	3	3	2	2	2							3	3	1	1
CO5	3	3	2	2	1	3						3	3	1	1

EMSC202	EMBEDDED CONTROL SYSTEMS DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To provide a clear understanding on the basic concept of embedded controlsystem.
- To know the fundamentals of Real time operatingsystem.
- 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 embeddedcontroller.

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; MultitaskingSemaphores.

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 EmbeddedSystems-UsingAssemblyandCforPIC18",PearsonEducation,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 communicationsystem.
2. Design real time embedded systems using the concepts ofRTOS.
3. Explain and design of software for embeddedcontrol.
4. Implement the real-time operating systemprinciple.
5. Design simple A/D and D/A interfacecircuits.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**										**3**		
CO2	**3**	**2**	**3**	**2**									**3**		
CO3	**3**	**3**	**3**	**3**	**2**								**3**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**2**								**3**	**1**	**1**
CO5	**3**	**3**	**3**	**3**	**1**								**3**	**1**	**1**

EMSC203	DIGITAL INSTRMENTATION	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To obtain the subject knowledge and ability to use basic Data acquisition systemconcepts.
- To familiarize the students the functioning of different types of instrument communication, interfacing and datatransmission.
- 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 higherstudies.
- To promote student awareness of the lifelong learning and to introduce them to professional ethics and codes of professionalpractice.
- To prepare students for successful careers in industry that meets the needs of latest developments in industriesas employableprofessionals.

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 Acquisitionsystems.

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 systemconfiguration.

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 videodisplay.

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 Instrumentationconcepts.
2. An ability to design and conduct experiments as well as to organize, analyze and interpret data on multidisciplinarydomains.
3. Be able to identify problems in major issues of Instrument Communication Systems, analyze problems & solve them using the base of EmbeddedTechnology.
4. To provide guidance and to develop inter-process communication techniques based on hardware– software approaches for real time processautomations.
5. An ability to effectively communicate technical informationin speech, presentation, and inwriting.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1									2		
CO2	3	2											2		
CO3	3	3	2	2	1								3	1	1
CO4	3	3	2	2	1								3	1	1
CO5	3	3	2	2	1								3	1	1

EMSC204	ADVANCED DIGITAL SYSTEM DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES:

- Review the analysis and design of combinational logiccircuits.
- 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 logicdevices
- Study the different fault diagnosis and testmethods.

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 – Circuitrealization.

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 modecircuits.

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 Differencemethod – 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. NripendraNBiswas,"LogicDesignTheory"*PrenticeHall ofIndia*,Digitized(2007).
4. Parag K Lala, "Digital System design using PLD" *BS Publications*,2008.
5. M.MorrisMano & Michael D.Ciletti, " Digital Design" , *Pearson*, Fifth Edition,2013
6. Parag K Lala, "Fault tolerant and fault testable hardware design" *BSPublications*, 2002.

COURSE OUTCOMES:

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

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2								3		
CO2	3	3	3		1								3		
CO3	3	2	2	2	3								2	2	1
CO4	3	3	3	2	3								2	1	2
CO5	3	3	3	2	2								3	1	1

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 DSPProcessor.
- To explain embedded C language programmingtechniques.
- To explain the design of hardware interfacing circuits, Microcontroller and DSPProcessor system designconsiderations.

List of Experiments

1. Study of DSP and ARMProcessors
2. Graphics LCD Display using ARM processor LPC2148
3. Interfacing Real Time Clock and Serial port with ARM processor LPC 2148
4. Stepper motor control using ARM processor LPC 2148
5. DAC using Cortex M4 ARM Processor
6. Study of SPARTAN 6 FPGA Processor
7. Linear and Circular Convolution using DSP TMS320C6713Processor
8. Analog to Digital Conversion using DSP TMS320C5416 Processor
9. DigitaltoAnalogConversionusingDSPTMS320C6713Processor
10. Applications of DSP TMS320C6713Processor
    i. Low PassFilter
    ii. High PassFilter
    iii. Band PassFilter
    iv. Band RejectionFilter

COURSE OUTCOMES:

Upon completion of the course the student will be able to

i. Explain the architecture and operation of various ARM and DSP Processors.

ii. Identify and explain the operations of peripherals and memories typically interfaced with ARM and DSP Processors.

iii. Analyze instruction sets of LPC 2148,TMS320F2812, TMS320VC5416 and TMS320C6713 Processors.

iv. Gain hands-on experience in doing experiments on LPC 2148, TMS320F2812, TMS320VC5416 and TMS320C6713 Processor by using hardware kit in the laboratory and present the report.

v. Explain the hardware/software trade-offs involved in the design of ARM and DSP Processors.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2		2								3		3
CO2	2		2		3								3		3
CO3	3	2	2		3								2		3
CO4	3	2	2						1		1		2		3
CO5	2		2		3				2		2		3	2	2

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 oralpresentation
- ToacquiretheabilityofwritingtechnicalpapersforConferencesandJournals

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 minuteson 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 counsellorbased on the technical presentation and the report and also on the interaction shownduring theseminar

OUTCOMES:

1. The students will be getting the training to face the audience and to interact with the audience with confidence.
2. To tackle any problem during group discussion in the corporate interviews.
3. To enable the students capable of preparing reports based on what they have learnt in the industry
4. To make the students think in the direction of practical applications of their work.
5. To enable the students, understand the limitations of their ideas and make them find ways to overcome those limitations.

Mapping with Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2		2	2		1		1		2	2	2
CO2	2			2		2			1				2		2
CO3				2		2			1	2	1		2	1	1
CO4						1			2	2	1			1	1
CO5	2	2	2			1	1						1		1

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 withGuide/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 properjustification.
- To prepare and deliver presentation on the selected thesis topic ofresearch.
- To submit the duly certified progress report of Thesis work Phase – I in standard format for satisfactory completion of thework.

COURSE OUTCOMES:

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

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						3	1				1	1	2	
CO2	3	2	3	2	2			2					1		
CO3	2	1		1	1					1	1	2	2	1	
CO4	3									1	3				2
CO5	2									2					1

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

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 endof the training, the student has to submit a detailed report on the training he had, with in 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-voceexamination.

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.
3. The students will be getting the training to face the audience and to interact with the audience with confidence.
4. To tackle any problem during group discussion in the corporate interviews.
5. To enable the students capable of preparing reports based on what they have learnt in the industry

Mapping with Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2		2	2		1		1		2	2	2
CO2	2			2		2			1				2		2
CO3				2		2			1	2	1		2	1	1
CO4						1			2	2	1			1	1
CO5	2	2	2			1	1						1		1

EMST401	THESIS PHASE-II	L	T	P
		0	8	0

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

1. Identify the Embedded system problem
2. Analyze, design 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 Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3	3	3									2		
CO3	2			1	3								1		1
CO4	3							2		3				3	
CO5	2									3					3

EMSEX0X	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To study the analysis of discrete randomsignals.
- To study the digital filterdesign.
- To study the applications of adaptivefiltering.
- To study the analysis of speechsignals.
- To study the multi-rate signal processingfundamentals
- To introduce the various types oftransforms.

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 Datarecords - StochasticModels.

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 recursivesolution.

Multirate Signal Processing

Mathematical representation of change of the sampling rate - Interpolation and Decimation - Decimation by integer factor – Interpolation by an integer factory - Direct form FIR filterstructures – Single and multistage realization - Poly-phase realization – Application to subbandcoding.

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/Cole2004.

COURSE OUTCOMES:

Students should be able to:

1. To understand advanced digital signal processingalgorithms
2. To design adaptive filters for a givenapplication
3. To design multi-rate DSPsystems.
4. To understand decimation and interpolation of discrete-timesignals.
5. To understand advanced digital signal transforms and theiralgorithms

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**											**2**		
CO2	**3**	**3**	**3**	**2**									**2**		
CO3	**3**	**3**	**2**	**2**	**1**								**2**		
CO4	**3**	**3**	**2**	**3**	**2**								**3**	**2**	**2**
CO5	**3**	**3**	**2**	**3**	**2**								**3**	**1**	**1**

		L	T	P
EMSEX0X	DIGITAL IMAGE PROCESSING	4	0	0

COURSE OBJECTIVES:

- To understand the image fundamentals and mathematical transforms necessary for image processing.
- To understand about SamplingTechniques.
- To know different transform and various algorithms to evaluatethem
- To know the design of Digitalfilters
- To know different codingmethods
- To understand the image segmentationtechniques.

Digital Image Fundamentals and Image Transforms

Digital Image Fundamentals - Elements of digital image processing systems - Elements of visual perception –Image Sampling and Quantization - Neighbors 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- RestorationinthepresenceofnoiseonlySpatialFiltering-Inversefiltering–Wienerfiltering - 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 linkingand 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 - Clusteringmethods

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 imagewatermarking

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, 4thEdition, 2007.

COURSE OUTCOMES:

1. Explain different transform and various algorithms to evaluatethem
2. Implement the design of Digitalfilters
3. Implement the different codingmethods
4. Apply the basic concepts of Imagesegmentation,
5. Explain image recognitions and theapplications

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**	**1**									**2**		
CO2	**3**	**3**	**1**	**1**									**2**		
CO3	**3**	**3**	**2**	**2**	**1**								**2**	**2**	**2**
CO4	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**
CO5	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**

EMSEX0X	DISTRIBUTED EMBEDDED COMPUTING	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To expose the students to the fundamentals of Network Management, Security and CommunicationTechnologies.
- To understand the basics of internet with knowledge of internet serverinterfacing.
- To study Java basedNetworking.
- To get introduced to Embedded Network RoutingAgents
- To study the Networking on-chip real time multiprocessor embeddedsystems.

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 corporatedatabasesHTMLandXMLWebpagedesignandtheuseofactivecomponents.

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 - casestudies.

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, UniversitatPaderborn, Germany, Kluwer Academic Publishers,

Boston, April 2001, pp.248.
5. David Reilly,MichaelReily, “Java Network Programming And Distributed Computing”, Addison-WesleyProfessional,2002.
6. Mclaughlin, “Java & XML”, O’reilly Media, 3rd edition,2006.

COURSE OUTCOMES:

1. Explains various network (hardware andsecurity.
2. Explains basic concepts of internet database and webpagedesign.
3. Explains the distributed database computing using embeddedJava.
4. Describes the embedded agent design and operationmechanism.
5. Explains the real time multiprocessor distributed embeddedsystems

Mapping with Program Outcomes															
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	**3**	**2**	**1**	**1**									**2**		
CO 2	**3**	**3**											**2**		
CO 3	**3**	**3**	**2**	**2**	**1**								**3**		
CO 4	**3**	**3**	**2**	**2**	**2**								**2**	**2**	**2**

EMSEX0X	MEDICAL INSTRUMENTATION SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To understand basics of measurementsystem.
- To understand the concept of various biomedical instruments andtechnologies.
- To acquire knowledge about sensing devices used in biomedicalinstruments.
- To understand the biomedical instruments used inhospitals.
- To discuss about the reduction of noise in biomedicalinstruments.
- To obtain basic knowledge on medical imagingsystems.

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 patientsafety.

Sensing Devices for Biomedical Instruments

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

MeasurementSystems

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 TompkinsAlgorithm

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,IncNoida. 4th 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, 4th 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 BiomedicalInstruments.
2. Acquires knowledge about Electrodes, Sensors and Transducers for biomedical signal acquisition
3. GivesanideaaboutECG,EEGandEMGrecordingtechniquesandtheirinstrumentation
4. Helps to know about signal processing and filtering techniques for noise and artifact removal.
5. Describes the modern medical imaging modalities andinstruments

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**	**1**									**3**		
CO2	**3**	**3**	**1**	**1**									**2**		
CO3	**3**	**3**	**2**	**2**	**2**								**3**	**2**	**2**
CO4	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**
CO5	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**

EMSEX0X	FPGA BASED EMBEDDED SYSTEM DESIGN	L	T	P
		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 – TransistorParasiticCapacitance–Logicaleffort–Librarycelldesign–Libraryarchitecture.

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/Oblocks.

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 TimeClock.

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 theweb).

COURSE OUTCOMES:

1. Underlying fundamental concepts of VLSI have been broughtout.
2. Memory management and input/output technology of various processors have been pointedout.
3. Architecture of various processors have beenunderstood.
4. Softwares for the processors have beenlearnt.
5. Some basic design examples using VLSI processors have beendescribed.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**											**2**		
CO2	**3**	**2**											**2**		
CO3	**3**	**2**	**2**	**2**	**1**								**2**	**1**	**1**
CO4	**3**	**3**	**2**	**2**	**1**								**3**	**2**	**2**
CO5	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**

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 andimplementation.
- The evolution and growth of integrated circuit, the methods of layout and the different approaches for their design are to bediscussed.
- A detailed study of the fabrication techniques is to be made. Analysis of analogand digital VLSI circuits is to be carried out. The need for application of specific devices and their features along with examples are to bedealt.
- 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 moreprecisely.

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 &CMOScircuits - Simple layout examples - Sheet resistance, area capacitance, wiring capacitance - Dry capacitiveloads.

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/Dconverters.

Digital VLSI

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

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 andConditioning.

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" McGrawHill 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 McGrawHill,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 designconcepts
2. Understand various fabrication process technologies used in VLSIdevices.
3.Be able to analyze and design CMOS analog IC building blocks like MOS amplifiers,
4.Current mirrors and multistage differentialamplifiers
5. Be able to analyze and design CMOS digital IC building blocks

Mapping with Program Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1									2		
CO 2	3	2	1	2									3		
CO 3	3	2	2	2	2								3	2	2
CO 4	2	3	2	2	1								3	2	1
CO 5	3	3	2	2	1								3	1	1

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 surroundingthem.
- To know the major classes, components and applications of MEMS devices/systems andto demonstrate an understanding of the fundamental principles behind the operation of thesedevices/systems.
- To learn Bulk micromachining process and to understand the concept of different etching process and etching materials in fabricationprocess.
- To impart knowledge about surface micromachining process and to understand the types and concept of bondingprocess.
- To study and design of different types of MEMS actuators, Micro grippers, MEMS resonators and theirapplications.

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 wafertypes.

Bulk Micro Machining

Wet etching of silicon-Isotropic etching-anisotropic etching, alkali hydroxide etchants-ammonium hydroxide- tetramethyl ammoniumhydroxide (TMAH)-ethylene diaminepyrochatechol (EDP)-ultrasonic agitation in wet etching stop layers fordopant elective etchants. Porous-silicon formation – anistrophic wet etching of porous aluminum-anistrophicwetetching-quartz-vapourphaseetches.RIElaserdrivenbulkprocessing.

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 lessplating.

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 sacrificialprocesses.

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, CenageLearning,2nd edition2012.
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 andsystems.
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 anisotropicetching.
4. Analyze semiconductor materials for common micro components anddevices.
5. Understanding the types of bonding process and the techniques used for sacrificial process.
6.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1									2		
CO2	3	2	1	2									3		
CO3	3	2	2	2	2								3	2	2
CO4	3	3	2	2	1								3	1	1
CO5	3	3	2	2	1								3	1	1

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

COURSE OBJECTIVES:

- To expose the students to the fundamentals of embeddedProgramming.
- 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 indepth.
- The syllabus also covers the topic ‘scripting languages for embeddedsystems’.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employabilityskills.

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 – FlashMemory.

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 embeddedCprograms.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 andQueues - 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 Embeddedsystems.

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 – ErrorsandExceptions–Functions–Modules–ClassesandOOP–ExecutionEnvironment.

Embedded Software Development Tools

Host and target machines – Linkers / Locators for Embedded Software – Debugging techniques–InstructionsetsimulatorsLaboratorytools–Practicalexample–Sourcecode.

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:

- The learning process delivers insight into various programming languages / softwares compatible to embedded process development with improved design & programming skills.
- Develop advanced programs in EmbeddedC.
- Get knowledge in data structure andOOP.
- Develop programs using scriptinglanguages.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systemsdesign.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**	**1**									**3**		
CO2	**3**	**3**	**1**	**1**									**2**		
CO3	**3**	**3**	**2**	**2**	**1**								**2**	**2**	**2**
CO4	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**
CO5	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**

EMSEX0X	ROBOTICS AND AUTOMATION	L	T	P
		4	0	0

COURSE OBJECTIVES:

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

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 Bearingscrews.

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. WemerDepperand Kurt Stoll, "Pneumatic Application", KemprathReihe, Vogel BuchVerlagWurzbutg,1987.
5. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An IntegratedApproach",EasternEconomyEdition,PrenticeHallofIndiaPvt.Ltd.,2006.
6. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press,2001.

COURSE OUTCOMES:

1. Explain the basic concepts of working ofrobot.
2. Analyze the function of manipulators in therobot.
3. Use robots in differentapplications.
4. Knowledge of industrial automation by transfer lines and automated assemblylines.
5. Ability to understand the electronic control systems in metal machining and other manufacturingprocesses.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**	**1**									**3**		
CO2	**3**	**2**											**2**		
CO3	**2**	**3**	**2**	**2**	**1**								**2**	**2**	**2**
CO4	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**
CO5	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**

EMSEX0X	EMBEDDED PRODUCT DEVELOPMENT TECHNOLOGY	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To understand basics of product design anddevelopment.
- To acquire knowledge about testingmethodologies.
- To understand the basic concepts of product development based on its reliability, cost, robustness
- To discuss about the need for CAE, CAD, CAM, IDEtools in product design.
- To obtain basic knowledge on industrialdesign.
- To understand the concept of developing products in an embeddedsystem.

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 - componentStandardization.

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-productperformanceanalysis-IndustrialDesign-RobustDesign–TestingMethodologies.

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 CruiseController, 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 andtesting.
2. Provides an idea for designing a consumer specificproduct.
3. Gives knowledge up gradation on recent trends in embedded systemsdesign.
4. Describes the economic analysis and the consideration while designinga product.
5. Helps to improve the integration of customer requirementsin product design.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1									3		
CO2	3	2	1	2									2		
CO3	3	3	3	2	2								3	2	2
CO4	3	2	2	2	1								3	1	1
CO5	3	3	2	2	1								3	1	1

EMSEX0X	SCADA FOR EMBEDDED APPLICATIONS	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To understand basics ofSCADA.
- To understand the concept of various components involved withSCADA.
- To acquire knowledge about SCADA communicationprotocols.
- To study about monitoring and control techniques related toSCADA.
- To obtain basic knowledge implementation of SCADA in embeddedsystems.
- To learn about the application of SCADA in Embeddedsystem.

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), CommunicationNetwork,SCADAServer,SCADAControlsystemsandControlpanels.

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. WilliamT.Shaw,"CybersecurityforSCADAsystems",PennWellBooks,2006.
4. DavidBaileyandEdwinWright,"PracticalSCADAforindustry",Newnes,2003
5. Stuart G. Mccrady, "Designing SCADA application software: A practical approach", Elsevier, 1st edition,2013.

COURSE OUTCOMES:

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

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**											**3**		
CO2	**3**	**3**	**3**	**2**									**2**		
CO3	**3**	**3**	**2**	**2**	**3**								**1**	**3**	**3**
CO4	**3**	**3**	**2**	**2**	**2**								**3**	**1**	**1**
CO5	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**

EMSEX0X	WIRELESS MOBILE COMMUNICATION	L	T	P
		4	0	0

COURSE OBJECTIVES:

- Expose the students to the fundamentals of wireless communicationtechnologies.
- Teach the fundamentals of cellularconcepts.
- Study the concepts of mobile radiopropagation.
- Explore various modulation techniquesused.
- Introduce network routingprotocols.
- Study the various multiple accesstechniques.

Introduction

Brief history of wireless communication - elements of wireless communication systems- radio frequency spectrum and bandwidth requirements - Universal MobileCommunicationSystems- Personal Communication systems- emerging trends in wireless communications Wireless systems and standards: AMPS and ATACS systems- 2G, 2.5G, 3G and B3G systems andstandards.

Cellular Concept

Frequency Reuse – Channel Assignment and Handoff Strategies – Interference and System Capacity – Trunkingand 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 BudgetDesign.

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 PathChannels.

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) - PacketRadio.

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 pointedout.
3. Architecture of various mobile radio models have beenunderstood.
4. Various mobile radio modulation techniques have beendescribed.
5. Different access techniques have beenlearnt.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											2		
CO2	3	2	1	1									2		
CO3	3	2	2	2	1								3	2	21
CO4	3	3	2	2	2								3	1	1
CO5	3	3	2	2	2								3	1	1

EMSEX0X	CLOUD COMPUTING	L	T	P
		4	0	0

COURSE OBJECTIVES:

- To know the principles of cloudcomputing.
- To study the various cloud servicemodels
- To understand the basics ofvirtualization
- To familiarize with the programming models available incloud
- To get an insight on some applications and prospects of cloudcomputing

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-PublicCloud-Community Cloud-Hybrid Cloud

Virtualization

Introduction- Virtualization Opportunities- Processor Virtualization- Memory Virtualization Storage Virtualization - Network Virtualization - Data VirtualizationApplicationVirtualization - 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-MapReduce --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 gridapplications

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 theClouds.

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 cloudcomputing
2. Familiarize with thecloud services offered by thecompanies
3. Understand the concept ofVirtualization.
4. Discuss the suitability of each programming model to different kinds ofapplication
5. Identify the areas of application and explore futureprospects.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**										**2**		
CO2	**2**	**3**											**2**		
CO3	**2**	**3**	**2**	**2**	**1**								**3**	**2**	**1**
CO4	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**
CO5	**3**	**3**	**2**	**2**	**1**								**3**	**1**	**1**

		L	T	P
EMSEX0X	OPTIMIZATION TECHNIQUES	4	0	0

COURSE OBJECTIVES:

- To introduce the fundamental concepts of optimizationtechniques.
- To acquire sound knowledge of obtaining optimal solutions to the power system problems with the help of different mathematicaltechniques.
- To understand various algorithms with their comparative study for the utilization of optimization problemsolution.
- To analyse the concepts of various classical and modern methods for constrained and unconstrainedproblems.
- To gain in-depth knowledge about variety of performance measures for optimization problems applied in the engineeringfields.

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-Tuckerconditions.

Geometric Programming and Integer Programming

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

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 McGrawHill, 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 optimizationproblem.
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 andmultivariabledomains.
4. Apply the methods of optimization in practicalconditions.
5. Analyze a research problem having requirement of optimizationtechniques.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2			2			2		3	2	2
CO2	3	2						2			2		2		
CO3	3	2	2	3	3			2			2		3		
CO4	3	2	2	2	2			2			2		2	2	
CO5	3	2	2					2			2		2	2	2

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 validstudy
- To explore the techniques of defining a research problem and investigate the various research designs, highlighting their maincharacteristics
- To familiarize with the art of TechnicalCommunication
- To study the different types of Listening and SpeechTechniques
- Torealizetheartofwritingtechnicalreportsandproposals
- Tounderstandtheethicalissuesofwritingtechnicalpapers

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 researchdesigns

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 correcttone.

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, andOnline 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 ofexpertise
2. Know the significance of Technicalcommunication
3. Familiarize with thedifferent types of Listening and SpeechTechniques
4. Prepare technical reports and proposals as perguidelines
5. Implement the acquired knowledge in preparation of technicalpapers.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2			2			2		3	2	2
CO2	3	2						2			2		2		
CO3	3	2	2	3	3			2			2		3		
CO4	3	2	2	2	2			2			2		2	2	
CO5	3	2	2					2			2		2	2	2

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 neuralnetworks.
- To teach the importance, architecture, algorithm and application of artificial neural networks.
- To impart knowledge on fuzzy logicsystems.
- To give exposure to genetic algorithm and swarm optimizationmethods.

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 propagationnetwork.

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 Networktoolbox.

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 logictoolbox.

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 optimizationproblem.

SwarmOptimization

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 optimizationproblems.

REFERENCES:

1. LawreneFaussett, "Fundamental of neural networks", Prentice Hall,2004.
2. RajasekaranandVilyalakshmiPaiG.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 neuralnetworks.
2. Understand the process of the neural networktraining.
3. Acquire knowledge about fuzzy logicsystems.
4. Able to implement genetic algorithm and swarm optimization methods for various embedded system optimizationproblems.
5. Able to use the MATLAB based fuzzy logic and neural networktoolboxes.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**3**		**1**								**2**		
CO2	**3**	**3**	**3**		**1**								**2**		
CO3	**3**	**3**	**3**		**1**								**2**		
CO4	**3**	**2**	**3**		**1**								**2**		
CO5	**3**	**3**	**3**		**1**								**2**		

		L	T	P
EMSEX0X	INTERNET OF THINGS	4	0	0

COURSE OBJECTIVES:

- To understand the concepts of Internet ofThings
- To conceptualize Cloud computing and Fogcomputing
- To familiarize with the IOT Services andprotocols
- To gain knowledge on the Security and privacy inIoT
- To explore the application areas where IoT can beapplied

Introduction

Definition-benefits-IoT architectures- a reference architecture-service-oriented architecture-API-oriented architecture-taxonomy of resource management activities in IoT-various protocolsinIoTcommunicationlayers-IoTapplications-challengesandresearchdomains

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 RFIDprotocols–issueswithIoTstandardization–unifieddatastandards–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 inIoT

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 IoTnetworks

REFERENCES:

1. RajkumarBuyyaAmirVahidDastjerdi,*InternetofThings:PrinciplesandParadigms,*
2. Morgan Kaufmann, 2016
3. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.
4. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer,2011.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley,2012
6. HakimaChaouchi,TheInternetofThings-ConnectingObjectstotheWeb,Wiley,2010

COURSE OUTCOMES:

1. Acquire knowledge onIoT
2. Familiarize with IoTservices
3. Analyze various protocols forIoT
4. Distinguish between cloud and Fogcomputing
5. Learn about the Security and privacy inIoT
6.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**													
CO2	**3**	**2**	**2**	**2**										**2**	
CO3	**3**	**2**	**2**	**2**										**2**	**2**
CO4	**3**		**2**	**2**										**2**	**2**
CO5	**3**	**2**	**2**	**2**										**2**	

EMSEX0X	INTELLECTUAL PROPERTY RIGHTS	L	T	P
		4	0	0

COURSE OBJECTIVES:

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

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 andregulations

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 inIndia

Trademark

Definition-Types-Functions- Trademark Selection and Searching- TheTrademark 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-LawofTrademarks,Copyrights,Patents, andTrade Secrets", Cengage learning,2013.
2. NeerajPandeyand 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 propertyrights.
2. Familiarize with the copyrightlaws.
3. Acquire knowledge on Patenting andDesign.
4. Learn about Trademark and Trade secretslaw.
5. Focus on Intellectual PropertyManagement.

Mapping with Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		3			3	2						2	
CO2	3	2	2	3		3	3	2		3			3	2	
CO3	3	3	2	3	2		2			3			3	2	
CO4	3	3		3		2	3			3			3	2	3
CO5	3	2	3	2	2	3	2	1		2			3	1	3