Scheme of Instruction & Examination
M.E / M.Tech Four Semester Course (Regular) 2015-2016

S.No.	Subject	Periods per Week		Duration	Max. Marks		C
		L/T	D/P	(Hours)	SEE	CIE	
			SEMESTER – I				
1.	Core	3	--	3	70	30	3
2.	Core	3	--	3	70	30	3
3.	Core / Elective	3	--	3	70	30	3
4.	Core / Elective	3	--	3	70	30	3
5.	Core / Elective	3	--	3	70	30	3
6.	Core	3	--	3	70	30	3
7.	Lab – I	--	3	--	--	50	2
8.	Seminar – I	--	3	--	--	50	2
	Total	18	6	--	480	220	22
			SEMESTER – II				
1.	Core	3	--	3	70	30	3
2.	Core	3	--	3	70	30	3
3.	Core / Elective	3	--	3	70	30	3
4.	Core / Elective	3	--	3	70	30	3
5.	Core / Elective	3	--	3	70	30	3
6.	Core	3	--	3	70	30	3
7.	Lab – II	--	3	--	--	50	2
8.	Seminar – II	--	3	--	--	50	2
	Total	18	6	--	480	220	22
			SEMESTER – III				12
1.	Dissertation + Project Seminar*	--	6	--	--	100**	8
			SEMESTER –IV				
1.	Dissertation	--	--	Viva-voce	Grade***		**64**

Note: Six core Subjects and Six Elective subjects should be completed by the end of Semester – II.

* One Project Seminar presentation.

** 50 marks to be awarded by guide and 50 marks to be awarded by Viva committee with guide and two internal faculty members.

*** Excellent / Very Good /Good/ Satisfactory / Unsatisfactory.

(i) Theory question paper have total 7 questions out of which candidate has to answer 5 questions including one compulsory question of 30 Marks. This compulsory question, consisting of 6 to 10 questions, which will cover the entire syllabus. Other questions will be of 15 marks each.

(ii) Sessional marks 30 are based on 2 class tests (each weightage 10 marks). Performance of both the tests will be taken into account.

CIE : Continuous Internal Evaluation SEE : Semester End Examination

SCHEME OF INSTRUCTION & EXAMINATION
M.E / M.Tech Six Semester Course (Part Time) 2015-2016

S.No.	Subject	Periods per Week		Duration	Max. Marks		C
		L/T	D/P	(Hours)	SEE	CIE	
				SEMESTER – I			
1.	Core –I	3	--	3	70	30	3
2.	Core / Elective	3	--	3	70	30	3
3.	Elective	3	--	3	70	30	3
4.	Lab – I /Seminar-I	--	3	--	--	50	2
				SEMESTER – II			
1.	Core –I	3	--	3	70	30	3
2.	Core / Elective	3	--	3	70	30	3
3.	Elective	3	--	3	70	30	3
4.	Lab – I /Seminar-I	--	3	--	--	50	2
				SEMESTER – III			
1.	Core –I	3	--	3	70	30	3
2.	Core / Elective	3	--	3	70	30	3
3.	Elective	3	--	3	70	30	3
4.	Lab – I /Seminar-I	--	3	--	--	50	2
				SEMESTER – IV			
1.	Core –I	3	--	3	70	30	3
2.	Core / Elective	3	--	3	70	30	3
3.	Elective	3	--	3	70	30	3
4.	Lab – I /Seminar-I	--	3	--	--	50	2
				SEMESTER – V			12
1.	Dissertation + Project Seminar*	--	6	--	--	100**	8
				SEMESTER –VI			
1.	Dissertation	--	--	Viva-voce	Grade***		**64**

Note: Six core Subjects and Six Elective subjects should be completed by the end of Semester-IV.

* One Project Seminar presentation.

** 50 marks to be awarded by guide and 50 marks to be awarded by Viva committee with guide and two internal faculty members.

*** Excellent / Very Good /Good/ Satisfactory / Unsatisfactory.Theory question paper have total 7 questions out of which candidate has to answer 5 questions including one compulsory question of 30 Marks. This compulsory question, consisting of 6 to 10 questions, which will cover the entire syllabus. Other questions will be of 15 marks each.Sessional marks 30 are based on 2 class tests (each weightage 10 marks). Performance of both the tests will be taken into account. **CIE : Continuous Internal Evaluation SEE : Semester End Examination**

List of Subjects for ME (ECE) Course (Regular/Part-Time) with Specialization in EMBEDDED SYSTEMS AND VLSI DESIGN w.e.f. 2015 -2016

S.No	Syllabus Ref. No	Subject	Periods per week
Core Subjects			
1	EC 4401	Embedded Systems Design	3
2	EC 4402	Embedded Systems Programming	3
3	EC 4403	Analog and Mixed Signal IC Design	3
4	EC 4404	Principles of VLSI System Design	3
5	EC 4405	VLSI Physical Design	3
6	EC 4406	Operating Systems for Embedded Systems	3
8	EC 4407	Laboratory-I	3
9	EC 4408	Laboratory-II	3
9	EC 4409	Seminar – I	3
10	EC 4410	Seminar – II	3
11	EC 4411	Project Seminar	3
12	EC 4412	Dissertation	--
Elective Subjects			
13	EC 4413	Satellite Navigation Systems	3
14	EC 4414	VLSI Technology	3
15	EC 4415	Microwave Integrated Circuits	3
16	EC 4216	Optimization Techniques	3
17	EC 4416	Numerical Methods in Engineering	3
18	EC 4417	CPLD & FPGA Architectures and Applications	3
19	EC 4426	DSP Processors – Architecture	3
20	EC 4418	Scripting Languages for VLSI Design Automation	3
21	EC 4120	Low Power VLSI Design	3
22	EC 4420	MEMS	3
23	EC 4223	VLSI Signal Processing	3
24	EC 4421	Software Defined Radio	3
25	EC 4118	Open CL Programming for Advanced Graphic Processors	3
26	EC 4224	Engineering Research Methodology	3

Note: Core of one specialization can be elective for other specialization provided condition for prerequisite is satisfied. However, prior permission of the Chairman is to be obtained. This is also applicable to electives.

EC 4401

EMBEDDED SYSTEMS DESIGN

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Introduction to Embedded Systems and design life cycle:
Introduction to embedded systems, Embedded design life cycle, Product Specification, Hardware/Software Partitioning, Iteration and Implementation, Detailed Hardware and Software Design, Hardware/Software Integration, Product Testing and Release, Maintaining and Upgrading Existing Products.

UNIT II
The Selection Process:
Packaging the Silicon, Adequate Performance, RTOS Availability, Tool Chain Availability, Other Issues in the Selection Process.

UNIT – III
Embedded hardware units:
Embedded devices in a system, The 8051 Microcontroller, architecture, timers and counters, interrupts, serial communication, real world interfacing with LCD, stepper motor and ADC.

UNIT – IV
The Partitioning Design:
Hardware/Software Duality, Hardware Trends, ASICs and Revision Costs, The Execution Environment, Memory Organization, System Startup.

UNIT – V

A Basic Toolset:
Host-Based Debugging, Remote Debuggers and Debug Kernels, ROM Emulator, Logic Analyzer, Bullet -Proof Run Control, Real-Time Trace, Hardware Breakpoints, Overlay Memory.

Suggested Reading

1. Arnold Berger, *Embedded Systems Design*, First South asian edition
2. Raj Kamal, *Embedded Systems – Architecture Programming and Design*, second edition, McGraw Hill
3. David E Simon, *An Embedded Software primer*, Low Price Edition, Pearson Education.

EC 4402

EMBEDDED SYSTEMS PROGRAMMING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Embedded Systems Programming in FPGA:
Embedded System Design Strategies: Microcontroller/DSP/FPGA, FPGA Design Flow, Embedded System Programming in FPGA, Project Design Flow, Overview of Verilog Modeling styles: Structural, Data Flow, Behavioral and switch level Modeling of digital system. Tasks and Functions, Test bench Design Timing Delays, Static timing analysis: Setup time & hold time violations and clock skew and Case studies

UNIT II

Embedded Systems Programming in CISC Micro-controller:
Overview of Intel 8051 Architecture, instruction set, Basic Programming: Assembly Language and C programming, I/O port programming, Timer, UART and Interrupt Programming.

UNIT III

Embedded Systems Programming in RISC Micro-controller: ARM Part I:
ARM architecture versions, Core Architecture, Register Organization, AMBA bus architecture, Instruction Set of ARM, Thumb Instruction set, Cache memory, Introduction to µVision IDE, Memory Accelerator Modulator, Interrupt Programming, GIC

UNIT IV

Embedded Systems Programming in ARM Part II:
Timer Programming, PWM, RTC and Watch dog Timer, Interfaces: UART, I2C, SPI, JEDEC, Memory Management Unit

UNIT V

Embedded Systems Programming with Real Time World Interface:
ADC, DAC, LED, LCD, Stepper Motor and Sensors

Suggested Reading:

1. Ming-Bo Lin., *Digital System Designs and Practices Using Verilog HDL and FPGAs*, Wiley India, 2008.
2. Samir Palnitkar, *Verilog HDL: A Guide to Digital Design and Synthesis*, Pearson Education, 2005.
3. Mohammad Ali Mazidi, Rolin D McKinley, Janice G Mazidi, The 8051 *Microcontroller and Embedded Systems*, Second Edition, Prentice Hall
4. Andrew N.Sloss, Domnic Symes, Chris Wright, *ARM system developers guide*, Elsevier publications.

EC 4403

ANALOG AND MIXED SIGNAL IC DESIGN

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Building Blocks of Opamp:

MOS Transistor – Nanometer Transistor and its model – body effect, Channel Length Modulation and short channel effects – velocity saturation, sub-threshold conduction, threshold voltage control, drain induced barrier lowering, gate induced drain leakage, Complete MOS Transistor Model and large and small signal models of BJTs and MOSFETs.

Current Mirrors and Single Stage Amplifiers – Simple CMOS current mirror, common source amplifier, source follower, common gate amplifier, cascode amplifiers. Source de-generated current mirrors, cascode current mirror, cascode gain stage and MOS differential pair and gain stage.

Biasing and References – Analog IC biasing, establishing constant trans-conductance and band-gap reference – Positive and negative temperature coefficient basics and circuits.

UNIT II

Basic Opamp and Compensation:

Basic two-stage MOS Operational amplifier, characteristic parameters, compensation, design and analysis of two-stage MOS opamp with given specifications. Stability and frequency compensation of op-amps.

UNIT – III

Operational Trans-conductance Amplifier (OTA):

Advanced current Mirrors – Wilson current mirror, Enhanced output-impedance current mirror and gain boosting and wide swing current mirror with enhanced output impedance and bipolar current mirrors – bipolar gain stages. **Single stage Opamp** – Folded-cascode opamp, current mirror opamp, fully differential opamp and common mode feedback circuits.

UNIT – IV

Applications of Opamp

Comparators: Op-Amp Based Comparators, Charge Injection Errors – Latched Comparators – CMOS and BiCMOS Comparators – Bipolar Comparators. **Switched capacitor circuits:** Basic building blocks; basic operation and analysis, inverting and non inverting integrators, signal flow diagrams, first order filter. **Sample and hold circuits** - Performance requirements, MOS sample and hold basics, clock feed through problems, S/H using transmission gates, high input impedance S/H circuits, improved S/H circuits from the point of slewing time, clock feed through cancellations.

UNIT – V

Mixed Signal IC Applications:

Data Converters – Review of Nyquist-Rate A/D and D/A converters, Oversampling converters – Over sampling without noise shaping and with noise shaping, system architectures and digital decimation filters. **Phase locked loops** – simple PLL, charge pump PLL and dynamics of PLL.

Suggested Reading

1. Tony Chan Carusone, David Johns and Ken Martin, Analog Integrated Circuit Design, 2nd edition, John Wiley & sons. 2013.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill Companies, 2013.
3. Philip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, 2nd edition, Oxford UniversitPress, 2010.

EC 4404

PRINCIPLES OF VLSI SYSTEM DESIGN

Instruction	3 Periods per week	University Examination – Duration	3 Hours
Sessionals	30 Marks	University Examination – Marks	70 Marks

UNIT I

Introduction to VLSI System design hierarchical design, Design abstraction, different levels of abstraction and domains. Computer aided design VLSI design flow, technology implications and economics, issues connected with technology defect densities yield and die size, components of chips cost.

UNIT II

Static and dynamic CMOS circuits, circuit characterizations and performance estimation: Resistance, Capacitance and Inductance, delay estimations power dissipation static and dynamic, design margining, reliability issues.

UNIT III

Differential CMOS circuits. Static CMOS digital latches, static random-access memory cell, DRAM cell, dynamic CMOS latches, synchronous system design techniques, gray-code counter, Bi-CMOS logic gates. Pseudo-nMOS and dynamic pre-charging. Domino-CMOS logic, no race logic, single-phase dynamic logic, differential CMOS logic, dynamic differential logic**.**

UNIT IV

CMOS design methods: Structured design strategies, Hierarchy, regularity modularity, chip design options: Programmable logic, logic structures, gate arrays. Sea-of-gate and gate array design, standard cell based designs- standard cell libraries design re use-full custom mark design.

UNIT V

CMOS sub system design: Adders and Subtractors, fast adders like carry by pass carry select and carry look ahead adders, Transmission Gate adder, Multipliers, array and fast multiplers, Parity Generators, Zero-One Detectors, Binary Counters, Multiplexers, shifters, memory elements.

Suggested Reading:

1. Weste Kamran Eshraghian, Principles of CMOS VLSI design-a Systems Perspective by Neilhe, Pearson Education Series, Asia, 2002.
2. Wolf, Modern VLSI Design, Pearson Education Series, 2002.
3. Jean M. Rabey, " Digital Integrated Circuits", Prentice Hall India, 2003
4. Ken Martin, Digital Integrated Circuit Design Oxford University Press 2000.

EC 4405

VLSI PHYSICIAL DESIGN

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Scope of physical design, Components of VLSI, Various layers of VLSI, Typical structures of BJTS, MOSFETS, Resistors, capacitors, inductors, interconnects, brief review of technology, cost and performance analysis.

UNIT II

Basic concepts of Physical Design, layout of basic structures wells, FET, BJT, resistors, capacitors, contacts, vias and wires (Interconnects). Mask overlays for different structures. Parasitics, latch up and its prevention. Device matching and common centroid techniques for analog circuits

UNIT III

Design rules, fabrication errors, alignment sequence and alignment inaccuracies, process variations and process deltas, drawn and actual dimensions and their effect on design rules– scalable design rules. Scalable CMOS (SCMOS) design rules, layout design, and stick diagrams, Hierarchical stick diagrams.

UNIT IV

Cell concepts, cell based layout design, Weinberger image array, physical design of logic gates – NOT, NAND and NOR – design hierarchies. System level physical design, large scale physical design, interconnect delay modeling, floor planning, routing and clock distribution.

UNIT V

CAD Tools: Layout editors, Design rule checkers, circuit extractors, Hierarchical circuit extractors, Automatic layout tools, modeling and extraction of circuit parameters from physical layout. Input-Output Interfacing: Power Supply, Bonding pad, Pad Ring, Input structures, Digital output structures, Low Voltage Differential swing, Power clamp, Core/Pad Limitation, Signal Propagation between Integrated Circuits.

Suggested Reading:

1. John P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley & sons, Inc.2012.
2. Wayne Wolf "Modern VLSI Design (System-on-Chip), Pearson Education, 3rd Edition 2005.
3. R. Jacob Baker; Harry W.Li., David E. Boyce, CMOS Circuit Design, Layout and Simulation, IEEE Press, Prentice Hall of India.
4. Etienne Sicard Sonia Delmas Bendhia "Advanced CMOS Cell Design" Tata McGraw Hill First Edition 2007.
5. Preas, M. Lorenzatti, "Physical Design and Automation of VLSI Systems", the Benjamin – Cummins Publishers, (1998).

EC 4406

OPERATING SYSTEMS FOR EMBEDDED SYSTEMS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT - I

Operating systems overview:

Operating system objective and functions, the evolution of operating system, major achievements developments leading to modern operating system, Microsoft windows overview, traditional Unix systems.

UNIT-II

Real time system concepts:

Differences between desktop o.s and rtos, foreground/background systems, critical sections of code, resources, multitasking, context switches, kernels,schudelers, mutual exclusion, deadlock synchronization, inter task communication, message queues isr processing time, non-maskable interrupts, memory requirements, advantages and disadvantages of real-time kernels.

UNIT-III

Os programming concepts:

Input/output, programs process, error handling, user identification, system calls and library functions in microc os: creating a task, task stacks, deleting a task changing a tasks priority, suspending and resuming a task.

UNIT-IV

Inter process communication:

Semaphore management: creating and deleting a semaphore, waiting on a semaphore, signaling a semaphore, getting a semaphore without waiting, obtaining the status of semaphore.

Mutual exclusion semaphores: creating and deleting a mutex, waiting on a mutex, signaling a mutex, getting a mutex without waiting, obtaining the status of a mutex, message queue management: creating, deleting a message queue sending a message to a queue(fifo), flushing a queue, using a queue as a counting semaphore.

UNIT-V

Network IPC sockets:

Introduction, socket descriptors, addressing, communication establishment, data transfer, socket options out of band data, non-blocking and asynchronous IO.

Suggested Reading:

1. William stallings,Operating Systems, fifth edition,Pearson publications.
2. Jean J Labrosse, Micro c/os II – The Real Time Kernel, second edition, CMP books
3. W. Richard Stevens,UNIX Network Programming - inter process communication, Volume 2, second edition, Prentice Hall.

EC 4407

LABORATORY-I

Instruction	3 Periods per week	University Examination – Duration	-
Sessionals	50 Marks	University Examination – Marks	-

Note: all the experiments are to be carried out independently by each student with different specifications. At least 12 experiments are to be carried out.

(i) Design and simulation of combinational circuits

(ii) Design and simulation of sequential circuits

(iii) Design and simulation of mixed signal circuits

(iv) Microcontroller programming

a. Toggling the LEDs,

b. serial data transmission,

c. LCD and Key pad interface

EC 4408

LABORATORY-II

(synthesis, backend and embedded systems laboratory)

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	50 Marks	University Examination - Marks	-

Note: all the experiments are to be carried out independently by each student with different specifications. Atleast 12 experiments are to be carried out.

(i) Synthesis of combinational circuits (4 to 6 MSI digital blocks).

(ii) Synthesis of sequential circuits (4 to 6 MSI digital blocks).

(iii) Schematic simulation, layout, DRC, LVS, parasitic extraction for cells (inverter, NAND gate, NOR gates).

(iv) Programming using real time operating systems

a. Multi tasking using round robin scheduling

b. IPC using message queues

c. IPC using semaphore

d. IPC using mail box

EC 4409

SEMINAR - I

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	50 Marks	University Examination - Marks	-

Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

i) Literature survey
ii) Organization of the material
iii) Presentation of OHP slides / LCD presentation
iv) Technical writing

Each student required to:

Submit a one page synopsis before the seminar talk for display on the notice board.

Give a 20 minutes time for presentation following by a 10 minutes discussion.

Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule shall not be entertained.

For award of sessional marks, students are to be judged by at least two faculty members on the basis of an oral and technical report preparation as well as their involvement in the discussions.

EC 4410

SEMINAR - II

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	50 Marks	University Examination - Marks	-

Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

i) Literature survey
ii) Organization of the material
iii) Presentation of OHP slides / LCD presentation
iv) Technical writing

Each student required to:

. Submit a one page synopsis before the seminar talk for display on the notice board.

Give a 20 minutes time for presentation following by a 10 minutes discussion.

Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule shall not be entertained.

For award of sessional marks, students are to be judged by at least two faculty members on the basis of an oral and technical report preparation as well as their involvement in the discussions.

EC 4411

PROJECT SEMINAR

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	100 Marks	University Examination - Marks	-

The main objective of the Project Seminar is to prepare the students for the dissertation to be executed in 4th semester. Solving a real life problem should be focus of Post Graduate dissertation. Faculty members should prepare the project briefs (giving scope and reference) at the beginning of the 3rd semester, which should be made available to the students at the departmental library. The project may be classified as hardware / software / modeling / simulation. It may comprise any elements such as analysis, synthesis and design.

The department will appoint a project coordinator who will coordinate the following:

- Allotment of projects and project guides.
- Conduct project - seminars.

Each student must be directed to decide on the following aspects

- Title of the dissertation work.
- Organization.
- Internal / External guide.
- Collection of literature related to the dissertation work.

Each student must present a seminar based on the above aspects as per the following guidelines:

Submit a one page synopsis before the seminar talk for display on the notice board.

Give a 20 minutes presentation through OHP, PC followed by a 10 minutes discussion.

Submit a report on the seminar presented giving the list of references.

Project Seminars are to be scheduled from the 3rd week to the last week of the semester.

The internal marks will be awarded based on preparation, presentation and participation.

EC 4412

DISSERTATION

Instruction	--	University Examination - Duration	--
Sessionals	--	University Examination - Marks	Grade+

The students must be given clear guidelines to execute and complete the project on which they have delivered a seminar in the 3rd semester of the course.

All projects will be monitored at least twice in a semester through student's presentation. Sessional marks should be based on the grades/marks, awarded by a monitoring committee of faculty members as also marks given by the supervisor.

Efforts be made that some of the projects are carries out in industries with the help of industry coordinates.

Common norms will be established for documentation of the project report by the respective department.

The final project reports must be submitted two weeks before the last working day of the semester.

The project works must be evaluated by an external examiner and based on his comments a viva voice will be conducted by the departmental committee containing of HOD, two senior faculty and supervisor.

+ Excellent /Very Good / Good/Satisfactory / Unsatisfactory

EC 4413

SATELLITE NAVIGATION SYSTEMS

Instruction	3 periods per week	University Examination – Duration	3 Hours
Sectionals	30 Marks	University Examination - Marks	70 Marks

UNIT – I

GPS fundamentals: Trilaiteration, Transit, Introduction and Heritage of NAVSTAR GPS, GPS principle of operation, architecture, operating frequencies, orbits, Keplerian elements, GPS and UTC Time.

UNIT-II

GPS Signals: Signal structure, C/A and P-Code, ECEF and ECI coordinate systems and WGS 84, Operation of Generic GPS receiver functional block diagram, Types of GPS Receivers: Dual, Single frequency code, carrier smoothed, code & carrier receivers.

UNIT-III

GPS Errors: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, multipath, Dilution of Precision, Spoofing and Anti-spoofing, GPS Modernization program: objectives, future satellites and new signals, RINEX Navigation and Observation data formats

UNIT-IV

Other Constellations and Augmentation systems: Other satellite navigation constellations, operation of Satellite based augmentation systems, Wide area augmentation system (WAAS) architecture, GAGAN and Local area augmentation system (LAAS) concept.

UNIT-V

GNSS Navigation Applications: Land Vehicle Navigation and Tracking, Marine applications, Applications of GNSS to Air Traffic Control, Surveying, Mapping and Geographical Information Systems, Military and Space.

Suggested Reading:

1. B.Hofmann Wollenhof, H.Lichtenegger, and J.Collins, “GPS Theory and Practice”, Springer Wien, New York, 2000.
2. Pratap Misra and Per Enge, “Global Positioning System Signals, Measurements, and Performance,” Ganga-Jamuna Press, Massachusetts, 2001.
3. Ahmed El-Rabbany, “Introduction to GPS,” Artech House, Boston, 2002.
4. Bradford W. Parkinson and James J. Spilker, “Global Positioning System: Theory and Applications,” Volume II, American Institute of Aeronautics and Astronautics, Inc., Washington, 1996.
5. Elliot D. Kaplan, “Understanding GPS Principles and Applications”, Artech House Boston,1996.
6. A.Leick, “GPS Satellite Surveying”, John Wiley and sons, 1990.

EC 4414

VLSI TECHNOLOGY

Instruction	3 periods per week	University Examination – Duration	3 Hours
Sectionals	30 Marks	University Examination - Marks	70 Marks

UNIT – I

Introduction – Integrated Circuits Review of history of VLSI technology progress–. Electronic Functions – Components – Analog and Digital ICs. Basic Devices in ICs – Structures Resistors – Capacitors – Inductors. Diodes – Bipolar Junction Transistors – Field Effect Transistors, Isolation techniques in MOS and bipolar technologies.

UNIT-II

Monolithic ICs – Silicon as the Base Material and its advantages, various Layers of ICs – Substrate – Active Layer -Oxide/Nitride Layers – Metal/Poly Silicon Layers – Functions of Each of the Layers. Process Flow for Realization of Devices. Description of Process Flow for Typical Devices viz., FET and BJT.

UNIT-III

Silicon Wafer Preparation – Electronic Grade Silicon – CZ and FZ Methods of Single Crystal Growth – Silicon Shaping – Prefabrication Processes. Epitaxy: Growth Dynamics – Process Steps, Vapor phase, Solid phase and Molecular Beam Epitaxial Processes, Oxide Growth: Structure of SiO2, Growth Mechanism and Dynamics – Oxide Growth by Thermal method.

UNIT-IV

Deposition techniques Chemical Vapor Deposition (CVD), PVD thermal evaporation and sputtering, Lithography: Steps involved in Photolithography – Quality of the Pattern – photo resists and their characteristics, X-ray – Electron Beam Lithography. Etching: Chemical, Electro Chemical – Plasma (Dry Etching) Reactive Plasma Etching.

UNIT-V

Ion implantation: Range and Penetration Depth – Damage and Annealing – Ion Implantation machine. Diffusion: Constant and Infinite Source Diffusions – Diffusion Profiles – Diffusion Systems – Multiple Diffusions and Junction Formations, Packaging: die and Bonding and Packaging, Testing.

Suggested Reading:

1. VLSI Technology, S.M. Sze, Mc Grawhill International Editions.
2. VLSI Technology, CY Chang and S.M. SZe , Tata Mc Graw-Hill Companies Inc.
3. The Silicon VLSI Technology Fundamentals, Practice and modeling, J.D.Plummer, M.D.Deal and P.B.Griffin , Pearson Education 2009
4. The Science and Engineering of Microelectronic Fabrication , Stephen A, Campbell Oxford 2001

EC 4415

MICROWAVE INTEGRATED CIRCUITS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

MIC Technology – Thick film and Thin film technology. Hybrid MIC's. Monolithic MIC technology.

UNIT II

Analysis of stripline and microstripline. Method of conformal Transformation. Characteristic parameters of strip. Microstrip lines. Microstrip Circuit Design. Impedance transformers. Filters, Lumped constant Microstrip circuits.

UNIT III

Coupled Microstrips and Directional couplers. Even and odd mode analysis. Theory of couled microstrip Directional couplers. Calculations for a coupled pair of Microstrips. Branch line couplers.

UNIT IV

Lumped Elements for MIC's Design and fabrication of lumped elements, circuits using lumped elements.

UNIT V

Nonreciprocal components for MIC's Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters. Design of microstrip circuits – high power and low power circuits.

Suggested Reading:

1. Gupta KC, and Amarjit Singh, Microwave Integrated circuits, Wiley Eastern,1974.
2. Leo Young, Advances in Microwaves, Academic Press.
3. Bharathi Bhat,and S.K. Koul"stripline-like transmission lines for microwave integrated circuits, New age international ,2007.

EC 4216

OPTIMIZATION TECHNIQUES

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Use of optimization methods. Introduction to classical optimization techniques, motivation to the simplex method, simplex algorithm, sensitivity analysis.

UNIT II

Search methods - Unrestricted search, exhaustive search, Fibonocci method, Golden section method, Direct search method, Random search methods, Univariate method, simplex method, Pattern search method.

UNIT III

Descent methods, Gradient of function, steepest decent method, conjugate gradient method. Characteristics of constrained problem, Direct methods, The complex method, cutting plane method.

UNIT IV

Review of a global optimization techniques such as Monte Carlo method, Simulated annealing and Tunneling algorithm.

UNIT V

Generic algorithm - Selection process, Crossover, Mutation, Schema theorem, comparison between binary and floating point implementation.

Suggested Reading:

1. SS Rao, “Optimization techniques”, PHI, 1989.
2. Zhigmiew Michelewicz, “Genetic algorithms + data structures = Evaluation programs”, Springer Verlog - 1992.
3. Merrium C. W., “Optimization theory and the design of feedback control systems”, McGraw Hill, 1964.
4. Weldo D.J., “Optimum seeking method”, PHI, 1964.

EC 4416

NUMERICAL METHODS IN ENGINEERING

Instruction	3 Periods per week	University Examination – Duration	3 Hours
Sessionals	30 Marks	University Examination – Marks	70 Marks

UNIT I

Solution of transcendental and polynomial equations – Newton – Raphson method, Chebyshev Method, Birge – Victa Method, Bairstow's method.

UNIT II

Interpolation for functions of a single variable – Newton's divided differences interpolation, Lagrange's interpolation, Newton's forward and backward interpolation, Stirling's Central differences interpolation. Bivariate interpolation – Lagrange's and Newton's formulas.

UNIT III

Eigen values and eigen vectors of a matrix – power method, Jacobi's method. Solution of systems of linear equations – Gauss – Jordan method, Gauss – Seidel iteration Method.

UNIT IV

Numerial differentiation, Numerical integration – Newton – Cotes formula, Trape Zoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Gaussian quadrature – Gauss – Legendre quadrature formula.

UNIT V

Numerical solution of ordinary differential equations – Runge – Kutta fourth order method, Adams – Bashforth methods, Adams – Moulton's methods, Milne's Predictor – Corrector method. Classification of partial differential equations – Finite difference schemes for one dimensional heat equation and Laplace's equations. Numerical solution of Integral equations – Finite difference methods for solving Fredholm's integral equation.

Suggested Reading:

1. Raja raman: Numerical Methods Prentice Hall of India, 3rd ed. (1995).
2. S.S. Sastry: Introductiory methods of Numerical Analysis, PHI., 1995.
3. M.K. Jain, S.R.K. Iyengar and R.K. jain: Numerical Methods for Scientific and Engineering Computation-Wiley Eastern, 1990.

EC 4417

CPLD & FPGA ARCHITECTURES AND APPLICATIONS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination – Marks	70 Marks

UNIT I

Programmable logic: Programmable read only memory (prom), programmable logic array (pla), programmable array logic (pal). Sequential programmable logic devices (splds). Programmable gate arrays (pgas), CPLD and FPGA, design flow using FPGA, programming technologies.

UNIT II

FPGAs: Field Programmable Gate Arrays – Logic blocks, routing architecture, Logic cells and features of commercially available FPGA's- XILINX XC4000, virtexII FPGA's, XILINX SPARTAN II, Alteras Act1, Act2, Act3 FPGA's, Actel FPGA's, AMD FPGA.

UNIT III

CPLD's: complex programmable logic devices, logic block, I/O block, interconnect matrix, logic blocks and features of altera flex logic 10000 series CPLD's , max 7000 series CPLD's, AT & T– ORCA's (Optimized Reconfigurable Cell Array), cypres flash 370 device technology, lattice plsi's architectures.

UNIT IV

Placement: objectives, placement algorithms: Mincut-Based placement, iterative improvement placement,simulated annealing.

Routing: objectives, segmented channel routing, Maze routing, Routability estimation, Net delays, computing signal delay in RC tree networks.

UNIT V

Digital Front End and back End tools for FPGAs & ASICs, FPGA implementation steps. Verification: introduction, logic simulation, design validation, timing verification. Testing concepts: failures, mechanisms and faults, fault coverage, ATPG methods, programmability failures.

Suggested Reading:

1. P.K. Chan & S. Mourad, Digital Design Using Field Programmable Gate Array, Pearson Education 2009.
2. S. Trimberger, Edr., Field Programmable Gate Array Technology, Kluwer Academic Publications, 1994.
3. J. Old Field, R. Dorf, Field Programmable Gate Arrays, John Wiley & Sons, Newyork, 1995.
4. S. Brown, R. Francis, J. Rose, Z.Vransic, Field Programmable Gate array, Kluwer Publn, 1992.
5. Manuals from Xilinx, Altera, AMD, Actel.

EC 4226

DSP PROCESSORS – ARCHITECTURE

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Introduction to DSP Processors: Differences between DSP and other p architectures, their comparison and need for special ASP[s], RISC & CISC CPUs.

UNIT II

Overview of DSP processor design: fixed point DSP[s] – Architecture of TMS 320C 5X, C54X Processors, addressing modes, Assembly instructions, Pipelining and on-chip peripherals. Floating point DSP[s]: Architecture of TMS 320 – IX.

UNIT III

Data formats, F.P. operations, addressing modes, instructions, pipelining and peripherals.

UNIT IV

DSP interfacing & software development tools: I/O interfacing with A/D converters, PC[s] , Dual port RAM[S], EPGA[s], DSP tools – Assembler, debugger, c-compiler, linker, editor, code composer studio.

UNIT V

Applications using DSP[s] adaptive filtering, spectrum analysis, Echo cancellation modems, voice synthesis and recognition. Brief ideas of AD, Motorola DSP CPU[s] and their comparison with TI CPU[S].

Suggested Reading:

1. C. Marren & G. Ewess, "A Simple Approach to Digital Signal Processing", WILEY Inter-science (1996).
2. K. Shin, "DSP Applications with TMS 320 Family", Prentice Hall (1987).
3. B. Ventakaramani, M. Bhaskar, "Digital Signal Processes, Architecture Processing and Applications", Tata Mc Graw Hill (2002).

EC 4418

SCRIPTING LANGUAGES FOR VLSI DESIGN AUTOMATION

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

Unit-I Linux Basics and Scripting Languages Overview

Introduction to Linux, File System of the Linux, General usage of Linux kernel & basic commands, Permissions for file, directory and users, Searching a file & directory, zipping and unzipping concepts, Introduction and overview of scripting languages.

Unit –II PERL Basics

PERL basics, file handles, operators, control structures, regular expressions, built in data types, operators, statements and declarations- simple, compound, loop statements, global and scoped declarations, Pattern matching - regular expression, pattern matching operators, character classes, positions, capturing and clustering.

Unit III PERL Programming

Lists and Hashes, Subroutines- syntax, semantics, proto types, format variables, references, data structures- arrays of arrays, hashes of arrays, hashes of functions.

Inter process communication, - signals, files, pipes, sockets. PERL debugger. Process Model, Thread Model.

Unit IV TCL / TK Scripting

Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Evel, Working With UNIX, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by Examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and Listbox Widgets Focus, Grabs and Dialogs

Unit V PYTHON Scripting

Introduction to Python, Using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour of the Standard Library.

Suggested Reading

1. Larry Wall, Tom Christiansen, John Orwant, "Programming PERL", Oreilly publications, 3rd ed.
2. Randal L, Schwartz Tom Phoenix, "Learning PERL," Oreilly publications.
3. Python Tutorial by Guido van Rossum, and Fred L. Drake, Jr., editor, Release 2.6.4
4. Practical Programming in Tcl and Tk by Brent Welch , Updated for Tcl 7.4 and Tk 4.0

EC 4120

LOW POWER VLSI DESIGN

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT-I

Introduction and need of low power design, sources of power dissipation, MOS transistor leakage components, SOI technology, FinFET, Back gate FET, power and energy basics, power dissipation in CMOS circuits, Energy-delay product as a metric, design strategies for low power.

UNIT-II

Power Estimation Techniques: Circuit Level – Modeling of Signals, Signal Probability Calculations, Statistical techniques; High Level Power Analysis – RTL Power Estimation, Fast Synthesis, Analytical Approaches, Architectural Power Estimation.

UNIT-III

Power Optimization Techniques – I: Dynamic Power Reduction – Dynamic Power Component, Circuit Parallelization, Voltage Scaling Based Circuit Techniques, Circuit Technology – Independent Power Reduction, Circuit Technology Dependent Power Reduction; Leakage Power Reduction – Leakage Components, Design Time Reduction Techniques, Run-time Stand-by Reduction Techniques, Run-time Active Reduction Techniques Reduction in Cache Memories.

UNIT-IV

Power Optimization Techniques – II: Low Power Very Fast Dynamic Logic Circuits, Low Power Arithmetic Operators, Energy Recovery Circuit Design, Adiabatic – Charging Principle and its implementation issues.

UNIT-V

Software Design for Low Power: Sources of Software Power Dissipation, Software Power Estimation, Software Power Optimizations, Automated Low-Power Code Generation, Co-design for Low Power.

Suggested Reading:

1. Low-Power CMOS VLSI Circuit Design, Kaushik Roy and Sharat Prasad, Wiley Inter-science Publications, 2000.
2. Low Power CMOS Circuits Technology, Logic Design and CAD Tools, 1st Indian Reprint, Christian Piguet, CRC Press, 2010.
3. Low Power Design Essentials, 1st Edition, J. Rabaey, Springer Publications, 2010.

EC 4420

MEMS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Introduction, Basic Structures of MEM Devices – (Canti Levers, Fixed Beams diaphragms). Broad Response of MEMS to Mechanical (force, pressure etc.) Thermal, Electrical, Optical and Magnetic stimuli, Compatibility of MEMS with VLSI Applications in Electronics, Broad Advantages and Disadvantages of MEMS from the point of Power Dissipation, Leakage etc.

UNIT II

Review of Mechanical Concepts like Stress, Strain, Bending Moment, Deflection Curve. Differential equations describing the Deflection under Concentrated Force, Distributed Force, Deflection Curves for Canti Levers – Fixed beam. Electrostatic Excitation – Columbic Force between the Fixed and Moving Electrodes. Deflection with voltage in C.L, Deflection Vs Voltage Curve, Critical Deflection, Description of the above w.r.t. Fixed Beams. Fringe Fields – Field Calculations using Laplace Equation. Discussion on the Approximate Solutions – Transient Response of the MEMS.

UNIT III

Two Terminal MEMS – capacitance Vs Voltage Curve – Variable Capacitor. Applications of Variable Capacitors. Two Terminal MEM Structures. Three Terminal MEM structures – Controlled Variable Capacitors – MEM as a Switch and Possible Applications

UNIT IV

MEM Circuits & Structures for Simple GATES – AND, OR, NAND, NOR, Exclusive OR, simple MEM Configurations for Flip-Flops Triggering, Applications to Counters, Converters. Applications for Analog Circuits like Frequency Converters, Wave Shaping. RF Switches for Modulation. MEM Transducers for Pressure, Force Temperature. Optical MEMS.

UNIT V

MEM Technologies: Silicon Based MEMS – Process Flow – Brief Account of Various Processes and Layers like Fixed Layer, Moving Layers, Spacers etc., Etching Technologies. Metal Based MEMS: Thin and Thick Film Technologies for MEMS. PROCESS flow and Description of the Processes. Status of MEMS in the Current Electronics scenario.

Suggested Reading:

1. Gabriel.M. Reviez, R.F. MEMS Theory, Design and Technology, Thon Wiley & Sons, 2003.
2. Strength of Materials – by Thimo Shenko, CBS Publishers & Distributors.
3. K. Pitt, M.R. Haskard – Thick Film Technology and Applications, 1997.
4. Wise K.D. (Guest Editor),"Special Issue of Proceedings of IEEE", Vol.86, No.8, Aug 1998.
5. Ristic L. (Ed.) Sensor Technology and Devices, Artech House, London 1994.
6. Thick and Thin Films in Microelectronics by Business Co., Inc, Staff, 1990.
7. IEEE Transactions on MEMS and IEEE Transactions on Electron devices.

EC 4223

VLSI SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT – I

Introduction to DSP: Typical DSP algorithms, DSP algorithms benefits, Representation of DSP algorithms. Pipelining and Parallel Processing: Introduction, Pipelining of FIR Digital filters, Parallel Processing, Pipelining and Parallel Processing for Low Power, Retiming: Introduction – Definitions and Properties – Solving System of Inequalities – Retiming Techniques

UNIT – II

Folding and Unfolding, Folding : Introduction -Folding Transform - Register minimization Techniques – Register minimization in folded architectures – folding of multirate systems, Unfolding: Introduction – An Algorithm for Unfolding – Properties of Unfolding – critical Path, Unfolding and Retiming – Applications of Unfolding

UNIT – III

Systolic Architecture Design: Introduction – Systolic Array Design Methodology – FIR Systolic Arrays – Selection of Scheduling Vector – Matrix Multiplication and 2D Systolic Array Design – Systolic Design for Space Representations contain Delays

UNIT – IV

Fast Convolution: Introduction – Cook-Toom Algorithm – Winogard algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection

UNIT – V

Low Power Design: Scaling Vs Power Consumption –Power Analysis, Power Reduction techniques – Power Estimation Approaches, Programmable DSP : Evaluation of Programmable Digital Signal Processors, DSP Processors for Mobile and Wireless Communications, Processors for Multimedia Signal Processing

Suggested Reading:

1. VLSI Digital Signal Processing- System Design and Implementation – Keshab K. Parthi, 1998, Wiley Inter Science.
2. VLSI and Modern Signal processing – Kung S. Y, H. J. While House, T. Kailath, 1985, Prentice Hall.
3. Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing – Jose E. France, Yannis Tsividis, 1994, Prentice Hall.
4. VLSI Digital Signal Processing – Medisetti V. K ,1995, IEEE Press (NY), USA.

EC 4421

SOFTWARE DEFINED RADIO

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Introduction to Software Defined Radio:

A Traditional Hardware Radio Architecture**,** Signal Processing Hardware History, Software Defined Radio Project Complexity.

A Basic Software Defined Radio Architecture:2G Radio Architectures, Hybrid Radio Architecture, Basic Software Defined Radio Block Diagram, System Level Functioning Partitioning,Digital Frequency Conversion Partitioning.

UNIT II

RF System Design:

Introduction- Noise and Channel Capacity, Link Budget, Receiver Requirements, Multicarrier Power Amplifiers, Signal Processing Capacity Tradeoff.

UNIT III

Analog-to-Digital and Digital-to-Analog Conversion:

Digital Conversion Fundamentals, Sample Rate, Bandpass Sampling, Oversampling- Antialias Filtering, Quantization, ADC Techniques-Successive Approximation, Figure of Merit-DACs, DAC Noise Budget, ADC Noise Budget.

UNIT IV

Digital Frequency Up- and Down Converters:

Introduction- Frequency Converter Fundamentals, Digital NCO, Digital Mixers, Digital Filters, Halfband Filters, CIC Filters,Decimation, Interpolation, and Multirate Processing,DUCs, Cascading Digital Converters and Digital Frequency Converters.

UNIT V

Hardware and Software Components:

SDR Requirements for Processing Power- DSPs- DSP Devices- DSP Compilers- Reconfigurable Processors- Adaptive Computing Machine- FPGAs, Major Software Architecture Choices, Hardware – Specific Software Architecture, Software Standards for Software Radio, Software Design Patterns, Component Choices, Real Time Operating Systems, High Level Software Languages, Hardware Languages.

Suggested Reading:

1. Paul Burns, Software Defined Radio for 3G, Artech House, 2002.
2. Tony J Rouphael, RF and DSP for SDR, Elsevier Newnes Press, 2008
3. Jouko Vanakka, Digital Synthesizers and Transmitter for Software Radio, Springer,2005.

EC 4118

OPEN CL PROGRAMMING FOR ADVANCED GRAPHIC PROCESSORS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessional	30 Marks	University Examination - Marks	70 Marks

UNIT I

Overview of Pipelining and Instruction Level Parallelism. Introduction to Multi-processors, Shared memory architecture, Multi-threading, Interconnection networks and clusters. Architecture of recent CPUs and GPUs: Intel Dual and Quad core processors, NVDIA Fermi and AMD Fusion processors.

UNIT II

Programming with MPI and GPU: Introduction: General MPI programs, MPI_Send and MPI_Recv, Collective Communication: Tree-structured communication, Broadcast, Reduce and other collective communication, programming model of GPU: Thread, Memory, Hierarchy, Host and Device, Software stack, and computer capability and Example of Matrix Multiplication using MPI and GPU.

UNIT III

OpenCL programming on CPU/GPU/APU: Software and hardware overview. OpenCL for GPU/APU processor, memory access and architecture, communication between Host and GPU, device scheduling, terminology, programming model, and example programs.

UNIT IV

Building and running OpenCL programs on GPU/APU: compiling, running calling conventions, predefined macros, debugging, setting the environment and breakpoint, and sample GDP session.

UNIT V

OpenCL Applications on GPU/APU: Examples of applications in Electromagnetic Estimations, Digital Signal Processing, Video Processing and Image Processing.

Suggested Readings:

1. John L. Hennessy and David A. Patterson, "Computer Architecture – A Quantitative Approach," 3rd Edition, Elsevier Publications, 2003.
2. Peter S Pacheco, "Parallel Programming with MPI," 1st Edition, Morgan Kaufmann Publishers, 1997.
3. AaftabMunshi, Benedict R. Gaster, Timothy G. Mattson and James Fung, "OpenCL Programming Guide," Addison Wesley Professional Publications, 2011
4. Benedict Gaster, Lee Howes, David R. Kaeli, Perhaad Mistry and Dana Schaa, "Heterogeneous Computing with OpenCL," Morgan Kaufmann Publications, 2011.
5. AMD Accelerated Parallel Processing OpenCL Programming Guide, 2011.

EC 4224

ENGINEERNG RESEARCH METHODOLOGY

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessional	30 Marks	University Examination - Marks	70 Marks

UNIT-I

Research Methodology:

Objectives and Motivation of research- types of research- Research approaches – Significance of Research-Research Methods versus Methodology-Research and Scientific method- Importance of research methodology – Research process- criteria of good research- Problems encountered by Researchers in India-benefits to society in general.

Defining Research Problem:

Definition of research problem- problem formulation- necessity of defining the problem- techniques involved in defining a problem.

UNIT-II

Literature Survey: Importance of Literature Survey-Sources of information-Assessment of Quality of journals and articles-Information through internet. Literature Review: Need of Review- Guidelines for Review-Record of Research Review.

UNIT-III

Research Design: Meaning of research design - need of research design- features of a good design- important concepts relating to research design- different research designs- Basic Principles of experimental designs- Developing a Research plan- Design of experimental set-up-Use of standards and codes.

UNIT-IV

Exploration of data: Analysis of data- Role of statistics for data analysis –Functions of statistics- Estimation of population parameters –Parametric vs non-parametric methods- Descriptive statistics- Point of central tendency- Measures of variability- Inferential statistics- estimation- Hypothesis testing – Use of statistical software.

Data Analysis : Deterministic data and random data- uncertainty analysis – tests for significance – Ch-square test- Student's 't' test- Regression modeling-ANOVA-F test- Time series analysis- Autocorrelation and Autoregressive modeling.

UNIT-V

Research Report Writing:

Format of research report- style of writing report- reference/ bibliography/Webiliography- Technical paper writing. Research proposal preparation: Writing a research proposal and research report- writing a Research Grant Proposal.

Suggested Reading:

1. C.R.Kothari, Research methodology, Methods & technique, New age international publishers, 2004.
2. R.Ganesan, Research Methodolgy for Engineers, MJP Publishers: Chennai, 2011.
3. Dr. Vijay Upagade and Dr.Aravind Shende; Research Methodology; S.Chand & company limited., NewDelhi;2004
4. P.Ramdass and A.Wilson Aruni; Research and Writing across the disciplines: MJP Publishers; Chennai 2009.

List of subjects for ME (ECE) Course (Regular & Part time) with Specialization in DIGITAL SYSTEMS w.e.f. 2015 -16

S.No	Syllabus Ref. No	Subject	Periods per week
Core Subjects			
1	EC 4101	Digital Design and PLDs	3
2	EC 4102	VLSI Design and Technology	3
3	EC 4103	Microcontroller Architecture	3
4	EC 4104	Advanced Communication & computer Networks	3
5	EC 4105	ASIC Verification with System VERILOG.	3
6	EC 4106	Design for Testability	3
7	EC 4107	Digital Systems Lab I	3
8	EC 4108	Digital Systems Lab II	3
9	EC 4109	Seminar I	3
10	EC 4110	Seminar II	3
11	EC 4111	Project seminar	3
12	EC 4112	Dissertation	--
Elective Subjects			
13	EC 4113	Advanced Computer Organization	3
14	EC 4114	System on Chip Architecture	3
15	EC 4115	Field Programmable Gate Arrays	3
16	EC 4116	Mobile Computing	3
17	EC 4117	Network Security and Cryptography	3
18	EC 4118	Open CL programming for Advanced Graphic processors	3
19	EC 4320	Optical Fiber Communication Systems	3
20	EC 4215	Image and Video Processing	3
21	EC 4216	Optimization Techniques	3
22	EC 4226	DSP Processors – Architecture	3
23	EC 4214	Wireless Communications and Networks	3
24	EC 4223	VLSI Signal Processing	3
25	EC 4119	Real Time Operating Systems	3
26	EC 4120	Low Power VLSI Design	3
27	EC 4224	Engineering Research Methodology	3

EC 4101

DIGITAL DESIGN AND PLDS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT-I

Tabulation and K-Map minimization method to simplify the multi outputs. Algebraic methods for Determining Prime implicants, Essential implicants. Top- down Modular Combination Logic Design, Design of a computer Arithmetic Logic Unit. Combinational circuit Design with Programmable logic Devices (PLDs).

UNIT-II

Introduction to sequential circuits, Sequential circuit model & classification state table and state diagram. Memory devices: Latches and Flip-Flops, excitation table, characteristic equations, state diagram. Sequential circuits: Mealy and Moore models.

UNIT-III

Analysis and Synthesis of Synchronous sequential circuits. Synchronous Sequential Circuit Models. Sequential Circuit Analysis. One hot finite state machine design method. Finite State controllers. Algorithmic State Machine (ASM) diagram.

UNIT-IV

Analysis and Synthesis of Asynchronous sequential circuits: Analysis of Pulse mode and fundamental mode circuits. Synthesis of Pulse mode circuits. Introduction to Races, Cycles and Hazards.

UNIT-V

Simplification of Sequential circuits. Redundant states, State reduction in completely and incompletely specified circuits. Compatible and Incompatible states. Merger diagrams, optimal state assignment methods.

Suggested Reading:

1. CD Victor, P. Nelson, H Troy Nagle, Bill D. Carrol and J David Irwin. "Digital Logic Circuit Analysis and Design", PHI, 1996.

2. Zvi Kohavi, Switching and Finite Automata Theory, TMH, 2001.

3. Digital System Design using Programmable Logic Devices – Parag K.Lala, 2003, BSP

EC 4102

VLSI DESIGN AND TECHNOLOGY

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Transistors and Devices MOS and Bipolar: Introduction, the MOS Transistor structure and operation, Threshold voltage, first order CV characteristics, velocity saturated current equation, Sub threshold conduction, Capacitances of MOS transistor, MOS Inverter Circuits: Introduction, Voltage Transfer characteristics, Complementary MOS (CMOS) Inverters Design. BiCMOS Inverter.

UNIT II

Designing Combinational Logic Gates in CMOS: Introduction, Static CMOS Design, Dynamic CMOS Design. Designing Sequential Logic circuits: Introduction, Static Latches and Registers, Dynamic Latches and Registers. Transmission Gates logic.

UNIT III

High Speed CMOS Logic Design: Switching Time Analysis, Detailed Load capacitance Calculation, Improving Delay calculation with input slope, Gate sizing for optimal path Delay, Optimizing paths with Logical Effort. Scaling of MOS Transistors, Design Rules, Stick diagram and Layout Design.

UNIT IV

Data path Design: Adder, Multiplier, Barrel Shifter, Logarithmic Shifter, Semiconductor Memory Design: Introduction, Core Memory, MOS Decoder, Static RAM cell Design, Memory Architecture Content-Addressable Memories (CAM).

UNIT V

Interconnect Design: Introduction, Interconnect RC Delays, Buffer Insertion very long wires, Interconnect coupling capacitance: Components of Coupling capacitance, Coupling effects on Delay, Crosstalk, Interconnect Inductance.

Suggested Reading:

1. David A Hodges, Horace G Jackson Resve A Saleg "Analysis and Design of Digital Integrated circuits" The McGraw Hill Companies 3rd edition, 2006
2. Jan M Rabaey, A Chandrakasan, Borvioje N "Digital Integrated Circuits Design Perspective" PHI-2nd edition,2005.Neil H E Weste, David Harris, Ayan Banarjee"CMOS VLSI Design a circuits and system perspective" Pearson 3nd Edition 2009.
3. Wayne Wolf, "Modern VLSI Design" 3rd ed., 1997, Pearson Education

EC 4103 MICROCONTROLLER ARCHITECTURE

Instruction	3 Periods per week	University Examination – Duration	3 Hours
Sessionals	30 Marks	University Examination – Marks	70 Marks

UNIT I

8051 Architecture and Programming:

Inside the 8051, Introduction to 8051 Assembly Programming, Assembly and Running an 8051 Program, The Program Counter and ROM space in the 8051, 8051 Data types and Directives, 8051 Flag bits and PSW register, 8051 Register banks and Stack, Loop and Jump instructions , Call instructions.

UNIT II

8051 Programming and Addressing modes:

8051 I/O programming, I/O bit manipulation programming, Immediate and Register addressing modes, Accessing memory using various addressing modes, Bit addresses for I/O and RAM, Extra 128-byte on chip RAM in 8052, Arithmetic instructions, Signed number concepts and Arithmetic operations, Logic and Compare instructions, Rotate instruction and Data serialization, BCD, ASCII and other application programs.

UNIT III

Timer, Serial communication and Interrupt programming:

Programming 8051 timers, Counter programming, Programming timers 0 and 1 in 8051 C, Basics of Serial Communication, 8051 Connection to RS232, 8051 Serial Port programming in Assembly, 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware interrupts, Programming the Serial Communication Interrupt.

UNIT IV

Real world Interfacing:

LCD interfacing, Keyboard interfacing, Parallel and Serial ADC, DAC Interfacing, Relays and Optoisolators, Stepper Motor interfacing, DC Motor interfacing and PWM.

UNIT V

ARM Processors fundamentals:

Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and the Vector Table, Core Extensions, Architecture Revision, ARM Processor families.

Suggested Reading:

1. Mohammad Ali Mazidi, Rolin D McKinley, Janice G Mazidi, The 8051 Microcontroller and Embedded Systems, Second Edition, Prentice Hall
2. Andrew N.Sloss, Domnic Symes, Chris Wright, ARM system developers guide, Elsevier publications.
3. Kenneth Ayala, The 8051 microcontroller, third edition, Penram international publications.

EC 4104 ADVANCED COMMUNICATION AND COMPUTER NETWORKS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Data Communications and Networks Overview: Data Communications Model Communication Tasks, Networks and Switching, Networking configurations, Protocols and Architecture, Key Elements of a Protocol, Protocols in Simplified Architecture, Protocol Data Units (PDU), Operation of a Protocol Architecture, Operation of a Protocol Architecture, Standardized Protocol Architectures, OSI and TCP/IP Architectures, Comparisons between OSI and TCP/IP, TCP/IP Addressing Concepts, concepts of Frequency, Spectrum and Bandwidth, Modem, Codec and Shannon Capacity.

UNIT II

Line Configuration, Flow Control, Sliding Window Flow Control, Error control, CRC, ARQ Protocols, Data Link Control, Bit stuffing, HDLC Operation; Hierarchy of FDM schemes, WDM Operation, TDM Link Control, Hierarchy of TDM, DS-1 Transmission Format, SONET/SDH Frame Formats. Asymmetrical Digital Subscriber Line, xDSL.

UNIT III

Circuit Switching and Packet Switching: Circuit Switching concepts, Circuit Switch Elements, Packet Switching Principles, Datagram and Virtual Circuit switching, X.25 Protocol Control Information. **Area Routing**: Path Selection Algorithms - Dijkstra's Algorithm, Bellman-Ford Algorithm, Packet Flooding and Deflection Routing Algorithm.

UNIT IV

LAN Architecture. Topologies, Choice of Topology, Ring and Star Usage, MAC and LLC, Generic MAC Frame Format, Bridge, Bridge Operation, Bridges and LANs with Alternative Routes, Spanning Tree, Loop resolution in bridges, Hubs, Two Level Star Topology, Layer 2 Switches, Wireless LAN, Multi cell Wireless LANs, IEEE 802.11 Architecture, IEEE 802.11 Medium Access Control logic.

UNIT V

Network layer: Internet Protocol: Internetworking, IPv4, IPv6 Transition from IPv4 to IPv6 Multicast Routing and Protocols: Basic Definitions and Techniques, Internet Group Management Protocol (IGMP). Transport and End-to-End Protocols: User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Mobile Transport Protocols, TCP Congestion Control. Application Layer**:** The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, Domain Name System (DNS).

Suggested Reading:

1. William Stallings, "Data and Computer Communications", Eigth Edition, Pearson Prentice Hall, 2007.
2. 2Behrouz A. Forouzan, "Data Communications and Networking", Fourth Edition, Tata Mc Graw Hill, 2007

EC 4105 ASIC VERIFICATION WITH SYSTEM VERILOG

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

Unit-I

Introduction to Verilog Introduction to Verilog, Modules and Ports, Structural, Data Flow, Behavioral and switch level Modeling, Tasks and Functions, Logic Synthesis, Timing Delays, Static timing analysis: Setup time & hold time violations, clock skew.

Unit –II

Introduction to verification: Test bench creation, Significance of Verification, Verilog for verification. **Introduction to System Verilog:** Advantages over Verilog, Verification process, Methodology, Randomization basics, Coverage basics **Data Types**: Built-in data types, Fixed and dynamic Arrays, Queues, Associative Arrays, Enumerated data types rocedural statements, Tasks and Functions, Time values

Unit-III Introduction to object oriented Programming

Communication between the Test bench and DUT, Interface Construct, Stimulus Timing, Interface Driving and Sampling, Programming block basics, System Verilog assertions.
OOPS: Object Oriented Programming significance and advantages, classes, objects, object handles, methods, Static and Global Variables, Using one class inside another class, Dynamic objects, Copying objects, Public Vs Local and Building a test bench

Unit-IV Verification using System Verilog

Randomization: Significance, randomization in system Verilog, Constraint randomization, atomic stimulus generation, random number generation, constraint tips and techniques.
Threads: Threads, Inter process communication, Events, Semaphores, Mailboxes virtual methods, Copying an Object, Inheritance, Abstract Classes and Pure Virtual Methods. Case study using Verification Machine.

Unit-V

Advanced System Verilog Callbacks, Parameterized Classes, Static and Singleton Classes
Coverage: Introduction, Coverage Types, Functional Coverage Strategies, cover group, Defining cover groups in classes, Data sampling, coverage points, Coverage methods, Cross coverage, Case study using Universal Verification Machine (UVM).

Suggested Reading

1. Ming-Bo Lin., Digital System Designs and Practices Using Verilog HDL and FPGAs, Wiley India, 2008.
2. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education, 2005.
3. Christ Spear and Greg Tumbush, System Verilog for Verification, 3rd ed., Springer, 2012.

EC4106 DESIGN FOR TESTABILITY

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Introduction to Test and Design fro Testability (DFT) Fundamentals.

Modeling: Modeling digital circuits at logic level, register level and structural models. Levels of modeling.

Logic Simulation: Types of simulation, Delay models, Element evaluation, Hazard detection, Gate level event driven simulation.

UNIT II

Fault Modeling – Logic fault models, Fault detection and redundancy, Fault equivalence and fault location. Single stuck and multiple stuck – Fault models. Fault simulation applications, General techniques for Combinational circuits.

UNIT III

Testing for single stuck faults (SSF) – Automated test pattern generation (ATPG/ATG) for SSFs in combinational and sequential circuits, Functional testing with specific fault models. Vector simulation – ATPG vectors, formats, Compaction and compression, Selecting ATPG Tool.

UNIT IV

Design for testability – testability trade-offs, techniques. Scan architectures and testing – controllability and absorbability, generic boundary scan, full integrated scan, storage cells for scan design. Board level and system level DFT approaches. Boundary scan standards. Compression techniques – different techniques, syndrome test and signature analysis.

UNIT V

Built-in self-test (BIST) – BIST Concepts and test pattern generation. Specific BIST Architectures – CSBL, BEST, RTS, LOCST, STUMPS, CBIST, CEBS, RTD, SST, CATS,

CSTP, BILBO. Brief ideas on some advanced BIST concepts and design for self-test at board level. Memory BIST (MBIST): Memory test architectures and techniques – Introduction to memory test, Types of memories and integration, Embedded memory testing model. Memory test requirements for MBIST. Brief ideas on embedded core testing.

Suggested Reading

1. Miron Abramovici, Melvin A. Breur, Arthur D. Friedman, Digital Systems Testing and Testable Design, Jaico Publishing House, 2001.
2. Alfred Crouch., Design for Test for Digital ICs & Embedded Core Systems, Prentice Hall.
3. Robert J. Feugate, Jr., Steven M. Mentyn, Introduction to VLSI Testing, Prentice Hall,
4. Englehood Cliffs, 1998.

EC4107 DIGITAL SYSTEM LAB – I

Instruction	3 Periods per week	University Examination - Duration	
Sessionals	50 Marks	University Examination - Marks	------

Section-1:

Micro Processor & Micro Controller

Part (a): Micro Controller 8051.

i. C/Assembly Language Programming of 8051: I/O Port, Timer, Serial & Interrupt Program using Keil (or equivalent) IDE

Part (b): Experimetns using 8051 Micro-controller Developer ADM based kit:

i. Stepper Motor
ii. LCD Display
iii. ADC & DAC

Debugging Software and Hardware using 8051 Simulator/Emulator, Proteus Software and Logic Analyzer.

Section – 2:

Computer Experiments Using Matlab

1. Setting up advanced control problem using SIMULINK.
2. Time response of non linear systems.
3. Creating frequency domain plots.
4. Performing state space communications and study of controllers and observers.
5. Implementation of Multi rate systems.
6. Experiments using DSP Processor.
   i) Convolution & Correlation.
   ii) FIR Filtering.
   iii) IIR Filtering.

EC 4108 DIGITAL SYSTEM LAB - II

Instruction	3 Periods per week	University Examination - Duration	
Sessionals	50 Marks	University Examination - Marks	------

Section - 3:

Part(a):

VHDL/Verilog

VHDL (or Verilog HDL) modeling, Simulation, Synthesis, Timing Analysis and implementation on FPGA/CPLD target devices.

i. Combinational Circuits
ii. Sequential Circuits and FSMs
iii. Case study (Complete FPGA design flow including on-chip debugging)

Suggested Tools: Xilinx ISE/Altera Quartus, Modelsim/Active HDL and Target boards.

Section - 4:

VLSI Design

i. Design of CMOS Inverter & NAND Gate.
ii. Design of Half Adder using NAND Gates & Full Adder Design using Half Adder.
iii. Design of 4-bit Adder using Full Adder.
iv. Design of 4-bit thermometer to Binary Code converter.
v. Layout Designs of above Digital Circuits.

Part (b):

Mini Project

EC 4109 **SEMINAR - I**

Instruction	3 Periods per week	University Examination - Duration	
Sessionals	50 Marks	University Examination - Marks	------

Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

- Literature survey
- Organization of the material
- Presentation of OHP slides / LCD presentation
- Technical writing Each

student required to:

- Submit a one page synopsis before the seminar talk for display on the notice board.

- Give a 20 minutes time for presentation following by a 10 minutes discussion.

- Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from week to the last week of the semester and any change in schedule shall not be entertained

For award of sessional marks, students are to be judged by at least two faculty

members on the basis of an oral and technical report preparation as well as their involvement in the discussions.

EC 4110 **SEMINAR – II**

Instruction	3 Periods per week	University Examination - Duration	
Sessionals	50 Marks	University Examination - Marks	------

Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

- Literature survey
- Organization of the material
- Presentation of OHP slides / LCD presentation
- Technical writing Each

student required to:

- Submit a one page synopsis before the seminar talk for display on the notice board.

- Give a 20 minutes time for presentation following by a 10 minutes discussion.

- Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from week to the last week of the semester and any change in schedule shall not be entertained

For award of sessional marks, students are to be judged by at least two faculty

members on the basis of an oral and technical report preparation as well as their involvement in the discussions.

EC 4111 **PROJECT SEMINAR**

Instruction	3 Periods per week	University Examination - Duration	
Sessionals	100 Marks	University Examination - Marks	------

The main objective of the Project Seminar is to prepare the students for the dissertation to be executed in 4th semester. Solving a real life problem should be focus of Post Graduate dissertation. Faculty members should prepare the project briefs (giving scope and reference) at the beginning of the 3rd semester, which should be made available to the students at the departmental library. The project may be classified as hardware / software / modeling / simulation. It may comprise any elements such as analysis, synthesis and design.

The department will appoint a project coordinator who will coordinate the following:

- Allotment of projects and project guides.
- Conduct project - seminars.

Each student must be directed to decide on the following aspects

- Title of the dissertation work.
- Organization.
- Internal / External guide.
- Collection of literature related to the dissertation work.

Each student must present a seminar based on the above aspects as per the following guidelines:

- Submit a one page synopsis before the seminar talk for display on the notice board.
- Give a 20 minutes presentation through OHP, PC followed by a 10 minutes discussion.
- Submit a report on the seminar presented giving the list of references.

Project Seminars are to be scheduled from the 3rd week to the last week of the semester.

The internal marks will be awarded based on preparation, presentation and participation.

EC 4112 **DISSERTATION**

Instruction	--	University Examination - Duration	--
Sessionals	--	University Examination - Marks	Grade+

The students must be given clear guidelines to execute and complete the project on which they have delivered a seminar in the 3rd semester of the course.

All projects will be monitored at least twice in a semester through student's presentation. Sessional marks should be based on the grades/marks, awarded by a monitoring committee of faculty members as also marks given by the supervisor.

Efforts be made that some of the projects are carries out in industries with the help of industry coordinates.

Common norms will be established for documentation of the project report by the respective department.

The final project reports must be submitted two weeks before the last working day of the semester.

The project works must be evaluated by an external examiner and based on his comments a viva voice will be conducted by the departmental committee containing of HOD, two senior faculty and supervisor.

+ **Excellent / Very Good / Good/Satisfactory / Unsatisfactory**

EC4113 ADVANCED COMPUTER ORGANIZAION

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT – I:

Processor Design:

CPU Organization, Data Representation, Instruction Formats, Data Path Design: Fixed Point Arithmetic and Floating Point Arithmetic, Instruction Pipelining, Super Scalar techniques, Linear pipeline processors, Super scalar and super pipeline design, Multi vector and SIMD computers.

UNIT – II:

Control Unit Design:

Basic Concepts: Hardwired Control Unit Design approach, Micro-programmed Control Unit Design Approach, Micro program sequencer, Case studies based on both the approaches.

UNIT – III:

Memory Organization:

Internal memory, computer memory system overview, The memory Hierarchy, Random access memories, Cache memory, Elements of cache design, Virtual memory- protection and examples of virtual memory, Replacement Policies.

UNIT – IV:

I-**O Organization**:

Accessing I/O Devices, Programmed I-O, Interrupts, DMA, Bus Arbitration; Synchronous bus and asynchronous bus, Interface circuits, Parallel port, Serial port, standard I/O interfaces, IO Processor, PCI bus, SCSI bus, USB bus protocols.

UNIT – V:

Parallel Computer Systems:

Instruction Level Parallelism (ILP) – Concept and Challenges, Dynamic Scheduling, Limitations on ILP, Thread Level Parallelism, Multi-processors – Characteristics, Symmetric and Distributive Shared Memory Architecture, Vector Processors and Super computers.

Text Books:

1. Hayes John P; "*Computer Architecture and Organization*"; 3rd Edition, MGH, 1998.

EC 4114 SYSTEM ON CHIP ARCHITECTURE

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT-I

Introduction to System on Chip: System Architecture components of the system, hardware and software, processor architecture, memory and addressing, system level interconnection, an approach for SOC design, system architecture and complexity.

Processor design: Processor architecture and organization, processor design trade-offs, the reduced instruction set computer, the acron risc machine, architectural inheritance, the arm programmers model, arm development tools.

UNIT- II

Organization of an soc: 3-stage pipeline arm organization, 5-stage pipeline arm organization, the arm coprocessor interface coprocessor instructions, data operations, data transfers, the thumb bit in the cpsr, the thumb programmer's model

UNIT III

Architectural support for system development: The arm memory interface, the advanced micro controller bus architecture(amba), the arm reference peripheral specification, hardware system prototyping tools, the armulator, the jtag boundary scan test architecture embedded trace, signal processing support

UNIT IV

Memory hierarchy: Memory size and speed: memory cost, on chip memory, caches: processor & memory speeds, unified & Harvard caches, cache performance metrics, the direct mapped cache the set-associative cache, the fully associative cache, write strategies cache design-an example.

UNIT V

Architectural support for operating systems: An introduction to operating system, the arm system control coprocessor, cp15 protection unit register, arm protection unit, cp15 mmu registers, arm mmu architecture, synchronization, context switching, input/ouput.

Suggested Reading:

1. Steve furber, " arm system-on-chip architecture ",second edition, pearson publications.
2. Andrew n.sloss, domnic symes,chris wright, "arm system developers guide, publications Elsevier.

EC 4115 FIELD PROGRAMMABLE GATE ARRAYS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT-I

Introduction to ASIC's: Types of ASIC's, ASIC design flow, Economics of ASIC's, Programmable ASIC's: CPLD and FPGA. Commercially available CPLD's and FPGA's: XILINX, ALTERA, ACTEL. FPGA Design cycle,

Implementation tools: Simulation and synthesis, Programming technologies.

UNIT-II

FPGA logic cell for XILINX, ALTERA and ACTEL ACT, Technology trends, Programmable I/O blocks, FPGA interconnect: Routing resources, Elmore's constant, RC delay and parasitic capacitance FPGA design flow, Dedicated Specialized Components of FPGAS.

UNIT-III

FPGA physical design, CAD tools, FPGA Partitioning, Partitioning methods .Floor planning: Goals and objectives, I/O, Power and clock planning, Low- level Low- level design entry. Application of FPGAS.

UNIT-IV

Placement: Goals and objectives, Placement algorithms: Min-cut based placement, Iterative Improvement and simulated annealing.

Routing, introduction, Global routing: Goals and objectives, Global routing methods, Back-annotation. Detailed Routing: Goals and objectives, Channel density, Segmented channel routing, Maze routing, Clock and power routing, Circuit extraction and DRC.

UNIT-V

Verification and Testing:- Verification: Logic simulation, Design validation, Timing verification, Testing Concepts: Failures, Mechanism and faults, Fault coverage, Design applications :General Design issues, Counter Examples, A Fast DMA Controller, Designing adders and accumulators with Xilinx Architecture. .

Suggested reading:

1. Pak and Chan, Samiha Mourad, "Digital Design using Field Programmable Gate Arrays", Pearson Education, 1st edition, 2009.
2. Michael John Sebastian Smith, "Application specific Integrated Circuits", Pearson Education Asia, 3rd edition 2001.
3. S. Trimberger, Edr, Field Programmable Gate Array Technology, Kluwer Academic Publications, 1994.
4. John V.Oldfield, Richard C Dore, Field Programmable Gate Arrays, Wiley Publications.

EC 4116 MOBILE COMPUTING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT-I:

Introduction: Challenges in mobile computing, coping with uncertainties, Resource poorness, bandwidth, etc. Cellular architecture, co-channel interference, frequency reuse, capacity increase by cell splitting.

Evolution of mobile system: CDMA, FDMA, TDMA, GSM.

UNIT-II:

Mobility Management: Cellular architecture, Co-channel interference, Mobility: handoff, types of handoffs; Location management, HLR-VLR scheme, Hierarchial scheme, Predictive location management schemes, Mobile IP, Cellular IP.

UNIT-III:

Publishing and Accessing Data in Air: Pull and Push based data delivery models, Data dissemination by broadcast, Broadcast disks, Directory service in air, energy efficient indexing scheme for push based data delivery.

File system support for mobility: Distributed file sharing for mobility support, Coda and other storage manager for mobility support.

UNIT-IV:

Ad hoc Network Routing protocols: Ad hoc network routing protocols, destination sequenced distance vector algorithm, Cluster based gate way switch routing, Global state routing, fish- eye state routing, dynamic source routing, ad hoc on- demand routing, location aided routing, Zonal routing algorithm.

UNIT-V:

Mobile Transaction and Commerce: Models for mobile transaction, Kangaroo and Joey transactions, Team transaction, Recovery model for mobile transactions. Electronic payment and protocols for mobile commerce.

Suggested Reading:

1. Jochen Schiller, Mobile Communications, 2nd edition, Pearson Education, 2004.
2. Hansmann, Merk, Nicklous, Stober, Principles of mobile Computing, 2nd edition, Springer International Edition, 2003.
3. A Survey of Mobile transactions appeared in distributed and parallel data bases, 16, 193-230,2004, Kluwer Academic Publishers.
4. Balancing Push and pull for Data Broadcast, S.Acharya, M.Franklin and S.Zdonik, Proceedings of the ACM SIGMOD, Tuscon, AZ, May 1997.

EC4117 NETWORK SECURITY AND CRYPTOGRAPHY

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT –I:

Introduction: Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security. Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques.

UNIT –II:

Modern Techniques :Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Differential andLinear Cryptanalysis, Block Cipher Design Principles and Modes of operations

Algorithms: Triple DES, International Data Encryption algorithm, Blowfish, RC5, CAST-128, RC2, Characteristics of Advanced Symmetric block cifers.

Conventional Encryption: Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation.

Public Key Cryptography:

Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography.

UNIT –III:

Number Theory: Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms.**Message authentication and Hash Functions:**

Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.

UNIT –IV:

Hash and Mac Algorithms: MD File, Message digest Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC. **Digital signatures and Authentication Protocols**: Digital signatures, Authentication Protocols, Digital signature standards.

Authentication Applications: Kerberos, X.509 directory Authentication service. Electronic Mail Security: Pretty Good Privacy, S/MIME.

UNIT –V:

IP Security:

Overview, Architecture, Authentication, Encapsulating Security Payload, Combining security Associations, Key Management. **Web Security:** Web Security requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction.**Intruders, Viruses and Worms:**

Intruders, Viruses and Related threats. **Fire Walls:** Fire wall Design Principles, Trusted systems.

TEXT BOOKS:

1. Cryptography and Network Security: Principles and Practice - William Stallings, 2000, PE.

REFERENCES:

1. Principles of Network and Systems Administration, Mark Burgess,John Wielptography

EC 4118
OPEN CL PROGRAMMING FORADVANCED GRAPHIC PROCESSORS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Overview of Pipelining and Instruction Level Parallelism. Introduction to Multi-processors, Shared memory architecture, Multi-threading, Interconnection networks and clusters.Architecture of recent CPUs and GPUs: Intel Dual and Quad core processors, NVDIA Fermi and AMD Fusion processors.

UNIT II

Programming with MPI and GPU: Introduction: General MPI programs, MPI_Send and MPI_Recv, Collective Communication: Tree-structured communication, Broadcast, Reduce and other collective communication, programming model of GPU: Thread, Memory, Hierarchy, Host and Device, Software stack, and computer capability and Example of Matrix Multiplication using MPI and GPU.

UNIT III

OpenCL programming on CPU/GPU/APU: Software and hardware overview. OpenCL for GPU/APU processor, memory access and architecture, communication between Host and GPU, device scheduling, terminology, programming model, and example programs.

UNIT IV

Building and running Open CL programs on GPU/APU: compiling, running calling conventions, predefined macros, debugging, setting the environment and breakpoint, and sample GDP session.

UNIT V

Open CL Applications on GPU/APU: Examples of applications in Electromagnetic Estimations, Digital Signal Processing, Video Processing and Image Processing.

Suggested Readings:

1. John L. Hennessy and David A. Patterson, "Computer Architecture – A Quantitative Approach," 3rd Edition, Elsevier Publications, 2003.
2. Peter S Pacheco, "Parallel Programming with MPI," 1st Edition, Morgan Kaufmann Publishers, 1997.
3. AaftabMunshi, Benedict R. Gaster, Timothy G. Mattson and James Fung, "OpenCL Programming Guide," Addison Wesley Professional Publications, 2011
4. Benedict Gaster, Lee Howes, David R. Kaeli, Perhaad Mistry and Dana Schaa, "Heterogeneous Computing with OpenCL," Morgan Kaufmann Publications, 2011.
5. AMD Accelerated Parallel Processing OpenCL Programming Guide, 2011

EC 4320 OPTICAL FIBRE COMMUNICATION SYSTEMS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Optical Fibres: Fibre Structures, Wave-guiding and fabrications, Overview of Optical fibre communications, Elements of an Optical fibre transmission Link, Nature of light, Basic optical laws and definitions, Modes and configurations, Mode theory of circular wave guides, Single, Multi mode step index and Graded index Fibres , Fibre materials. Signal degradation in Optical Fibres. Dispersion, Pulse broadening in graded index fibres, Mode coupling, Design optimization of single mode Fibres.

UNIT II

Optical Sources & Detectors: Semiconductors as optical Sources and their fabrication. LED and Laser diodes, Linearity of sources, Modal, Partition and reflection noise, Physical principles of PIN and APD, Photo detector noise, detector response time, Avalanche multiplication noise, Temperature effect on avalanche gain, Comparison of Photo detectors.

UNIT III

Optical Fibre communication: Basic communication system, Fundamental receiver operation, Digital receiver performance calculations. Preamplifiers types, Analog receivers. Fibre Links: Point to point links, Line coding, Error correction, Noise effects on digital transmission system performance. Overview of analog links, Carrier noise ratio in analog systems.

UNIT IV

Multi channel transmission techniques: WDM concepts and components. Operational principles of WDM, Passive components, Tunable sources, Tunable filters, Introduction of optical amplifiers.

UNIT V

Optical Networks: Basic Networks, SONET/SDH, Broadcast and select WDM networks, Wavelength Routed Networks, Nonlinear effects on Network Performance, Performance of EDFA+WDM systems, Optical CDMA, Ultrahigh capacity Networks.

Suggested Reading

1. Djafar K.mynbaev Lowell l.Scheiner “Fibre Optic Communications Technology”, Pearson Education Asia.

2. Senior John M. “Optical Fibre Communications Principles and Practice”, Prentice Hall India, second edition, 1996

3. Keiser Gerd , “Optical Fibre Communications”, Mc GrawHill, second edition,1991.

EC 4215 IMAGE AND VIDEO PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Fundamentals of Image Processing and Image Transforms; Basic steps of Image Processing System, Monochrome and color vision models**,** Image acquisition and display, Sampling and Quantization of an image – Basic relationship between pixels

Image Transforms: 2 D- Discrete Fourier Transform, Discrete Cosine Transform (DCT), Wavelet Transforms: Continuous Wavelet Transform, Discrete Wavelet Transforms.

UNIT II

Image Processing Techniques Image Enhancement Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering. Laplacian of Gaussian (LOG) filters.

Image Segmentation: Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region Based segmentation. Hough Transform, boundary detection, chain coding,

UNIT III

Image Compression Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Huffman coding, Arithmetic coding, LZW coding, Run length coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding, JPEG standards.

UNIT IV

Basic steps of Video Processing Analog Video, Digital Video. Principles of color video processing, composite versus component video, Time-Varying Image Formation models Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT V

2-D Motion Estimation Optical flow, General Methodologies, Pixel Based Motion Esimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding, Contant dependent video coding and Joint shape and texture coding ,MPEGs and H.26x standards.

Suggested Readings

1. Gonzaleze and Woods Digital Image Processing –, 3rd ed., Pearson.
2. Yao Wang, Joem Ostermann and Ya–quin Zhang Video processing and communication –. 1st Ed., PH Int.
3. M. Tekalp, "Digital Video Processing, Prentice Hall International.

EC 4216 OPTIMIZATION TECHNIQUES

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Use of optimization methods. Introduction to classical optimization techniques, motivation to the simplex method, simplex algorithm, sensitivity analysis.

UNIT II

Search methods - Unrestricted search, exhaustive search, Fibonocci method, Golden section method, Direct search method, Random search methods, Univariate method, simplex method, Pattern search method.

UNIT III

Descent methods, Gradient of function, steepest decent method, conjugate gradient method. Characteristics of constrained problem, Direct methods, The complex method, cutting plane method.

UNIT IV

Review of a global optimization techniques such as Monte Carlo method, Simulated annealing and Tunneling algorithm.

UNIT V

Generic algorithm - Selection process, Crossover, Mutation, Schema theorem, comparison between binary and floating point implementation.

Suggested Reading:

1. SS Rao, "Optimization techniques", PHI, 1989.
2. Zhigmiew Michelewicz, "Genetic algorithms + data structures = Evaluation programs", Springer Verlog - 1992.
3. Merrium C. W., "Optimization theory and the design of feedback control systems", McGraw Hill, 1964.
4. Weldo D.J., "Optimum seeking method", PHI, 1964.

EC 4226

DSP PROCESSORS – ARCHITECTURE

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 Marks

UNIT I

Introduction to DSP Processors: Differences between DSP and other □p architectures, their comparison and need for special ASP[s], RISC & CISC CPUs.

UNIT II

Overview of DSP processor design: fixed point DSP[s] – Architecture of TMS 320C 5X, C54X Processors, addressing modes, Assembly instructions, Pipelining and on-chip peripherals. Floating point DSP[s]: Architecture of TMS 320 – IX.

UNIT III

Data formats, F.P. operations, addressing modes, instructions, pipelining and peripherals.

UNIT IV

DSP interfacing & software development tools: I/O interfacing with A/D converters, PC[s] , Dual port RAM[S], EPGA[s], DSP tools – Assembler, debugger, c-compiler, linker, editor, code composer studio.

UNIT V

Applications using DSP[s] adaptive filtering, spectrum analysis, Echo cancellation modems, voice

synthesis and recognition. Brief ideas of AD, Motorola DSP CPU[s] and their comparison with TI CPU[S].

Suggested Reading:

1. C. Marren & G. Ewess, "A Simple Approach to Digital Signal Processing", WILEY Inter-science (1996).
2. K. Shin, "DSP Applications with TMS 320 Family", Prentice Hall (1987).
3. B. Ventakaramani, M. Bhaskar, "Digital Signal Processes, Architecture Processing and Applications", Tata Mc Graw Hill (2002).

EC 4214 WIRELESS COMMUNICATION AND NETWORKS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

EC 4223 VLSI SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

EC 4119 REAL TIME OPERATING SYSTEMS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

EC 4120 LOW POWER VLSI DESIGN

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

EC 4224 ENGINEERING RESEARCH METHODOLOGY

Instruction	3 periods per week	University Examination – Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT-I

Research Methodology:

Objectives and Motivation of research- types of research- Research approaches – Significance of Research-Research Methods versus Methodology-Research and Scientific method- Importance of research methodology – Research process- criteria of good research- Problems encountered by Researchers in India-benefits to society in general.

Defining Research Problem:

Definition of research problem- problem formulation- necessity of defining the problem- techniques involved in defining a problem.

UNIT-II

Literature Survey: Importance of Literature Survey-Sources of information-Assessment of Quality of journals and articles-Information through internet. Literature Review: Need of Review- Guidelines for Review-Record of Research Review.

UNIT-III

Research Design: Meaning of research design - need of research design- features of a good design- important concepts relating to research design- different research designs- Basic Principles of experimental designs- Developing a Research plan- Design of experimental set-up-Use of standards and codes.

UNIT-IV

Exploration of data: Analysis of data- Role of statistics for data analysis –Functions of statistics- Estimation of population parameters –Parametric vs non-parametric methods- Descriptive statistics- Point of central tendency- Measures of variability- Inferential statistics- estimation- Hypothesis testing – Use of statistical software.

Data Analysis : Deterministic data and random data- uncertainty analysis – tests for significance – Ch-square test- Student's 't' test- Regression modeling-ANOVA-F test- Time series analysis- Autocorrelation and Autoregressive modeling.

UNIT-V

Research Report Writing:

Format of research report- style of writing report- reference/ bibliography/Webiliography- Technical paper writing. Research proposal preparation: Writing a research proposal and research report- writing a Research Grant Proposal.

Suggested Reading:

1. C.R.Kothari, Research methodology, Methods & technique, New age international publishers, 2004.
2. R.Ganesan, Research Methodolgy for Engineers, MJP Publishers: Chennai, 2011.
3. Dr. Vijay Upagade and Dr.Aravind Shende; Research Methodology; S.Chand & company limited., NewDelhi;2004
4. P.Ramdass and A.Wilson Aruni; Research and Writing across the disciplines: MJP Publishers; Chennai 2009.

List of Subjects for ME (ECE) Course (Regular/Part-Time) with

Specialization in

MICROWAVE & RADAR ENGINEERING w.e.f. 2015 -2016

Sl.No.	Syllabus Ref. No.	Subject	Periods per week
Core Subjects			
1	EC 4301	Advanced Electromagnetic Engineering	3
2	EC 4302	Microwave Circuits	3
3	EC 4303	Radar Systems Engineering	3
4	EC 4304	Microwave Antennas	3
5	EC 4305	Microwave Integrated Circuits	3
6	EC 4306	Satellite Radio Navigation	3
7	EC 4307	Microwave Systems Laboratory-I	2
8	EC 4308	Microwave Systems Laboratory-II	2
9	EC 4309	Seminar-I	2
10	EC 4310	Seminar-II	2
11	EC 4311	Project Seminar	4
12	EC 4312	Dissertation	--
Elective Subjects			
13	EC 4313	Electromagnetic Interference and Compatibility	3
14	EC 4314	Computational Electromagnetics	3
15	EC 4315	Microwave Measurements	3

16	EC 4316	Microwave Semiconductor Devices	3
17	EC 4317	Phased Array Radar	3
18	EC 4318	Radar Signal Processing	3
19	EC 4319	Satellite & Microwave Communication	3
20	EC 4320	Optical Fiber Communication Systems	3
21	EC 4321	RF MEMS	3
22	EC 4322	Navigation System Engineering	3
23	EC 4323	Microwave Solid state Devices and Applications	3
24	EC 4241	Wireless Communications and Networks	3
25	EC 4216	Optimization Techniques	3
26	EC 4225	Engineering Mathematics	3
27	EC 4224	Engineering Research Methodology	3

Note: Core of one specialization can be elective for other specialization provided condition for prerequisite is satisfied. However, prior permission of the Chairman is to be obtained. This is also applicable to elect.

EC 4301

ADVANCED ELECTROMAGNETIC ENGINEERING

Institution:	3 Periods per week
Duration of University Examination:	3 hours
University Examination:	70 Marks
Sessionals:	30 Marks

UNIT I

Fundamentals- Review of Basic Electromagnetic Theory, Maxwell's equations, Wave Equation, Time-Harmonic Fields, Plane waves in lossless and lossy media, Poynting's Theorem, Reflection and Transmission of waves.

UNIT II

Theorems and Concepts- The Generalized Current Concept, Circuit-Field Relations, Auxiliary Vector potentials, The source concept, Duality, Uniqueness, Image Theory, The Equivalence Principle, Induction and Reciprocity theorems, Green's Functions.

UNIT III Guidance of Waves in Rectangular Cross section -The Parallel Plate Waveguide, The Rectangular Waveguide, Partially Filled Waveguide, The Dielectric Slab Guide, Surface Guided Waves.

UNIT IV

Guidance of Waves in Circular Cross section - Circular wave guide, Radial wave guide. Resonance of Waves- Resonators, Radiation of waves-Antennas.

UNIT V

Introduction to Metamaterials, EBG Structures and Frequency Selective Surfaces, Survey of Commercially available EM Simulation Software.

Suggested Reading

1. R.F.Harrington, *Time- Harmonic Electromagnetic Fields*, McGraw-Hill, 1961,reissued by IEEE Press,2001.
2. C.A.Balanis,*Advanced Engineering Electromagnetics*, John Wieley & Sons,1989.
3. R.E.Collin, *Field Theory of Guided Waves*, IEEE Press, 1991, 2nd Ed.
4. J.A.Kong,*Electromagnetic wave Theory*,EMW Publishing,2005,2008.

EC 4302

MICROWAVE CIRCUITS

Instruction**:**	3 Periods per week
Duration of University Examination:	3 Hours
University Examination:	70 Marks
Sessionals:	30 Marks

UNIT I

Introduction to micro wave. Circuit concept: one port junction. terminal voltage and currents in multipart junctions. Poynting's energy theorem. Normalized waves and scattering matrix. Properties of [s]matrix

UNIT II

Relationship between [s], [z]and[y] parameters. Wave amplitude transmission matrix[A]. Relation between [A] and [s]. [s]matrix of magic T. E and H plane tees. Directionl coupler. Applications of hybrid junction and magic tee.

UNIT III

Passive microwave devices. Even and odd mode analysis of symmetrical 4 port networks. Analysis and design of branch line couplers. Hybrid ring coupler. Frequency response. Branching synthesis of hybrids. Applications of hybrids.

UNIT IV

Micro wave propagation in ferrites. Principles of faraday rotation. Isolater. Gyrator. Circulator. Phase shifters. S-matrix of non reciprocal devices. Broad band matching multisection quarter wave transformers. Binomial and chebshev transformer designs. Tapered transmission line exponential and triangular tapers. Synthesis of transmission line tapers.

UNIT V

Wave analysis of periodic structures. Image parameters method of micro wave filter design. Power loss ratio. Filter design by insertion loss method. Frequency transformation maximally flat and chebyshev filter design and characteristics.

Suggested Reading

1. Altmen,JL., *Microwave Circuits*, D van nostrand co.,inc.,1964.
2. Collins. RE, *Foundations for Microwave Engineering*, McGraw Hill, 2nd edn,1992.
3. Ghosh.RN, *Microwave Circuit Theory and analysis*, mcGrew hill.
4. Pozer.DM, Microwave engineering,2^{nd} edn., john wiley andsons,inc.,1999.

EC 4303

RADAR SYSTEMS ENGINEERING

Instruction:	3 periods per week
Duration of university examination:	3 hours
University examination:	70 marks
Sessionals:	30 marks

Unit I

The radar range equation: Radar fundamentals. derivation of range equation, the search radar equation, jamming and radar range with jamming, radar clutter and radar range with clutter. radar range with combined interferences sources.

Unit II

The theory of target detection: Noise and false alarms. Detection of one sample of signal with noise, integration of pulse trains, detection of fluctuating targets, CFAR, Optimum and matched filter Theory. loss factors in detection.

Unit III

Targets and interference: Definition of radar cross section . Radar cross section of simple and complex objects, Spatial distribution of cross section. Bistatic cross section. CW and FM Radar: Doppler Effect. CW and FMCW Radar, Airborne Doppler Navigation, Multi frequency CW Radar.

Unit IV

MTI Radar: Delay lines and line cancellors, subclutter Visibility.MTI using range gates and filters, pulse Doppler radar. Non-coherent MTI radar. Application of Digital signal processing to radar system.

Tracking Radar: Different types of tracking techniques. Tracking in range. Tracking in Doppler. Search Acquisition radar. Comparision of Trackers.

Unit V

Introduction to pulse compression Radar: Height finding radars. Air traffic control. Radars and data handling . Atmospheric effects of radar. Electromagnetic compatibility aspects. Airborne Radars, synthetic Aperture Radar. Secondary surveillance Radars.

Suggested reading

1. David barton .k, *Modern radar system analysis*, Artech house, 1988.
2. Fred nathanson e, *Radar design principles signal processing and the environment,* McGraw Hill.1969.
3. Cook CE. Bernfield. M, "*Radar signals"* Academic press, 1967.
4. Skolnik, "*Introduction to radar systems"* ,Mcgraw hill, 2nd Edition 2003.

EC 4304

MICROWAVE ANTENNAS

Institution:	3 Periods per week
Duration of University Examination:	3 hours
University Examination:	70 Marks
Sessionals:	30 Marks

UNIT-I

Fundamental parameters and definitions for antennas, Theories of radiation, Image theory, Schelkunoff's equivalence theorem, Huygens' principle, Babinet's principle.

UNIT-II

Radiation from rectangular and circular apertures, design considerations, Fourier transform method in aperture antenna theory. Broadband antennas: Log periodic and Spiral antennas.

UNIT-III

Linear arrays: Uniform and Non uniform amplitude distribution, Planar arrays, Smart antenna methods, Smart antenna Algorithms, Synthesis of antenna arrays using Schelkunoff polynomial method, Fourier transform method and Woodward-Lawson method..

UNIT-IV

Printed antennas: Rectangular and circular patch antenna design, Feeding techniques for micro strip antennas, Methods of analysis, Printed antenna arrays, Bandwidth enhancement techniques.

UNIT-V

Integrated antennas for wireless personal communication systems: Fundamentals, Integrated handset antennas and human interactions, integrated antennas for laptops, Integrated antennas for mobile devices.

Suggested Reading

1. Constantine Balanis, *Modern Antenna Handbook*, John wiley, 2008.
2. Stutzman, W.L. and Thiele, H.A., "*Antenna Theory and Design*", 2nd Ed., John Wiley & Sons.
3. Bahl IJ, and Bhartia, *Microstrip Antennas*, Artech House, 1982.
4. D.G.Fang ,*Antenna Theory and Microstrip Antennas*, CRC press 2010.
5. James.JR.Hall PS.wood.C., *Micro strip Antenna-Theory and Design*, Peter Peregrinu.1981.

EC 4305

MICROWAVE INTEGARATED CIRCUITS

Instruction**:**	3 Periods per week
Duration of University Examination:	3 Hours
University Examination:	70 Marks
Sessionals:	30 Marks

UNIT I

Introduction, Types of MICs, Technology of Hybrid MICS: Dielectric substrates, thick film technology and materials, thin film technology and materials, methods of testing, encapsulation and mounting of active devices.

Technology of Monolithic MICS: Processes involved in fabrication, epitaxial growth of semiconductor layer, growth of dielectric layer, diffusion-ion implantation, electron beam technology.

UNIT II

Analysis of microstripline and strip line. Method of conformal Transformation. Characteristic parameters of Microstrip, strip lines. Introduction to slot line and coplanar waveguide.

UNIT III

Introduction to Coupled Microstrips, Even and odd mode analysis.Theory of couled microstrip Directional couplers. Calculations for a coupled pair of Microstrips. Branch line couplers.

UNIT IV

Lumped Elements for MIC's Design and fabrication of lumped elements, circuits using lumped elements-Impedance transformers, Filters.

UNIT V

Nonreciprocal components for MIC's, Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters. Applications of MIC's.

Suggested Reading

1. Gupta KC, and Amarjit Singh, Microwave Integrated circuits, Wiley Eastern,1974.
2. Hoffman R.K."Hand Book of Microwave integrated Circuits",Artech House,Boston,1987.
3. B. Bhat and S.K.Koul,"Stripline like transmission lines for microwave integrated circuits, New age publishers, 2007 Edition.
4. D.M.Pozar,"*Microwave Engineering*, John Wieley,USA,Paper back edition.

EC 4306

SATELLITE RADIO NAVIGATION

Instruction	3 periods per week	University Examination – Duration	3 Hours
Sectionals	30 Marks	University Examination - Marks	70 Marks

UNIT – I

GPS fundamentals: INS, Trilaiteration, Hyperbolic navigation, Transit, GPS principle of operation, architecture, operating frequencies, orbits, Keplerian element,Solar and Siderial days, GPS and UTC Time.

UNIT-II

GPS Signals: Signal structure, C/A and P-Code, ECEF and ECI coordinate systems and WGS 84 and Types of GPS Receivers, link budget.

UNIT-III

GPS Error: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, multipath; estimation of Total Electron Content (TEC) using dual frequency measurements, Various DOPs, Spoofing and Anti-spoofing: Future GPS satellites, new signals and their benefits.

UNIT-IV

GPS data processing, DGPS and Applications: RINEX Navigation and Observation data formats, Ambiguity resolution, cycle slips, Position estimation, Principle of operation of DGPS, architecture and errors.

UNIT-V

Other Constellations and Augmentation systems Other satellite navigation constellations, Relative advantages of SBAS and GBAS, Wide area augmentation system (WAAS) architecture, GAGAN, EGNOS and MSAS, Local area augmentation system (LAAS) concept.

Suggested Reading:

1. B.Hofmann Wollenhof, H.Lichtenegger, and J.Collins, “GPS Theory and Practice”, Springer Wien, new York, 2000.

2.Pratap Misra and Per Enge, “Global Positioning System Signals, Measurements, and Performance,” Ganga-Jamuna Press, Massachusetts, 2001.

3.Ahmed El-Rabbany, “Introduction to GPS,” Artech House, Boston, 2002.

4.Bradford W. Parkinson and James J. Spilker, “Global Positioning System: Theory and Applications,” Volume II, American Institute of Aeronautics and Astronautics, Inc., Washington, 1996.

5. Elliot D. Kaplan, “Understanding GPS Principles and Applications”, Artech House Boston,1996.

6.A.Leick, “GPS Satellite Surveying”, John Wiley and sons, 1990.

EC4307

MICROWAVE SYSTEMS LABORATORY-I

Instruction:	3 periods per week
Duration of University Examination:	--Hours
University Examination:	--Marks
Sessionals:	50 marks

1. Microwave source characteristics-Reflex Klystron and Gunn oscillator
2. Measurement of the input impedance of an open ended waveguide radiator.
3. Waveguide Discontinuities-Inductive and capacitive Diaphrams
4. Slide Screw Tuner-Equivalent circuit
5. Characterization of Waveguide Slotted Array
6. Frequency Scanned Array Characteristics
7. Communication through Optical Fibre
8. Optical Fibre Loss measurements
9. Study of Spectrum Analyzer

Note: The experiments will be decided and modified if necessary and conducted by the teacher concerned.

EC 4309

SEMINAR - I

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	50 Marks	University Examination - Marks	-

Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

- ✓ Literature survey
- ✓ Organization of the material
- ✓ Presentation of OHP slides / LCD presentation
- ✓ Technical writing

Each student required to:

Submit a one page synopsis before the seminar talk for display on the notice board.

Give a 20 minutes time for presentation following by a 10 minutes discussion.

Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule shall not be entertained.

For award of sessional marks, students are to be judged by at least two faculty members on the basis of an oral and technical report preparation as well as their involvement in the discussions.

EC 4310

SEMINAR - II

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	50 Marks	University Examination - Marks	-

Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

- Literature survey
- Organization of the material
- Presentation of OHP slides / LCD presentation
- Technical writing

Each student required to:

. Submit a one page synopsis before the seminar talk for display on the notice board.

Give a 20 minutes time for presentation following by a 10 minutes discussion.

Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule shall not be entertained.

For award of sessional marks, students are to be judged by at least two faculty members on the basis of an oral and technical report preparation as well as their involvement in the discussions.

EC4308

MICROWAVE SYSTEMS LABORATORY-II

Instruction:	3 periods per week
Duration of University Examination:	--Hours
University Examination:	--Marks
Sessionals:	50 marks

1. Calibration with Vector Network Analyzer
2. Study of non-ideal behavior of lumped circuit components using Network Analyzer
3. Characterization of Micro strip Filters, Couplers and Resonators using Spectrum Analyzer and Network Analyzer.
4. Software simulation and design of passive Microwave Components and printed antennas using

   Ansys HFSS

   Agilent Advanced Design System (ADS)

   AWR Microwave office

   SONNET High Frequency EM simulator

   Zeland IE3D

5. Software simulation of MEMS switches, phase shifters using COMSOL Multi physics.

Note: The experiments will be decided and modified if necessary and conducted by the teacher concerned.

EC 4313

ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks

UNIT 1

Introduction and History of EMI-EMC, Sources & effects of EMI – Intersystem & Intrasystem, Electromagnetic Environment Effects (E3), Common EMI measurement units. Time domain & frequency domain representation of periodic, non-periodic and digital waveforms.

UNIT 2

Conducted Emission & Susceptibility, Radiated Emission & Susceptibility, ESD, Introduction of Commercial & Military EMI Standards, Measurement of EMI, Shielded Enclosure, Antennas, Probes Equipment & Accessories used in EMI measurement.

UNIT 3

EMI Mitigation Techniques, Grounding, Shielding, Filtering & Bonding, EMI Suppression Components like EMI Filters (DC/AC), RFI Filters, EMI Gaskets, RF absorbing material, Transient Voltage Suppressors, Honey-comb vents etc., Cables, Connectors.

UNIT 4

Sub-system and System level EMC, EMC Design of analog and digital Sub-systems, Mixed Signal PCB layout for better EMC, Analog and Digital grounds, EMC of A/D & D/A Converters, EMC of DC-DC Converters and Power Supplies, EMC Design Guidelines , Introduction to Signal Integrity, .

UNIT 5

Introduction to Numerical EMI & EMC Simulation Techniques, Survey of Commercially available EMC Software, Introduction to Intentional EMI, EMP, Electromagnetic Weapons.

Suggested Reading:

1. Clayton R. Paul **"***Introduction to Electromagnetic Compatibility***"** Wiley Publication.

2. Dr. V.P. Kodali, "*Engineering Electromagnetic Compatibility*" IEEE Press,1996.

3. Henry W. Ott," Electromagnetic Compatibility Engineering**"** Wiley Publications.

EC 4314

COMPUTATIONAL ELECTROMAGNETICS

Instruction:	3 Periods per week
Duration of university examination:	3 Hours
University Examination:	70 Marks
Sessionals:	30 Marks

UNIT I

Fundamental Concepts: Integral equations versus differential equations, radiation and edge conditions, modal representation of fields in bounded and unbounded media.

UNIT II

Green's Functions: Green's function technique for the solution of partial differential equations, classification of Green's functions, various methods for the determination of Green's functions including Fourier transform technique and Ohm-Rayleigh technique, dyadic Green's functions, determination of Green's functions for free space, transmission lines, waveguides, and microstrips.

UNIT III

Integral Equations: Formulation of typical problems in terms of integral equations: wire antennas, scattering, apertures in conducting screens and waveguides, discontinuities in waveguides and microstrip lines; Solution of Integral equations: General Method of Moments (MoM) for the solution of integro-differential equations, choice of expansion and weighting functions, application of MoM to typical electromagnetic problems.

UNIT IV

Finite Element Method: Typical finite elements, Solution of two dimensional Laplace and Poisson's equations, solution of scalar Helmholtz equation.

UNIT V

Finite-difference Time-domain Method: Finite differences, finite difference representation of Maxwell's equations and wave equation, numerical dispersion, Yee's finite difference algorithm, stability conditions, programming aspects, absorbing boundary conditions.

Suggested Reading

1. Peterson, A.F, Ray, S.L. and Mittra, R., "*Computational Methods for Electromagnetics*", Wiley-IEEE Press. 1998.
2. Harrington, R.F., "*Field Computation by Moment Methods*", Wiley- IEEE Press. 1993.
3. Sadiku, M.N.O., "*Numerical Techniques in Electromagnetics*", 2nd Ed., CRC Press-2.
4. Ramesh Garg, "*Analytical and Computational Methods in Electromagnetics*", Artech House,2008.

EC 4315

MICROWAVE MEASUREMENTS

Instruction:	3 Periods per week
Duration of university examination:	3 Hours
University Examination:	70 Marks
Sessionals:	30 Marks

UNIT I

Measurement of wave length and Frequency, equivalent circuit of cavity wave meters. Typical wave meters, Resonant cavities. Methods of frequency measurements-Direct measurement – Interpolation method.

UNIT II

Measurement of reflection coefficient Low, high, medium VSWR measurements. Standing wave pattern, Slotted line section and its limitation. Impedance measurement techniques. Nodal shift method. Tangent method. Reflectometer.

UNIT III

Measurement of microwave power: Typical barater elements, thermistor. Bolometer bridge circuits, extending range of bolometer devices, low and high power measurement techniques.

UNIT IV

Measurement of attenuation: insertion loss method. Substitution method. Measurement of S-parameters. Network Analyser principle. Reflection and Transmission measurements using vector network Analyser.

UNIT V

Measurements on passive microwave components. Characteristics of directional coupler. Isolator, Circulator. Antenna Measurements. Measurements of radiation pattern, Antenna gain measurements. Far field and Near field techniques.

Suggested Reading

1. Ginzton, EL,. Microwave Measurements, McGraw Hill

2. Sucher & Fox. Microwave Measurements. Vol.I, II, III.

3. Montgemery. Cc., Techniques of Microwave Measurements, Radiation Lab Series.

EC 4316

MICROWAVE SEMICONDUCTOR DEVICES

Instruction**:**	3 Periods per week
Duration of University Examination:	3 Hours
University Examination:	70 Marks
Sessionals:	30 Marks

UNIT I

Transient and ac behavior of p-n junctions, effect of doping profile on the capacitance of p-n junctions, noise in p-n junctions, high-frequency equivalent circuit. Varactor diode: Equivalent circuit, static and dynamic figures of merit Manley Rowe power relation. Parametric amplifiers. Up converter, Degeneration amplifiers, Varactor multipliers. Charge storage capacitance.

UNIT II

Tunnel diode: equivalent circuit. Tunnel diode stability, Tunnel diode amplifiers. Gunn devices: Volt amp. Characteristics, Small signal, Nonlinear, large signal theory, Modes of operation of Gunn diode, Gunn amplifiers-Gunn oscillators, Avalanche transit time MW diodes. Small signal theory, Large signal operation, Noise.

UNIT III

PIN diodes: Description, the I-layer. Equivalent circuit behavior under reverse bias and forward bias. Diode impedance. Materials. Applications- Switches, limiters, phase shifters and modulators.

UNIT IV

Schottky Barrier Diode: Physics of Schottky barriers. Design of and performance of Schottky barrier diode applications. IMPATT & TRAPATT diodes: Principles and applications as amplifiers and oscillators.

UNIT V

High frequency limitations of BJT, microwave bipolar transistors, heterojunction bipolar transistors; GaAs FETs, low noise and power GaAs FETs and their applications. DC biasing and impedance matching. Microwave transistor 'S' parameters. Operating characteristics of MISFETs and MESFETs, short-channel effects, high electron mobility transistor.

Suggested Reading

1. S.Y.Liao, *Microwave Devices and Circuits*, Third addition, Prentice Hall.

2. Watson, "Microwave Semiconductor Devices and their applications", McGraw Hill, 1969.

3. Sze, S.M., and Ng, K.K., "Physics of Semiconductor Dev ices", 3rd Ed., wiley-Interscience,2006.

4. Golio, M., "RF and Microwave Semiconductor devices Handbook", CRC Press (2002).

EC 4317

PHASED ARRAY RADAR

Instruction:	3 Periods per week
Duration of University Examination:	3Hours
University Examination:	70Marks
Sessionals:	30 Marks

Unit I

Conventional scanning techniques, Mechanical versus electronic scanning, Techniques of Electronic scanning, Frequency, Phase and time delay scanning principle, Hybrid scanning techniques.

Unit II

Array Theory, Linear and Planner arrays, various grid configuration, Concept of cell and grid, Calculation of minimum number of elements, Radiation pattern, Grating lobe formation, Rectangular and triangular grid design of arrays.

Unit III

Feed Networks for phased Arrays, Corporate Feed, Lens and Reflect feed Techniques, Optimum f/d ratio basic building block for corporate feed network, Series, Parallel feed networks, Comparison of various feeding techniques, Antenna Array Architecture, Brick/ Tile Type construction.

Unit IV

Frequency scanned array design, Snake feed, Frequency-phase scanning, Phase scanning, Digital phase shifter PIN diode and Ferrite phase shifters for phased arrays, Beam pointing errors due to digitalization, Beam pointing accuracy.

Unit V

Search patterns, Calculation of search frame time, Airborne phased array design, Electronic scanning radar parameter calculation, Application of phased arrays, Phased Array Radar Systems, Active Phased Array, TR/ATR Modules.

Suggested Reading

1) Olliner & knittel, Phased Array Radar, Artech House, 1972.
2) Kahrilas, PJ, Electronic Scanning Radar Systems Design Handbook, Artech House, 1976.
3) Skolnik, MI, Radar Handbook, Mcgraw Hillso, NY, 1970.
4) Hansen, RC, Significant Phased Array Papers.
5) Galati,G-(editor), Advanced Radar Technique and Systems, Peter Peregrims Ltd, London, 1993.

EC 4318

RADAR SIGNAL PROCESSING

Instruction**:**	3 Periods per week
Duration of University Examination:	3 Hours
University Examination:	70 Marks
Sessionals:	30 Marks

UNIT I

Introduction: Radar Block Diagram, Radar Equation, Information Available from Radar Echo. Review of Radar Range Performance– General Radar Range Equation, Radar Detection with Noise Jamming, beacon and Repeater Equations, Bistatic Radar. Matched Filter Receiver – Impulse Response, Frequency Response Characteristic and its Derivation, Matched Filter and Correlation Function, Correlation Detection and Cross-Correlation Receiver, Efficiency of Non-Matched Filters, Matched Filter for Non-White Noise.

UNIT II

Detection of Radar Signals in Noise: Detection Criteria – Neyman-Pearson Observer, Likelihood-Ratio Receiver, Inverse Probability Receiver, Sequential Observer, Detectors –Envelope Detector, Logarithmic Detector, I/Q Detector. Automatic Detection - CFAR Receiver, Cell Averaging CFAR Receiver, CFAR Loss, CFAR Uses in Radar. Radar Signal Management – Schematics, Component Parts, Resources and Constraints.

UNIT III

Waveform Selection [3, 2]: Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse, Noise Like Waveforms, Waveform Design Requirements, Optimum Waveforms for Detection in Clutter, Family of Radar Waveforms.

UNIT IV

Pulse Compression in Radar Signals: Introduction, Significance, Types, Linear FM Pulse Compression – lock Diagram, Characteristics, Reduction of Time Side lobes, Stretch Techniques, Generation and Decoding of FM Waveforms – Block Schematic and Characteristics of Passive System, Digital Compression, SAW Pulse Compression

UNIT V

Phase Coding Techniques: Principles, Binary Phase Coding, Barker Codes, Maximal Length Sequences (MLS/LRS/PN), Block Diagram of a Phase Coded CW Radar. Poly Phase Codes : Frank Codes, Costas Codes, Non-Linear FM Pulse Compression, Doppler Tolerant PC Waveforms – Short Pulse, Linear Period Modulation (LPM/HFM), Side lobe Reduction for Phase Coded PC Signals.

Suggested Reading

1. Radar Handbook - M.I. Skolnik, 2nd Ed., 1991, McGraw Hill.
2. Radar Design Principles : Signal Processing and The Environment - Fred E. Nathanson, 2nd Ed., 1999, PHI.
3. Introduction to Radar Systems - M.I. Skolnik, 3rd Ed., 2001, TMH.
4. Radar Principles - Peyton Z. Peebles, Jr., 2004, John Wiley.
5. Radar Signal Processing and Adaptive Systems - R. Nitzberg, 1999, Artech House.
6. Radar Design Principles - F.E. Nathanson, 1st Ed., 1969, McGraw Hill.

EC 4319

SATELLITE AND MICROWAVE COMMUNICATIONS

Instruction	3 periods per week	University Examination – Duration	3 Hours
Sectionals	30 Marks	University Examination - Marks	70 Marks

UNIT – I

Introductory concepts: Transmission problem, simplified transmission system, the decibel and basic derived decibel unit, Neper, practical transmission, speech, SNR, Noise figure and noise temperature, CCITT modulation plan.

UNIT-II

LOS and Tropospheric scatter communication system: Link engineering, propagation characteristics in free space, Introduction to Tropospheric scatter communication system, phenomenon of tropospheric scatter, tropospheric fading, path loss calculations,

UNIT-III

Earth Station Technology: Introduction, Elements of an Earth Station, Types of Earth Stations, Equipment Reliability and Space Qualification, Redundancy.

UNIT-IV

Mobile Satellite Communications- Introduction, International Maritime Satellite (INMARSAT), Mobile satellite Communications with Non-Geo Satellite, VSAT Systems: VSAT Network Configurations, VSAT System Elements, Advantages and Applications of VSAT Systems, Recent Applications of Satellite Communications.

UNIT-V

Modern Developments and Future Trends-Introduction, Micro and Nano Satellites, Satellite Laser Communication, Air-Craft launching, Orbital refueling, Deep Space Communication, GNSS.

Suggested Reading:

1. Roger L Free man, "Telecommunication transmission handbook", John Wiley, 4th Edition, 1998.
2. T.Pratt & C.W. Bostian, "Satellite Communication Systems", PHI, 1st edition, 1986.
3. B.G.Evans, Satellite communication system edited, 3rd edition, IET, U.K., 2008.
4. Dennis Roddy, "Satellite Communication Systems", Mc Graw Hill publications, 4th Edition, 2006.
5. Wayne Tomasi "Advanced Electronics Communication System" Pearson Education, 6th Edt, Apr 2003.

EC 4320

OPTICAL FIBER COMMUNICATION SYSTEMS

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks

UNIT I

Optical Fibres: Fibre Structures, Wave-guiding and fabrications, Overview of Optical fibre communications, Elements of an Optical fibre transmission Link, Nature of light, Basic optical laws and definitions, Modes and configurations, Mode theory of circular wave guides, Single, Multi mode step index and Graded index Fibres , Fibre materials. Signal degradation in Optical Fibres. Dispersion, Pulse broadening in graded index fibres, Mode coupling, Design optimization of single mode Fibres.

UNIT II

Optical Sources & Detectors: Semiconductors as optical Sources and their fabrication. LED and Laser diodes, Linearity of sources, Modal, Partition and reflection noise, Physical principles of PIN and APD, Photo detector noise, detector response time, Avalanche multiplication noise, Temperature effect on avalanche gain, Comparison of Photo detectors.

UNIT III

Optical Fibre communication: Basic communication system, Fundamental receiver operation, Digital receiver performance calculations. Preamplifiers types, Analog receivers. Fibre Links: Point to point links, Line coding, Error correction, Noise effects on digital transmission system performance. Overview of analog links, Carrier noise ratio in analog systems.

UNIT IV

Multi channel transmission techniques: WDM concepts and components. Operational principles of WDM, Passive components, Tunable sources, Tunable filters, Introduction of optical amplifiers.

UNIT V

Optical Networks: Basic Networks, SONET/SDH, Broadcast and select WDM networks, Wavelength Routed Networks, Nonlinear effects on Network Performance, Performance of EDFA+WDM systems, Optical CDMA, Ultrahigh capacity Networks.

Suggested Reading

1. Djafar K.mynbaev Lowell l.Scheiner “Fibre Optic Communications Technology”, Pearson Education Asia.

2. Senior John M. “Optical Fibre Communications Principles and Practice”, Prentice Hall India, second edition, 1996

3. Keiser Gerd , “Optical Fibre Communications”, Mc GrawHill, second edition,1999.

EC 4321

RF MEMS

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks

UNIT-1

Microelectromechanical Systems (MEMS) And Radio Frequency MEMS: Introduction – Microfabrication for MEMS – Electromechanical transducers – Microsensing for MEMS – Materials for MEMS.

MEMS Materials And Fabrication Techniques: Metals – Semiconductors – Thin films for MEMS and their deposition techniques – Materials for polymer MEMS – Bulk micromachining for silicon-based MEMS – Silicon surface micromaching – Microstereo lithography for polymer MEMS.

UNIT-2

RF MEMS Switches: Introduction – Switch parameters – Basics of switching – Switches for RF and microwave applications – Electrostatic switching – Approaches for low-actuation –voltage switches – thermal switching. Bistable micro relays and microactuators. –MEMS switch design, modeling and evaluation –MEMS switch design considerations.MEMS Inductors and Capacitors: Introduction – MEMS inductors – MEMS capacitors.

UNIT-3

Micromachined RF Filters and Phase Shifters: Introduction – Modeling of mechanical filters - Micromechanical filters –Micromachined phase shifters: Introduction – Types of phase shifters and their limitations – MEMS phase shifters.

UNIT-4

Micromachined Antenna: Introduction - Overview of microstrip antenna – Micromachining techniques to improve antenna performance – Micromachining as a fabrication process for small antenna – Micromachined reconfigurable antenna.

UNIT-5

Micromachined Transmission Lines And Components: Introduction – Micromachined transmission lines and components – Design, fabrication and measurements. Integration And Packaging for RF MEMS Devices: Role of MEMS packages, Types of MEMS packages, Multichip module packaging, Reliability issues, Thermal issues.

Suggested Readings

1. Vijay K Varadan, Vinoy K J and Jose K A, "RF MEMS and Their Applications“, Published by John Wiley & Sons Ltd, England, reprinted April 2003.
2. Gabriel M Rebeiz, “RF MEMS Theory, Design and Technology “, John Wiley & Sons Ltd, New Jersey, 2003.
3. Hector J De Los Santos,”RF MEMS Circuit Design for Wireless communications”, Artech House, 2002.

EC4323

MICROWAVE SOLID STATE DEVICES AND APPLICATIONS

Instruction**:**	3Periods per week
Duration of University Examination:	3 Hours
University Examination:	70 Marks
Sessionals:	30 Marks

UNIT-I

Introduction to two terminal microwave devices. Microwave BJTs. GaAs FETs, low noise and power GaAs FETs and their applications. DC biasing, Z and Y smith charts and impedance matching circuits.

UNIT-II

RF Switches, Phase shifter and attenuators: SPST and SPDT design using FETs, FET based attenuators and phase shifters. Characterization of Switches, attenuators and phase shifters

UNIT-III

Amplifiers - Microwave transistor 'S' parameters. Power gain equations, stability, impedance matching,constant gain and noise figure circles; Small signal, low noise, high-power and broadband amplifier designs. Characterization of amplifiers.

UNIT-IV

Oscillators: Negative resistance concept, types of resonators, oscillator condition. One port, two port, YIG dielectric oscillators, broad band oscillator, Gunn diode oscillator design, and wave guide cavity IMPATT oscillator design. FET oscillator design. Characterization of oscillators.

UNIT-V

Microwave Mixers design: Diode mixer theory, single diode mixers; single balanced, double balanced mixers.FET mixer theory, balanced FET mixers, and special mixer circuits. Characterization of Mixers.

Texts/References

1.S.Y. Liao, Microwave Circuit Analysis and Amplifier Design, Prentice Hall, 1987.
2.G.D. Vendelin, A.M. Pavio, U.L. Rohde, Microwave Circuit Design, Using Linear and Non-linear Techniques, John Wiley, 1990.
3.S.Y.Liao, Microwave Devices and Circuits, Third addition, , Prentice Hall.
4.Microwave Transistor Amplifiers: Analysis and Design (2nd Edition) , 1996 by Guillermo Gonzalez
5.Microwave Mixers (Artech House Antennas and Propagation Library) (Artech House Microwave Library) 1993 by Stephen A. Maas
6.Control Components Using Si, GaAs, and GaN Technologies By Inder J. Bahl.

EC 4224 ENGINEERING RESEARCH METHODOLOGY

Instruction	3 periods per week	University Examination – Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT-I

Research Methodology:

Objectives and Motivation of research- types of research- Research approaches – Significance of Research-Research Methods versus Methodology-Research and Scientific method- Importance of research methodology – Research process- criteria of good research- Problems encountered by Researchers in India-benefits to society in general.

Defining Research Problem:

Definition of research problem- problem formulation- necessity of defining the problem-techniques involved in defining a problem.

UNIT-II

Literature Survey: Importance of Literature Survey-Sources of information-Assessment of Quality of journals and articles-Information through internet. Literature Review: Need of Review-Guidelines for Review-Record of Research Review.

UNIT-III

Research Design: Meaning of research design - need of research design- features of a good design-important concepts relating to research design- different research designs- Basic Principles of experimental designs- Developing a Research plan- Design of experimental set-up-Use of standards and codes.

UNIT-IV

Exploration of data: Analysis of data- Role of statistics for data analysis –Functions of statistics-Estimation of population parameters –Parametric vs non-parametric methods- Descriptive statistics- Point of central tendency- Measures of variability- Inferential statistics- estimation-Hypothesis testing – Use of statistical software.

Data Analysis : Deterministic data and random data- uncertainty analysis – tests for significance – Ch-square test- Student's 't' test- Regression modeling-ANOVA-F test- Time series analysis-Autocorrelation and Autoregressive modeling.

UNIT-V

Research Report Writing:

Format of research report- style of writing report- reference/ bibliography/Webiliography-Technical paper writing. Research proposal preparation: Writing a research proposal and research report- writing a Research Grant Proposal.

Suggested Reading:

1. C.R.Kothari, Research methodology, Methods & technique, New age international publishers, 2004.

2. R.Ganesan, Research Methodolgy for Engineers, MJP Publishers: Chennai, 2011.

3. Dr. Vijay Upagade and Dr.Aravind Shende; Research Methodology; S.Chand & company limited., NewDelhi;2004

4. P.Ramdass and A.Wilson Aruni; Research and Writing across the disciplines: MJP Publishers; Chennai 2009.

List of Subjects for ME (ECE) Course (Regular/Part-Time) with specialization in
SYSTEMS AND SIGNAL PROCESSING w.e.f. 2015-2016

S.No	Syllabus Ref. No	Subject	Periods per week
Core Subjects			
1	EC 4201	Digital Spectral Analysis	3
2	EC 4202	Adaptive Signal Processing	3
3	EC 4203	Digital Control	3
4	EC 4204	Modern Digital Signal Processing	3
5	EC 4205	Real Time Signal Processing	3
6	EC 4206	Coding Theory & Techniques	3
7	EC 4207	Systems & Signal Processing Laboratory –I	3
8	EC 4208	Systems & Signal Processing Laboratory – II	3
9	EC 4209	Seminar I	3
10	EC 4210	Seminar II	3
11	EC 4211	Project Seminar	3
12	EC 4212	Dissertation	--
Elective Subjects			
13	EC 4213	Multimedia Information Systems	3
14	EC 4318	Radar Signal Processing	3
15	EC 4214	Wireless Communication and Networks	3
16	EC 4215	Digital Video Processing	3
17	EC 4216	Optimization Techniques	3
18	EC 4225	Engineering Mathematics	3
19	EC 4217	Spread Spectrum Communications	3
20	EC 4218	Pattern Recognition	3
21	EC 4219	Speech Signal Processing	3
22	EC 4220	Ad-Hoc Wireless and Sensor Networks	3
23	EC 4221	Neural Networks & Fuzzy Logic	3
24	EC 4222	Systems Simulation & Modeling	3
25	EC 4223	VLSI Signal Processing	3
26	EC 4224	Engineering Research Methodology	3

Note: Core of one specialization can be elective for other specialization provided condition for prerequisite is satisfied. However, prior permission of the Chairman is to be obtained. This is also applicable to elect.

EC 4201

DIGITAL SPECTRAL ANALYSIS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Review of probability and Random process theory. Introduction. Classical approach. Bayes theorem. Disrete Random variables. Continuous Random variables. Joint Distribution. Variance standard deviation. Binomial poissons and Normal distribution. Entropy. Ergodicity. Spectral interpretation of ergodicity. Covarince ergodic process.

UNIT II

Classical spectral estimation: Windows. Resolution and the Stability. Time bandwidth product, Cross correlation, and Auto correlation estimation. Correlogram method of PSD estimation, periodogram method of PSD estimation, combined periodogram / correlogram method of estimation. Application of sunspot numbers.

UNIT III

Parametric models of Random processes: AR, MA and ARMA Random process models, Relation among AR, MA and ARMA parameters to the autocorrelation sequence. Spectral factorization, AR process properties. Forward and backward linear prediction. Levinson's algorithm. Reflection coefficients.

UNIT IV

Autoregressive Spectral estimation Block data algorithms: Reflection coefficient estimation methods. Geomtric hannonic & Recursive MLE methods. Least squares LP estimation methods. Combined forward 7 backward LP algorithm Application of sunspot numbers.

UNIT V

AR Spectral estimation: Sequential data algorithms: Gradient adaptive AR method, RLS method, Fast RLS method. Minimum variance spectral estimation. Derivation of the minimum variance spectral estimator Relationship of MA and AR spectral estimators. Implementation of MA spectral estimator.

Suggested Reading:

1. Marple, Jr. SL., Digital Spectral Analysis with applications, PHI, PTR, Englewood Cliffs New Jersey.
2. Proakis John G., Dlmitres, G. Manolakis., Digital Signal Processing. Principles and Algorithm and applications, PHI. India. Pvt. Ltd., New Delhi, 1997.
3. Auhanasios Papoulis, Probabilty, Random Variables and Stochastic Processes, MGH, Inc., 1991.
4. Singh. RP and Sapre SD., Communication Systems Analog and Digital, Tata McGrawHill Publishing Co.. Ltd.. New Delhi.

EC 4202

ADAPTIVE SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Approaches to the development *of* adaptive filter theory. Introduction to filtering, smoothing and prediction. Wiener filter theory, introduction; Error performance surface; Normal equation; Principle of orthogonality; Minimum mean squared error; example.

UNIT II

Gradient algorithms; Learning curves; LMS gradient algorithm; LMS stochastic gradient algorithms; convergence of LMS algorithms.

UNIT III

Applications of adaptive filter to adaptive noise canceling, Echo cancellation in telephone circuits and adaptive beam forming.

UNIT IV

Kalman Filter theory; Introduction; recursive minimum mean square estimation for scalar random variables; statement of the kalman filtering problem: the innovations process; Estimation of state using the innovations process; Filtering examples.

UNIT V

Vector Kalman filter formulation. Examples. Application of kalman filter to target tracking.

Suggested Reading:

1. Sophoclas, *J*. Orphanidies, "Optimum signal processing an introduction", McMillan, 1985.

2. Simon Haykins, "Adaptive signal processing", PHI, 1986.

3. Bernard Widrow, "Adaptive signal processing", PHI,1986.

4. Bozic. SM., Digital and Kalman Filtering.

EC 4203

DIGITAL CONTROL

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

TRANSFER FUNCTIONS ,BLOCK DIAGRAMS ,AND SIGNAL FLOW GRAPHS

Review of Z-Transform, Applications of Z-Transform, Signals between sampling instants-Submultiple sampling method & Delayed Z-Transform and the modified Z-Transform.

Introduction to Pulse Transfer Function and Z-Transfer function, Relation between G(s) and G(z), Closed loop systems, Sampled Signal Flow Graph, Modified Z-Transfer function, Multirate Discrete Data Systems(Slow-Fast, Fast-Slow, Multirate Systems with All Digital systems, Closed loop multi sampled systems, and Cyclic Rate sampled systems, Zero order hold, first order hold and Polygonal hold.

UNIT II

STATE VARIABLE TECHNIQUE

State Equations of Discrete Data systems with Sample and Hold Devices, State equations of Digital Systems with All-Digital Elements, The State Transition Equations(the recursive method and the z-transform method), Relationship between State Equations and Transfer Functions, Characteristic Equation, Eigen Values and Eigen Vectors, Methods of Computing the Transition Matrix(The Cay-ley Hamilton Theorem, The Z-Transform Method), State Diagrams of Digital Systems, Decomp[osition of Discrete- Data Transfer Functions.

UNIT III

TIME DOMAIN AND Z-DOMAIN ANALYSIS

Introduction, Prototype Second Order system, Comparison of Time Responses of Continuous Data and Discrete Data systems, Steady State Error analysis of Digital Control systems, Correlation between time response and root locations in S-plane and Z-plane, Dominant Characteristic Equation, Root loci of Digital Control systems, Effects of adding poles and Zeroes to Open loop transfer function

FREQUENCY DOMAIN ANALYSIS

Introduction, Polar plot of GH (z), Nyquist Stability criterion, Bode plot, Gain Margin and Phase Margin, Bandwidth considerations, and Sensitivity analysis

UNIT IV

DESIGN OF DISCRETE DATA CONTROL SYSTEMS

Introduction, Cascade Compensation by continuous data Controllers, Design of Continuous Data Controllers with Equivalent Digital Controllers, Digital controllers, Design of Digital Control systems with Digital controllers through Bilinear transformation, Design in the Z-plane using Root Locus Diagram.

UNIT V

DESIGN OF DIGITAL CONTROL SYSTEMS

Control System parameters, Conventional design tools- Root locus and Bode plots, compensation-Phase lead, phase lag and PID controllers. Applications of DSPs in control systems-PID controllers, Motor control and Robotics.

Suggested Reading:

1. BC Kuo, “Digital Control Systems”, Second Edition, Saunders college Publishing, 1992.
2. Nekoogar F and Moriarty G, “ Digital Control Using Digital Signal Processing”, Prentice Hall Inc, 1999.
3. M. Gopal, “ Digital Control and State Variable Methods(conventional and intelligent Control) Systems, Third Edition, TMH.

EC 4204

MODERN DIGITAL SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

FIR filters: Review of frequency response of discrete time systems and FIR filters, Optimal FIR filters, Frequency sampling method of FIR filters, Comparison of different methods, FIR cascaded and lattice structures.

UNIT II

IIR filters: Design of digital IIR low pass filters, Spectral or frequency transformation of IIR filters, Computer aided design of IIR filters, cascaded and lattice structures of IIR filters, Finite word length effects in IIR filters..

UNIT III

Multirate signal processing – Decimation by a integer factor , Interpolation by a integer factor , Sampling rate conversion by a rational factor , Design of practical sampling rate converters, Software implementation of sampling rate converters, Applications of Multirate signal processing.

UNIT IV

Multi rate filter banks and wavelets: Digital filter banks, Two- channel quadrature mirror filter banks, L – channel QMF banks, multi level filter banks.

UNIT V

Introduction to wavelet transforms – Short time Fourier transform, Gabar transform, wavelet transform, Recursive multi resolution Decomposition, Haar Haar wavelet, Digital filter implementation of the interpretation. Filtering

Suggested Reading:

1. Emmanuel C. Ifeachor and Barrie W. Jervis, 'Digital Signal Processing- A practical approach, 2nd edition, Pearson Education, 2004.
2. Proakis, JG and Manolakis, DG, 'Digital signal Processing', PHI, 4th ed., 2006.
3. Roberto Cristi, Modern Digital Signal Processing, Thomson Books, 2004.
4. SK Mitra, Digital Signal Processing, TMH, 2006.

EC 4205

REAL TIME SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Real time concepts, Structural levels of processing, Digital Signal processing and DSP systems, Comparison between general purpose and DSP processors. Examples of digital signal processors, Motivation of the specialized processors. Fixed point vs Floating point, native data word width.

UNIT II

Key features of TMS 320CS54XX, architecture, addressing modes and Instruction set of TMS 320C54XX, special instructions - FIRS and LMS.

UNIT III

Architecture, addressing modes and instruction set of Analog devices Blackfin Processor ADSP 215XX

UNIT IV

Implementation of Digital Filters on DSP Processors – FFT, FIR filters, IIR filters, Adaptive filters and multirate filters.

UNIT V

Practical DSP applications in communications, Sine wave generators and applications, Noise generators and applications, DTMF tone detection, Adaptive echo cancellation, Speech enhancement techniques.

Suggested Reading:

1. John G. Ackenhhusin, Real time Signal Processing, Prentice Hall of India, 1999.
2. Sen M. Kuo and Bob H. Lee, Real time Digital Signal Processing - Implementations, applications and experiments with TMS 55XX, John Wiley Publications, 2001.
3. TMS 320C54XX,User's guide.
4. Avatar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP processors, Thomson Brooks, 2004.
5. Data Sheets of Blackfin Processor.

EC 4206

CODING THEORY AND TECHNIQUES

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT–I:

Coding for Reliable Digital Transmission and Storage: Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies. Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Applications of Block codes.

UNIT – II:

Cyclic Codes: Description, Generator and Parity - check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding ,Cyclic Hamming Codes, Shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

UNIT–III:

Convolutional Codes:

Introduction of convolution code, Polynomial description of convolution code, Generator matrix of convolution code, State diagram, Tree diagram, Trellis diagram, Sequential decoding and Viterbi decoding, Known good convolution code, Introduction to LDPC and Turbo codes.

UNIT–IV:

Burst–Error-Correcting Codes: Decoding of Single-Burst error Correcting Cyclic codes, Burst-Error-Correcting Convolutional Codes, Bounds on Burst Error-Correcting Capability, Interleaved Cyclic and Convolutional Codes, Phased-Burst–Error-Correcting Cyclic and Convolutional codes.

UNIT-V:

BCH – Codes: BCH code-Definition, Minimum distance and BCH Bounds, Decoding Procedure for BCH Codes-Syndrome Computation and Iterative Algorithms, Error Location Polynomials and Numbers for single and double error correction

Suggested Reading:

1. *Error Control Coding-Fundamentals and Applications* –Shu Lin, Daniel J.Costello,Jr, Prentice Hall, Inc.
2. *Error Correcting Coding Theory*-Man Young Rhee-1989, McGraw-Hill Publishing
3. *Digital Communications - Fundamental and Application* - Bernard Sklar, PE.
4. *Digital Communications* - John G. Proakis, 5th Ed., 2008, TMH.
5. *Introduction to Error Control Codes* - Salvatore Gravano - oxford
6. *Error Correction Coding – Mathematical Methods and Algorithms* – Todd K.Moon, 2006, Wiley India.
7. *Information Theory, Coding and Cryptography* – Ranjan Bose, 2nd Ed, 2009, TM

EC 4207

SYSYEMS AND SIGNAL PROCESSING LABORATORY –I

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	50 Marks	University Examination - Marks	-

Section - 1:

Generating basic waveforms (impulse, step .ramp, exponential, in…) Design of FIR filtering, with and with windows. Design of IIR filtering (butterworth, chebyshow, IIR, BLT combination) FFT, DCT (frequency response analysis)

Section -2:

Using the simulink generate the basic waveforms ((impulse, step .ramp, exponential, sin…) observe the waveforms on the CRO Using simulink generate the modulated waveforms Time response of nonlinear system Creating discrtet time control system

Section -3:

Using the tool GUIDE for generating the frontend

EC 4208

SYSYEMS AND SIGNAL PROCESSING LABORATORY –II

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	50 Marks	University Examination - Marks	-

Section - 1:

Understanding the DSP memory architecture

Part (a): Declaring and initializing the variables.

And moving the data to and from memory (register to memory, memory to register)

ii. Setting up Circular buffering , hardwared loops

a. Adding the 10 consecutive numbers
b. Splitting he numbers

c. Bit level operations.

Understanding the DSP MAC capabilities

Windowing

Convolution
FIR filtering

Understanding the DSP parallel instruction optimization

FFT without parallel instruction FFT
with parallel instructions;

Interfacing the DSP processor in real-time.

Initialization of Audio codec.
Interfacing with serial port.

Testing with loop back’

EC 4209

SEMINAR - I

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	50 Marks	University Examination - Marks	-

Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

i) Literature survey
ii) Organization of the material
iii) Presentation of OHP slides / LCD presentation
iv) Technical writing

Each student required to:

1. Submit a one page synopsis before the seminar talk for display on the notice board.

2. Give a 20 minutes time for presentation following by a 10 minutes discussion.

3. Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule shall not be entertained.

For award of sessional marks, students are to be judged by at least two faculty members on the basis of an oral and technical report preparation as well as their involvement in the discussions.

EC 4210

SEMINAR - II

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	50 Marks	University Examination - Marks	-

Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

i) Literature survey
ii) Organization of the material
iii) Presentation of OHP slides / LCD presentation
iv) Technical writing

Each student required to:

4. Submit a one page synopsis before the seminar talk for display on the notice board.

5. Give a 20 minutes time for presentation following by a 10 minutes discussion.

6. Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule shall not be entertained.

For award of sessional marks, students are to be judged by at least two faculty members on the basis of an oral and technical report preparation as well as their involvement in the discussions.

EC 4211

PROJECT SEMINAR

Instruction	3 Periods per week	University Examination - Duration	-
Sessionals	100 Marks	University Examination - Marks	-

The main objective of the Project Seminar is to prepare the students for the dissertation to be executed in 4th semester. Solving a real life problem should be focus of Post Graduate dissertation. Faculty members should prepare the project briefs (giving scope and reference) at the beginning of the 3rd semester, which should be made available to the students at the departmental library. The project may be classified as hardware / software / modeling / simulation. It may comprise any elements such as analysis, synthesis and design.

The department will appoint a project coordinator who will coordinate the following:
Allotment of projects and project guides.
Conduct project - seminars.
Each student must be directed to decide on the following aspects:

- Title of the dissertation work.
- Organization.
- Internal / External guide.
- Collection of literature related to the dissertation work.

Each student must present a seminar based on the above aspects as per the following guidelines:

1. Submit a one page synopsis before the seminar talk for display on the notice board.

2. Give a 20 minutes presentation through OHP, PC followed by a 10 minutes discussion.

3. Submit a report on the seminar presented giving the list of references.

Project Seminars are to be scheduled from the 3rd week to the last week of the semester.

The internal marks will be awarded based on preparation, presentation and participation.

EC 4212

DISSERTATION

Instruction	--	University Examination - Duration	--
Sessionals	--	University Examination - Marks	Grade+

The students must be given clear guidelines to execute and complete the project on which they have delivered a seminar in the 3rd semester of the course.

All projects will be monitored at least twice in a semester through student's presentation. Sessional marks should be based on the grades/marks, awarded by a monitoring committee of faculty members as also marks given by the supervisor.

Efforts be made that some of the projects are carries out in industries with the help of industry coordinates.

Common norms will be established for documentation of the project report by the respective department.

The final project reports must be submitted two weeks before the last working day of the semester.
The project works must be evaluated by an external examiner and based on his comments a viva voice will be conducted by the departmental committee containing of HOD, two senior faculty and supervisor.

+ Excellent /Very Good / Good/Satisfactory / Unsatisfactory

EC 4318

RADAR SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT-I

Introduction : Classification of Radars based on functions, principles of operation etc., performance measures and interplay between Radar parameters, Target parameters and Environment parameters. Classical Detection and Estimation Theory, Binary Hypotheses Testing, Likelyhood Ratio Test, Neymon square, MAP, Maximum Likelihood Estimation of parameters, Cramer-Rao Bounds, Chemoof Bounds.

UNIT – II

Representation of Singals, K-L expansion, Equivalent Low-pass representation of Band pass signals and noise. Detection of Slowly Fluctuating point Targets in white noise and coloured noise. Swerling Target models. Optimum receivers. Correlator and Band pass M atohed Filter Receivers. PD – PF performance; Coherent and non-coherent Integration sub-optimum Reception. Radar Power – Aperture product.

UNIT III

Range and Doppler Resolution : Ambiguity function and its properties. Local and Global Accuracy. Signal Design. LFM. Polyphase coded signals Detection of a Doppler shifted slowly fluctuating point target return in a discrete scatterer environment.

UNIT IV

Dobly dipersive Fading Target and Clutter models-Scattering function description. Land clutter-pulse length limited and Beam width limited clutter. Sea clutter.

UNIT V

Optimum / Sub optimum reception of Range Spread / Doppler Spread / Doubly spread targets in the presence of noise and clutter. Introduction to Adaptive Detection and CFAR Techniques.

Suggested Reading:

1. Di Franco. JV and Rubin, WL., “Radar Detection”, Artech House, 1980.
2. Gaspare Galati (Ed), “Advanced Radar Techniques and Systems”, Peter Perigrinus Ltd., 1993.
3. Ramon Nitzberg, “Radar Signal Processing and Adaptive Systems”, Artech House, 1999.
4. August. W Rihaczek, “Principles of High Resolution Radar”, Artech House, 1996.

EC 4215

DIGITAL VIDEO PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Fundamentals of Image Processing and Image Transforms; Basic steps of Image Processing System, Monochrome and color vision models**,** Image acquisition and display, Sampling and Quantization of an image – Basic relationship between pixels

Image Transforms: 2 D- Discrete Fourier Transform, Discrete Cosine Transform (DCT), Wavelet Transforms: Continuous Wavelet Transform, Discrete Wavelet Transforms.

UNIT II

Image Processing Techniques Image Enhancement Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering. Laplacian of Gaussian (LOG) filters.

Image Segmentation: Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region Based segmentation. Hough Transform, boundary detection, chain coding,

UNIT III

Image Compression Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Huffman coding, Arithmetic coding, LZW coding, Run length coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding, JPEG standards.

UNIT IV

Basic steps of Video Processing Analog Video, Digital Video. Principles of color video processing, composite versus component video, Time-Varying Image Formation models Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT V

2-D Motion Estimation Optical flow, General Methodologies, Pixel Based Motion Esimation, Block-Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding, Contant dependent video coding and Joint shape and texture coding ,MPEGs and H.26x standards.

Suggested Readings

4. Gonzaleze and Woods Digital Image Processing –, 3rd ed., Pearson.
5. Yao Wang, Joem Ostermann and Ya–quin Zhang Video processing and communication –. 1st Ed., PH Int.

M. Tekalp, "Digital Video Processing, Prentice Hall International

EC 4216

OPTIMIZATION TECHNIQUES

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Use of optimization methods. Introduction to classical optimization techniques, motivation to the simplex method, simplex algorithm, sensitivity analysis.

UNIT II

Search methods - Unrestricted search, exhaustive search, Fibonocci method, Golden section method, Direct search method, Random search methods, Univariate method, simplex method, Pattern search method.

UNIT III

Descent methods, Gradient of function, steepest decent method, conjugate gradient method. Characteristics of constrained problem, Direct methods, The complex method, cutting plane method.

UNIT IV

Review of a global optimization techniques such as Monte Carlo method, Simulated annealing and Tunneling algorithm.

UNIT V

Generic algorithm - Selection process, Crossover, Mutation, Schema theorem, comparison between binary and floating point implementation.

Suggested Reading:

1. SS Rao, “Optimization techniques”, PHI, 1989.
2. Zhigmiew Michelewicz, “Genetic algorithms + data structures = Evaluation programs”, Springer Verlog - 1992.
3. Merrium C. W., “Optimization theory and the design of feedback control systems”, McGraw Hill, 1964.
4. Weldo D.J., “Optimum seeking method”, PHI, 1964.

EC 4217 SPREAD SPECTRUM COMMUNICATIONS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT_I: Introduction to Spread Spectrum Systems

Fundamental Concepts of Spread Spectrum Systems,Pseudo Noise Sequences, Direct Sequence Spread Spectrum, Frequency hop Spread Spectrum, Hybrid Direct Sequence Frequency Hop Spread Spectrum, Code Division Multiple Access.

Binary Shift Register Sequence for Spread Spectrum Systems: Introduction, Definitions, Mathematical Background and Sequence Generator Fundamentals, Maximum Length Sequences and Gold Codes.

UNIT_II Code Tracking Loops

Introduction, Optimum Tracking of Wideband Signals, Baseband Delay Lock Tracking Loop, Tau-Dither Non Coherent Tracking Loop, Double Dither Non Coherent Tracking Loop.

UNIT_III Initial Synchronization of the Receiver Spreading Code

Introduction, Problem Definition and the Optimum Synchronizer, Serial Search Synchronization Techniques, Synchronization using a Matched Filter, Synchronization by Estimated the Received Spreading Code.

UNIT_IV Cellular Code Division Multiple Access(CDMA) Principles

Introduction, Wideband Mobile Channel , The Cellular CDMA System, Single user Receiver in a Multi user Channel, CDMA System Capacity,

Multi User Detection in CDMA Cellular Radio: Optimal multi user Detection, Linear suboptimal Detectors, Interference Combat Detection Schems, Interference Cancellation Techniques.

UNIT_V Performance of Spread Spectrum Systems in Jamming Environments:

Spread Spectrum Communication model, Performance of Spread Spectrum Systems without coding.

Performance of Spread Spectrum Systems With Forward Error Correction: Elementary Block Coding Concepts, Optimum Decoding Rule, Calculation of Error Probability, Elementary Convolution Coding Concepts, Viterbi Algorithm, Decoding and Bit Error Rate.

Text Books:

1.Rodger E Ziemer , Roger L. Peterson and David E Borth-"Introduction to Spread Spectrum Communications-Pearson,1st Edition,1995" .

2.Mosa Ali Abu –Rgheff-Introduction to CDMA Wireless Communication. Elsevier Publications,2008.

EC 4218

PATTERN RECOGNITION

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

Introduction to Pattern Recognition: Features, Feature vectors and classifiers. Bayesian Decision Theory, Two-category classifier, Minimum-Error-Rate classification, Discriminant functions and Decision surfaces: Multi-category and two category cases. discriminant functions for Normal Density.

UNIT II

Maximum-Likelihood Parameter Estimation Technique: General principle, Parameter estimation from a Multivariate Normal distribution, Bayesian parameter estimation: Univariate and Multivariate Gaussian distributions, Component Analysis and Discriminants: Principal Component Analysis and Fisher Linear Discriminant, and Expectation –Maximization for a 2D Normal model.

UNIT III

Non parametric Techniques : Introduction, Density Estimation, Parzen windows: Convergence of the mean, Convergence of the variance, The Nearest Neighbor Rule, Convergence and Error Rate for the Nearest Neighbor Rule, Metrics and Nearest Neighbor classification: Properties of metrics and Tangent distance.

UNIT IV

Linear Discriminant Functions and Decision Surfaces: Two-category and Multi-category cases, Generalized Linear Discriminant Functions, Minimizing the Perceptron Criterion Function: Convergence proof for single-Sample correction, Some Direct Generalizations, Support Vector Machines, separable and non separable classes.

UNIT V

Multi-layer Neural Networks and Clustering: Feed-Forward Operation and Classification, Back-propagation algorithm, Error surfaces, Back-propagation as Feature Mapping, Data Description and Clustering: similarity Measures. Criterion Functions for Clustering, K Means and Fuzzy K means clustering Techniques, Hierarchical Clustering and clustering using Graph Theoretic Methods.

Suggested Reading:

1. Richard O Duda, Peter E Heart, David G Stork “Pattern Classification”, John Wiley & sons, 2002.
2. J.T. Tou & R.C. Gonzalez, “Pattern Recognition Principles”, Addison Wesley Press, London, 1974.

EC 4219

SPEECH SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

The process of speech production: Production Mechanism and acoustic phonetics. Digital models for speech signals: Vocal Tract, Radiation, Excitation and complete model speech perception: Loudness, Bark Scale, masking, perception and Psychoacoustics.

UNIT II

Short-time Period analysis: Short-time energy, Average magnitude, zero crossing, Speech vs Silence discrimination and zero crossing rate, Pitch period estimation using parallel processing approach. Autocorrelation function, Pitch period estimation using Auto correlation function, The average magnitude function, median smoothing. Short time Fourier Analysis: Fourier transform interpretation, linear filtering interpretation, sampling rates in time and frequency, Filter banks, Spectrograms, pitch detection. Cepstral analysis, Complex and real cepstrum, pitch detection and Formant estimation.

UNIT III

Digital speech representation and coding: Review of PCM, adaptive PCM, differential PCM, delta modulation. Linear Predictive coding (LPC) analysis: Basic principles, autocorrelation and covariance methods, Computation of LP coefficients, Cholesky decomposition, Durbin's recursive solution, Frequency domain interpretation of LPC, CELP.

UNIT IV

Analysis by synthesis: Phase vocoder, subband coding, Formant/homomorphic vocoder, cepstral vocoder, vector Quantizer coder, Speech Enhancement techniques: Spectral subtraction, enhancement by resynthesis.

UNIT V

Automatic speech recognition: Basic pattern recognition approaches, Evaluating the similarity of speech patterns, Dynamic Time Warping (DTW), HMM's for speech recognition, forward, backword algorithms and parameter estimation. Speaker recognition, Features that distinguish speakers.

Suggested Reading:

1. Rabinar and Schafer, Digital Processing of Speech Signals, Pearson Education, 2004.
2. Deller, Hansen, Proakis, "Discrete-Time Processing of Speech signals", IEEE presses, 2000.
3. R & J Rabinar and Juang, "Fundamentals of speech recognition", Prentice Hall, 1993.
4. Douglas O'Shaughnessy, Speech Communication: Human and Machine, 2nd ed., University Press, Hyderabad, 2001.

EC 4220 AD-HOC WIRELESS AND SENSOR NETWORKS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT_I:Wireless LANs and PANs

Introduction, Fundamentals of WLANS,IEEE 802.11 Standards, HIPERLAN Standard, Bluetooth, Home RF. Ad-hoc Wireless networks Introduction, Issues in Ad-hoc Wireless Networks.

UNIT_II:MAC Protocols

Introduction, Issues in Designing a MAC protocol for Ad-hoc Wireless Networks, Design goals of a MAC protocol for Ad Hoc Wireless Networks, Classifications of MAC protocols, Contention –based protocols, contention-based protocols with reservation Mechanisms, Contention –based MAC protocols with Scheduling Mechanisms, MAC protocols that use Directional Antennas, other MAC protocols.

UNIT_III:Routing protocols

Introduction, Issues in Designing a Routing protocol for Ad Hoc Wireless Networks, Classification of Routing protocols, Table-Driven Routing protocols, On-Demand Routing protocols, Hybrid Routing protocols, Routing protocols with Efficient Flooding Mechanisms, Hierarchical Routing protocols, Power –Aware Routing protocols.

UNIT_IV:Transportation Layer Protocols

Introduction, Issues in Designing a Transport Layer protocol for Ad-hoc Wireless Networks, Design goals of a Transport Layer Protocol for Ad hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad hoc Wireless networks, Other Transport Layer protocol for Ad hoc Wireless Networks.

UNIT_V:Wireless Sensor Networks

Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC protocols for Sensor Networks, Location Discovery , Quality of a Sensor Network ,Evolving Standards, Other Issues.

Textbooks:

1.Ad Hoc Wireless Networks: Architectures and protocols-c.Siva Ram Murthy and B.S. Manoj,2004,PHI.

2.Wireless Ad-hoc and Sensor Networks:Protocols, Performance and Control –Jagannathan sarangapani, CRC Press.

Reference books:

1. Ad hoc Mobile Wireless Networks:Protocols&Systems, C.K.Toh, 1st Ed.Pearson Education.
2. Wireless Sensor Networks-C.S.Raghavendra, Krishna M. Sivalingam,2004,Springer

EC 4221

NEURAL NETWORKS AND FUZZY LOGIC

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT-I:

Introduction:

Introduction to ANS (Artificial Neural systems) Technology, ANS simulation, Types of Neural Networks: Hopfield, perceptron and related models, Adaline and Madaline: Adaline and the Adaptive Linear Combiner, the Madaline and simulating the Adaline. Essential vector operations, Lateral Inhibition and Sensory Processing.

UNIT-II:

Probabilistic Models, Fuzzy ARTMAP and Recurrent Networks:-Probabilistic Neural Networks, General Regression Neural Networks, Fuzzy ARTMAP, Recurrent Back propagation Neural Networks, Hybrid Learning Neural Networks:-Counter propagation Network, Radial basis Function Networks.

UNIT-III

Application of Neural Networks:-

Design and optimization of Systems: Non-Linear optimization, Inverse design problems, Pattern Recognition Applications: Control Chart pattern Recognition, Recognition of Machine-Cells in a group technology layout. Complex pattern Recognition tasks: Pattern mapping, Temporal patters, pattern variability, Neocognitron, Addition of lateral inhibition and Feedback to the Neocognitron.

UNIT – IV

Introduction to Fuzzy systems, Fuzzy sets and operations on Fuzzy sets, Basics of Fuzzy relations, Fuzzy measures, Fuzzy integrals, Transform Image coding with Adaptive Fuzzy systems, Adaptive FAM systems for Transform coding.

UNIT-V

Comparison of Fuzzy and Kalman-Filter Target, Tracking control systems, Fuzzy and Math-Model Controllers, Real Time Target Tracking, Fuzzy Controller, Kalmaln-Filter Controller, Fuzzified CMAC and RBF – Network based self learning Controllers.

Suggested Reading:

1. James A. Freeman and David M. Skapura,Neural Networks; Algorithms Applications and Programming Techniques, Pearson Education, India,2008.
2. James A. Anderson ,An introduction to Neural Networks ,PHI,2003.
3. B.Yegnanarayana,Artificial Neural Networks, PHI Publications India,2006.
4. M.Ananda Rao and J.Srinivas, Neural Networks: Algorithms and Applications, Narosa Publications 2009.

EC 4222

SYSTEMS SIMULATION AND MODELING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

System and its model. Nature of simulation. Continuous system. Numerical integration. Erection of integration method. Example systems.

UNIT II

Discrete systems. Fixed time step. Event-to-event models. Random Process simulation. Monte-carlo computation and stochastic simulation.

UNIT III

Queuing systems: Single and two serve queues. More general queues. Activity networks. Network model of project Analysis.

UNIT IV

Critical path. Uncertainities. Resourse allocation and costs. Inventory and forecasting Models. Poisson and Erlang variates.

UNIT V

Forecasting and regression analysis. Evaluation. Length of runs. Variance reduction. Validation. Factors in selecting of simulation language.

Suggested Reading:

1. Deo N, System simulation with digital computer, PHI, 1979.
2. Geoffrey Gordon, System simulation, PHI, 1978.

EC 4214

WIRELESS COMMUNICATION AND NETWORKS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination - Marks	70 Marks

UNIT I

The cellular concept system design Fundamentals: Introduction, Frequency reuse, Channel Assignment Strategies, Handoff Strategies-prioritizing Handoffs, Practical Handoff Consideration Interference and system capacity, co channel interference and system capacity, Channel planning for wireless systems, Adjacent Channel Interference, Power control for reducing interference, Trunking and Grade of service, improving coverage& Capacity in Cellular Systems-Cell Splitting, Sectoring.

UNIT II

Mobile radio propagation: large scale path loss

Introduction to Radio wave propagation, free space propagation model, Relating power to electric field, The three basic propagation mechanisms, Reflection –Reflection from Dielectrics, Brewster Angle, Reflection from perfect conductors, Ground Reflection(Two Ray) model, Diffraction-Fresnel Zone Geometry, Knife edge diffraction model, Multiple knife edge diffraction, Scattering, Outdoor propagation models: longley Ryce model, okumura model, Hata model, PCS Extension to Hata model, Walfisch and Bertoni Model, Wideband PCS Microcell model. Indoor propagation models: partition losses(same floor), partition losses between floors, log distance path loss model, ericsson multiple breakpoint model, attenuation factor model, signal penetration into buildings,Ray tracking and site specific Modeling.

UNITIII

Mobile Radio Propagation :Small Fading and Multipath

Small scale multipath propagation Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel-Relationship between Bandwidth and Received power, Small scale multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile multipath channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small Scale Fading –Fading effects due to Multipath Time Delay Spread, Flat Fading, Frequency Selective fading, Fading effects due to Doppler Spread fast fading, slow fading, Statistical models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model.

UNIT IV

Equalization and Diversity

Introduction, Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non linear Equalization-Decision Feedback Equalization(DFE),Maximum Likelihood Sequence Estimation(MLSE) Equalizer, Algorithms for adaptive equalization-zero forcing algorithm, Practical space Diversity Consideration-selection Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT V

Wireless Networks

Introduction to wireless Networks, Advantages and Disadvantages of Wireless Local Area Networks, WLAN Topologies,WLAN standard IEEE 802.11 Medium Access Control, Comparision of IEEE 802.11 a,b,g and n standards, IEEE 802.16 AND ITS ENHANCEMENTS, Wireless PANs , Hiper Lan, WLL

Suggested Reading:

1.Wireless Communications, Principles Practice-Theodore, S.Rappaport,2nd Ed.,2002,PHI.
2. Wireless Communications-Andrea Goldsmith,2005 Cambridge University Press.
3. Principles of wireless networks-Kaveh pah Laven and P.Krishna Murthy, 2002,PE
4. mobile cellular Communication-Gottapu Sasibhushana Rao, Pearson Education,2012.

Reference books:

1. Wireless Digital Communications-Kamilo Feher,1999, PHI.
2. Wireless Communication and Networking-William Stallings,2003,PHI.

EC 4223

VLSI SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination – Marks	70 Marks

UNIT – I

Introduction to DSP: Typical DSP algorithms, DSP algorithms benefits, Representation of DSP algorithms. Pipelining and Parallel Processing: Introduction, Pipelining of FIR Digital filters, Parallel Processing, Pipelining and Parallel Processing for Low Power, Retiming: Introduction – Definitions and Properties – Solving System of Inequalities – Retiming Techniques

UNIT – II

Folding and Unfolding, Folding : Introduction -Folding Transform - Register minimization Techniques – Register minimization in folded architectures – folding of multirate systems, Unfolding: Introduction – An Algorithm for Unfolding – Properties of Unfolding – critical Path, Unfolding and Retiming – Applications of Unfolding

UNIT – III

Systolic Architecture Design: Introduction – Systolic Array Design Methodology – FIR Systolic Arrays – Selection of Scheduling Vector – Matrix Multiplication and 2D Systolic Array Design – Systolic Design for Space Representations contain Delays

UNIT – IV

Fast Convolution: Introduction – Cook-Toom Algorithm – Winograd algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection

UNIT – V

Low Power Design: Scaling Vs Power Consumption –Power Analysis, Power Reduction techniques – Power Estimation Approaches, Programmable DSP : Evaluation of Programmable Digital Signal Processors, DSP Processors for Mobile and Wireless Communications, Processors for Multimedia Signal Processing

Suggested Reading:

1. Keshab K. Parthi, VLSI Digital Signal Processing- System Design and Implementation –1998, Wiley Inter Science.
2. Kung S. Y, H. J. While House, T. Kailath, VLSI and Modern Signal processing, 1985, Prentice Hall.
3. Jose E. France, Yannis Tsividis, Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing –1994, Prentice Hall.
4. Medisetti V. K ,VLSI Digital Signal Processing , IEEE Press (NY), USA, 1995.

EC 4224 ENGINEERING RESEARCH METHODOLGY

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	30 Marks	University Examination – Marks	70 Marks

UNIT-I

Research Methodology:

Objectives and Motivation of research- types of research- Research approaches – Significance of Research-Research Methods versus Methodology-Research and Scientific method- Importance of research methodology – Research process- criteria of good research- Problems encountered by Researchers in India-benefits to society in general.

Defining Research Problem:

Definition of research problem- problem formulation- necessity of defining the problem- techniques involved in defining a problem.

UNIT-II

Literature Survey: Importance of Literature Survey-Sources of information-Assessment of Quality of journals and articles-Information through internet. Literature Review: Need of Review- Guidelines for Review-Record of Research Review.

UNIT-III

Research Design: Meaning of research design - need of research design- features of a good design- important concepts relating to research design- different research designs- Basic Principles of experimental designs- Developing a Research plan- Design of experimental set-up-Use of standards and codes.

UNIT-IV

Exploration of data: Analysis of data- Role of statistics for data analysis –Functions of statistics- Estimation of population parameters –Parametric vs non-parametric methods- Descriptive statistics- Point of central tendency- Measures of variability- Inferential statistics- estimation- Hypothesis testing – Use of statistical software.

Data Analysis : Deterministic data and random data- uncertainty analysis – tests for significance – Ch-square test- Student's 't' test- Regression modeling-ANOVA-F test- Time series analysis- Autocorrelation and Autoregressive modeling.

UNIT-V

Research Report Writing:

Format of research report- style of writing report- reference/ bibliography/Webiliography- Technical paper writing. Research proposal preparation: Writing a research proposal and research report- writing a Research Grant Proposal.

Suggested Reading:

1. C.R.Kothari, Research methodology, Methods & technique, New age international publishers, 2004.
2. R.Ganesan, Research Methodolgy for Engineers, MJP Publishers: Chennai, 2011.
3. Dr. Vijay Upagade and Dr.Aravind Shende; Research Methodology; S.Chand & company limited., NewDelhi;2004
4. P.Ramdass and A.Wilson Aruni; Research and Writing across the disciplines: MJP Publishers; Chennai 2009.