Scheme of Instruction & Examination
M.E / M.Tech Four Semester Course (Regular) 2010-2011

S.No.	Subject	Periods per Week		Duration	Max. Marks	
		L/T	D/P	(Hours)	Univ.Exam	Sessional
			SEMESTER – I			
1.	Core	3	--	3	80	20
2.	Core	3	--	3	80	20
3.	Core / Elective	3	--	3	80	20
4.	Core / Elective	3	--	3	80	20
5.	Core / Elective	3	--	3	80	20
6.	Elective	3	--	3	80	20
7.	Lab – I	--	3	--	--	50
8.	Seminar – I	--	3	--	--	50
	Total	18	6	--	480	220
			SEMESTER – II			
1.	Core	3	--	3	80	20
2.	Core	3	--	3	80	20
3.	Core / Elective	3	--	3	80	20
4.	Core / Elective	3	--	3	80	20
5.	Core / Elective	3	--	3	80	20
6.	Elective	3	--	3	80	20
7.	Lab – II	--	3	--	--	50
8.	Seminar – II	--	3	--	--	50
	Total	18	6	--	480	220
			SEMESTER – III			
1.	Dissertation + Project Seminar*	--	6	--	--	100**
			SEMESTER –IV			
1.	Dissertation	--	--	Viva-voce	Grade***	--

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 20 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 20 are based on 2 class tests (each weightage 10 marks). Performance of both the tests will be taken into account.

SCHEME OF INSTRUCTION & EXAMINATION
M.E / M.Tech Six Semester Course (Part Time) 2010-2011

S.No.	Subject	Periods per Week		Duration	Max. Marks	
		L/T	D/P	(Hours)	Univ.Exam	Sessional
			SEMESTER – I			
1.	Core –I	3	--	3	80	20
2.	Core / Elective	3	--	3	80	20
3.	Elective	3	--	3	80	20
4.	Lab – I /Seminar-I	--	3	--	--	50
			SEMESTER – II			
1.	Core –I	3	--	3	80	20
2.	Core / Elective	3	--	3	80	20
3.	Elective	3	--	3	80	20
4.	Lab – I /Seminar-I	--	3	--	--	50
			SEMESTER – III			
1.	Core –I	3	--	3	80	20
2.	Core / Elective	3	--	3	80	20
3.	Elective	3	--	3	80	20
4.	Lab – I /Seminar-I	--	3	--	--	50
			SEMESTER – IV			
1.	Core –I	3	--	3	80	20
2.	Core / Elective	3	--	3	80	20
3.	Elective	3	--	3	80	20
4.	Lab – I /Seminar-I	--	3	--	--	50
			SEMESTER – V			
1.	Dissertation + Project Seminar*	--	6	--	--	100**
			SEMESTER –VI			
1.	Dissertation	--	--	Viva-voce	Grade***	--

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 20 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 20 are based on 2 class tests (each weightage 10 marks). Performance of both the tests will be taken into account.

List of Subjects for ME (ECE) Course (Regular/Part-Time) with specialization in DIGITAL SYSTEMS W.E.F. 2010-2011

S.No	Syllabus Ref. No	Subject	Periods per week
Core Subjects			
1	EC 501	Digital Design and PLDs	3
2	EC 502	VLSI Design and Technology	3
3	EC 503	Microcontrollers for Embedded System Design	3
4	EC 504	Data and Computer Communication Networks	3
5	EC 564	Modern Digital Signal Processing	3
6	EC 594	Coding Theory & Techniques	3
7	EC 507-1	Digital Systems Lab I	3
8	EC 507-2	Digital Systems Lab II	3
9	EC 508-1	Seminar I	3
10	EC 508-2	Seminar II	3
11	EC 508-3	Project seminar	3
12	EC 509	Dissertation	--
Elective Subjects			
13	EC 510	Advanced Computer Organization	3
14	EC 511	System on Chip Architecture	3
15	EC 512	Advanced Computer Graphics	3
16	EC 513	Multimedia Information Systems	3
17	EC 514	Computer Vision	3
18	EC 515	Mobile Computing	3
19	EC 516	Field Programmable Gate Arrays	3
20	EC 517	Advanced Digital Design with Verilog HDL	3
21	EC 565	Real Time Signal Processing	3
22	EC 572	Optimization Techniques	3
23	EC 576	Speech Signal Processing	3
24	EC 577	Image & Video Processing	3
25	EC 578	Neural Networks & Fuzzy Logic	3
26	EC 591	Modern Digital Communication Systems	3
27	EC 592	Wireless Mobile Communication System	3
28	EC 601	Optical Fibre Communication Systems	3
29	EC 632	Analog and Mixed signal IC Design	3
30	EC 635	Real Time Operating Systems	3
31	EC 642	Design for Testability	3
32	EC 648	Low Power VLSI Design	3
33	EC 650	VLSI Signal Processing	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.

List of Subjects for ME (ECE) Course (Regular/Part-Time) with specialization in MICROWAVE & RADAR ENGINEERING W.E.F. 2010-2011

S.No	Syllabus Ref. No	Subject	Periods per week
Core Subjects			
1	EC 531	Electro-magnetic Field Theory	3
2	EC 532	Microwave Circuits	3
3	EC 533	Microwave Antennas	3
4	EC 534	Radar Systems Engineering	3
5	EC 535	Global Navigational Satellite Systems	3
6	EC 536	Microwave Integrated Circuits	3
7	EC 537-1	Microwave Systems Lab I	3
8	EC 537-2	Microwave Systems Lab II	3
9	EC 538-1	Seminar I	3
10	EC 538-2	Seminar II	3
11	EC 538-3	Project seminar	3
12	EC 539	Dissertation	--
Elective Subjects			
13	EC 513	Multimedia Information Systems	3
14	EC 540	Electromagnetic Interference and Compatibility	3
15	EC 541	Microwave Measurement	3
16	EC 542	Numerical Methods in Electromagnetics	3
17	EC 543	Phased Array Radar	3
18	EC 544	Microwave Solid-state Devices	3
19	EC 545	Radar Signal Processing	3
20	EC 546	Radio Navigational Aids	3
21	EC 572	Optimization Techniques	3
22	EC 577	Image & Video Processing	3
23	EC 592	Wireless Mobile Communication Systems	3
24	EC 600	Satellite & Microwave Communication	3
25	EC 601	Optical Fibre Communication Systems	3
26	MT 501	Engineering Mathematics	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.

List of Subjects for ME (ECE) Course (Regular/Part-Time) with specialization in SYSTEMS AND SIGNAL PROCESSING W.E.F. 2010-2011

S.No	Syllabus Ref. No	Subject	Periods per week
Core Subjects			
1	EC 561	Digital Spectral Analysis	3
2	EC 562	Adaptive Signal Processing	3
3	EC 563	Digital Control	3
4	EC 564	Modern Digital Signal Processing	3
5	EC 565	Real Time Signal Processing	3
6	EC 594	Coding Theory & Techniques	3
7	EC 567-1	Systems & Signal Processing Laboratory –I	3
8	EC 567-2	Systems & Signal Processing Laboratory – II	3
9	EC 568-1	Seminar I	3
10	EC 568-2	Seminar II	3
11	EC 568-3	Project Seminar	3
12	EC 569	Dissertation	--
Elective Subjects			
13	EC 513	Multimedia Information Systems	3
14	EC 545	Radar Signal Processing	3
15	EC 570	Optimal Control Theory	3
16	EC 571	Adaptive Control Systems	3
17	EC 572	Optimization Techniques	3
18	EC 573	Non Linear Control Theory	3
19	EC 574	Guidance and Control	3
20	EC 575	Pattern Recognition	3
21	EC 576	Speech Signal Processing	3
22	EC 577	Image & Video Processing	3
23	EC 578	Neural Networks & Fuzzy Logic	3
24	EC 579	Systems Simulation & Modeling	3
25	EC 580	Numerical Methods in Engineering	3
26	EC 650	VLSI Signal Processing	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.

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

COMMUNICATION ENGINEERING W.E.F. 2010-2011

S.No	Syllabus Ref. No	Subject	Periods per week
Core Subjects			
1	EC 504	Data and Computer Communication Networks	3
2	EC 564	Modern Digital Signal Processing	3
3	EC 591	Modern Digital Communication Systems	3
4	EC 592	Wireless Mobile Communication Systems	3
5	EC 593	Probability and Random Processes	3
6	EC 594	Coding Theory & Techniques	3
7	EC 597-1	Communications Lab	3
8	EC 597-2	Computer Communication Networks Lab	3
9	EC 598-1	Seminar – I	3
10	EC 598-2	Seminar – II	3
11	EC 598-3	Project Seminar	3
12	EC 599	Dissertation	--
Elective Subjects			
13	EC 545	Radar Signal Processing	3
14	EC 546	Radio Navigational Aids	3
15	EC 572	Optimization Techniques	3
16	EC 577	Image & Video Processing	3
17	EC 578	Neural Networks and Fuzzy logic	3
18	EC 600	Satellite and Microwave Communications	3
19	EC 601	Optical Fibre Communication Systems	3
20	EC 602	Statistical Signal Processing	3
21	EC 603	Smart Antennas for Mobile Communications	3
22	EC 604	Voice Over Internet Protocols	3
23	EC 605	Detection & Estimation Theory	3
24	EC 606	Embedded System Design	3
25	EC 607	Digital System Design Using VHDL	3
26	EC 608	Data Compression	3
27	EC 650	VLSI Signal Processing	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.

List of Subjects for ME (ECE) Course (Regular/Part-Time) with specialization in EMBEDDED SYSTEMS AND VLSI DESIGN W.E.F. 2010-2011

S.No	Syllabus Ref. No	Subject	Periods per week
Core Subjects			
1	EC 503	Micro Controllers for Embedded System Design	3
2	EC 631	Digital IC Design	3
3	EC 632	Analog and Mixed Signal IC Design	3
4	EC 633	Principles of VLSI System Design	3
5	EC 634	VLSI Physical Design	3
6	EC 635	Real Time Operating Systems	3
8	EC 637-1	Design and Simulation Laboratory-I	3
9	EC 637-2	Design and Simulation Laboratory-II	3
9	EC 638-1	Seminar – I	3
10	EC 638-2	Seminar – II	3
11	EC 638-3	Project Seminar	3
12	EC 639	Dissertation	--
Elective Subjects			
13	EC 504	Data and Computer Communication Networks	3
14	EC 510	Advanced Computer Organization	3
15	EC 536	Microwave Integrated Circuits	3
16	EC 572	Optimization Techniques	3
17	EC 580	Numerical Methods in Engineering	3
18	EC 640	CPLD & FPGA Architectures and Applications	3
19	EC 641	DSP PROCESSORS – ARCHITECTURE	3
20	EC 642	Design For Testability	3
21	EC 643	Graph Theory and Its Applications to VLSI	3
22	EC 644	Algorithms Analysis and Design	3
23	EC 645	Scripting Languages for VLSI Design Automation	3
24	EC 646	Physics of Semiconductor Devices	3
25	EC 647	VLSI Technology	3
26	EC 648	Low Power VLSI Design	3
27	EC 649	MEMS	3
28	EC 650	VLSI Signal Processing	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 501

DIGITAL DESIGN AND PLDS

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

UNIT-I

Tabulation and K-Map minimization method to simplify the multi outputs. Top-down Modular Combination Logic Design, Combinational circuit Design with Programmable logic Devices (PLDs). Semi custom Logic Devices, Logic Array Circuits.

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. One hot finite state machine design method. Finite State controllers. Algorithmic State Machine (ASM) diagram. Redundant states State reduction in completely and incompletely specified circuits, optimal state assignment methods.

UNIT-IV

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

UNIT-V

Sequential circuits with Programmable logic Devices: Registered Programmable Logic Devices, Programmable Gate Arrays, Sequential Circuit Design and PLD Device selection, PLD Design Examples, Computer aided Design of Sequential PLDs.

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

EC 502

VLSI DESIGN AND TECHNOLOGY

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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, Capacitance 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, and Dynamic CMOS Design. Designing Sequential Logic circuits: Introduction, Static Latches and Registers, Dynamic Latches and Registers. Transmission Gates logic.

UNIT III

Scaling of MOS Transistors, Design Rules, Stick diagram and Layout Design and Tools, Wires and Vias. Subsystem Design: Subsystem Design Principles, Field Programmable Gate Arrays.

UNIT IV

Data path Design: Adder, Multiplier, Shifter, Semiconductor Memory Design: Introduction, 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.
3. Wayne Wolf, “Modern VLSI Design” 3rd ed., Pearson Education, 1997.
4. Neil H E Weste Kamran Eshraghian “Principles of CMOS VLSI Design a system perspective” Pearson 3nd Edition 2005.

EC 503

MICROCONTROLLER FOR EMBEDDED SYSTEMS DESIGN

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

UNIT-I

Introduction to Embedded Systems: Review of Microprocessors and their features. Differences between Microprocessors and Microcontrollers, Application areas of Embedded Systems, Categories of Embedded Systems. Overview of Embedded System Architecture, Challenges & Trends of Embedded Systems, Hardware Architecture, Software Architecture.

UNIT-II

Architecture, Instruction Set, Addressing Modes, ALP, Timers and Counters, Serial Communication, Interrupt Programming of 8051. Interfacing with External Memory, Expansion of IO Ports. Introduction to embedded cross compilers.

UNIT-III

Interfacing 8051 with ADC, DAC, LCD and Stepper Motor. PIC 18 Family Overview, Architecture, Instruction Set, Addressing modes, Timers and Interrupts of PIC 18.

UNIT-IV

Capture/Compare and PWM modules of PIC 18. Introduction to RISC Concepts with ARM Processor. Embedded Software Development Tools, Host and Target Machines, Linkers/Locators for Embedded Software, Getting Embedded Software into the Target System.

UNIT-V

Debugging Techniques- Testing on your Host Machine, Instruction Set Simulators, Using Laboratory Tools.

Case Studies: Design of Embedded Systems using Microcontrollers – for applications in the area of communications and automotives. (GSM/GPRS, CAN , Zigbee)

Suggested Reading:

1. David.E.Simon , “An Embedded Software Primer” Pearson Education.
2. Mazidi M.A and Mazidi J.G, “The 8051 Microcontroller and Embedded Systems” , Pearson 2007.
3. Mazidi, MCKinlay and Danny Causey, “PIC Microcontrollers and Embedded Systems”, Pearson Education.
4. Raj Kamal,Embedded Systems – Architecture, Programming and Design ,2nd Edition, TMH, 2008.

EC 504
DATA AND COMPUTER COMMUNICATION NETWORKS

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

UNIT - I

Data Communications and Networks Overview: Data Communications Model Communication Tasks, Basic concepts of Networking 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, Interfacing, Characteristics of Physical Layer Interface, 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 Switching applications, Circuit Switch Elements, Three Stage Space Division Switch, Blocking and Non-blocking switching, Time Division Switching, Control Signaling Functions, In Channel Signaling, Common Channel Signaling, Introduction to Signaling System Number 7 (SS7), Packet Switching Principles, Datagram and Virtual Circuit switching, Effects of variable packet size, X.25, X.25 Protocol Control Information. Routing: Routing in Circuit Switched Network, Routing in Packet Switched Network, Routing Strategies, Least Cost Algorithms, Bellman-Ford 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

ATM, Architecture of ATM, Congestion Control and Quality of Service in ATM, Internetworking, IPv4, IPv6 comparison , Transport layer protocols, UDP Operation, TCP features, Flow Control, Error Control, Congestion Control, Network Management System, SNMP, SIP, and H.323 architectures, *Security in the Internet,* IP Security, Firewalls.

Suggested Reading:

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

EC 507-1

DIGITAL SYSTEMS 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 Multirate systems.
6. Experiments using DSP Processor.
    i) Convolution & Correlation.
    ii) FIR Filtering.
    iii) IIR Filtering.

EC 507-2

DIGITAL SYSTEMS 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 508-1

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:

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 508-2

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:

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 508-3

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 509

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 510

ADVANCED COMPUTER ORGANIZATION

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

Suggested Reading:

1. William Stallings, Computer Organization and Architecture designing for Performance, 7th edition, PHI, 2007.
2. Carl Hamacher, Vranesic, Zaky, Computer Organization, 5th edition, MGH.
3. Hayes John P; Computer Architecture and organization; 3rd Edition, MGH, 1998.
4. John L. Hennessy and David A. Patterson, Computer Architecture – A quantitative Approach, 3rd Edition, Elsevier, 2005.

EC 511

SYSTEM ON CHIP ARCHITECTURE

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

UNIT – I

Introduction to Processor Design: Abstraction in Hardware Design, MUO a simple processor , Processor design trade off, Design for low power consumption. ARM Processor as System-on-Chip: Acorn RISC Machine – Architecture inheritance – ARM programming model – ARM development tools – 3 and 5 stage pipeline ARM organization – ARM instruction execution and implementation – ARM Co-processor interface

UNIT – II

ARM Assembly Language Programming: ARM instruction types – data transfer, data processing and control flow instructions – ARM instruction set – Co-processor instructions. Architectural Support for High Level Language: Data types – abstraction in Software design – Expressions – Loops – Functions and Procedures – Conditional Statements – Use of Memory.

UNIT – III

Memory Hierarchy: Memory size and speed – On-chip memory – Caches – Cache design- an example – memory management

UNIT – IV

Architectural Support for System Development: Advanced Microcontroller bus architecture – ARM memory interface – ARM reference peripheral specification – Hardware system prototyping tools – Armulator – Debug architecture

UNIT – V

Architectural Support for Operating System: An introduction to Operating Systems – ARM system control coprocessor – CP15 protection unit registers – ARM protection unit – CP15 MMU registers – ARM MMU Architecture – Synchronization – Context Switching input and output

Suggested Reading:

1. Steve Furber, ARM System on Chip Architecture, 2nd ed., Addison Wesley Professional, 2000.
2. Ricardo Reis, Design of System on a Chip: Devices and Components, 1st ed., Springer, 2004.
3. Jason Andrews, Newnes, Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) , BK and CDROM
4. Prakash Rashinkar, System on Chip Verification – Methodologies and Techniques, Peter Paterson and Leena Singh L ,Kluwer Academic Publishers, 2001.

EC 512

ADVANCED COMPUTER GRAPHICS

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

UNIT-I

Raster graphics system and its working, Line-drawing algorithms (D.D.A and Bresenham's algorithms), Polygon filling, 2-D transformations.

UNIT-II

(Fundamentals of 3-D graphics) Projections (parallel projection and perspective projection) 3-D Transformations Bezier curves and B-spline curves. Visible-surface detection methods (Painter's algorithm and Z-buffer method)

UNIT-III

Color Models and Color Applications: Standard primaries and the chromaticity diagram XYZ Color Model. CIE Chromaticity Diagram, Intuitive Color Concepts, RGB Color model. YIQ Color Model, HSV Color Model, Conversion between HSV and R&B Models, HLS Color Model, Color Selection and Applications.

UNIT-IV

Animation: Design of Animation Sequences. General Computer- Animation functions. Raster Animations, Computer- Animation Languages, Key- Frame Systems. Moorphing, Simulating Accelerations, Motion Specifications, Direct Motion specification, Goal-directed systems, Kinematics and dynamics.

UNIT-V

Advanced Raster Graphics Architecture: Display – Processor systems standard graphics pipeline, Introduction to multi-processing, Pipeline Front-End Architectures, Parallel Front-End Architectures,

Multiprocessor Rasterization Architectures, Image-Parallel Rasterization, Object-Parallel Rasterization,Hybrid-Parallel Rasterization. Enhanced Display capabilities.

Suggested Reading:

1. Hearn Donald, Pauline Baker.M, Computer Graphics, 2nd edition, Pearson Education, 1997.
2. Foley, Vandam, Feiner, Hughes: Computer graphics Principles and practice, 2nd Edition, Addision – Wesley 1996.
3. David F. Rogers, Procedural Elements for Computer Graphics, 2nd Edition, McGraw-Hill, 2001.

EC 513

MULTIMEDIA INFORMATION SYSTEMS

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

UNIT I

Definition of Multimedia, Multimedia system description. Applications of Multimedia. Types of Multimedia: a non-interactive, interactive. Hypertext.

UNIT II

Multimedia Networking: ATM. ISDN. WAN and their comparisons, Multimedia synchronization. Serial and Parallel.

UNIT III

Motion estimation techniques: Bruteforce, algorithm three step, search algorithm. 2-D algorithm and conjugate direction search algorithm.

Image compression standards: Review on loseless and lossy comprssion models.JPEG.H261 MPEG1,MPEG2 and MPEG4.

UNIT IV

Audio coding: Introduction to multi rate signals. MPEG1 and MPEG2 audio encoder and decoder.

UNIT V

Multimedia information indexing and Retrieval: General information Retrieval (IR) model. Differences between IR and DBMS Basic IR models. File structure, audio indexing and Retrieval methods. Image Retrieval based on shape and moments and watermarking Techniques.

Suggested Reading:

1. Guojun Lu., Communication and Computing for distributed multimedia systems, Artech House, Bosto, London,1995.
2. Bhaskar V and Konstantindes K, Image and Video Compression Standards algorithms and Architecture kluwer Academic, Sept, 1997.
3. Judith Jeffocate, Printmedia in practice (Theory and Applications), PHI, 1998.

EC 514

COMPUTER VISION

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

UNIT I

Image Segmentation: Edge detection methods. Laplacian, gradient, LOG, Canny Operators. Line and Point detection methods. Region Based Segmentation methods.

UNIT II

2D Image representation: Chaincode, Polygonal approximation, Fourier descriptors. BSpline and moment methods.

UNIT III

Texture Segmentation: Statistical and syntactic texture description methods. Co.occurence matrices. Edge frequency. Law texture measures. Syntactic texture description method: Shape chain grammars and Grapgrammars.

UNIT IV

Motion analysis: Optical flow Computation: Global and local optical flow estimation. Detection of interest points, Object tracking, and Correspondance of interest points and Object bracking.

UNIT V

3D Vision: Basics of Projective geometry stereo correspondence algorithms. Radiometric considerations in determining gray level. Surface reflectances, Shape from shading and photometric stereo.

Suggested Reading :

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision” PWS Publishing. (In International Thomson Publishing Co.,), 1999.
2. Bolye. RD and Thomas. RC, “Computer Vision a first course”, Black well Scientific publication.
3. Robert J. Schalk Off, “Digital Image Processing and Computer Vision”, John Willey, 1989.

EC 515

MOBILE COMPUTING

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

EC 516

FIELD PROGRAMMABLE GATE ARRAYS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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, AC/DC IO Cells, clock and power inputs, FPGA interconnect: Routing resources, Elmore's constant, RC delay and parasitic capacitance FPGA design flow, Low-level design entry.

UNIT-III

FPGA physical design, CAD tools, Power dissipation, FPGA Partitioning, Partitioning methods.

Floor planning: Goals and objectives, I/O, Power and clock planning, Floor Planning tools.

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, ATPG methods, Design for testability, Scan Path Design, Boundary Scan design, BIST Design guidelines, Design of a Testing machine.

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 517

ADVANCED DIGITAL DESIGN WITH VERILOG HDL

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

UNIT-I

Review of Verilog HDL, Modeling styles: Behavioral, Dataflow, and Structural Modeling, gate delays, switch-level Modeling, Hierarchal structural modeling.

UNIT-II

Modeling of basic MSI Combinational Logic modules and Sequential Logic modules. Finite State Machine modeling.

UNIT-III

Design options of Digital Systems, Hierarchical system design, ASIC designs, PLD modeling, CPLD and FPGA devices.

Synthesis: Design flow of ASICs and FPGA based system, design environment and constraints logic synthesizers, Language structure synthesis, coding guidelines for clocks and reset.

UNIT-IV

Verification: Functional verification, simulation types, Test Bench design, Dynamic timing analysis, static timing analysis, value change dump (VCD) files. FPGA based design flow- a case study.

UNIT-V

Design Examples: Adders and Substractors, Multiplicaton and Division Algorithms, ALU, Digital Signal Processing modules: FIR and IIR Filters, Bus structures, Synchronous & Asynchronous data transfer, UART, baud rate generator. A simple CPU design.

Suggested Reading:

1. Ming-Bo Lin., Digital System Designs and Practices Using Verilog HDL and FPGAs. Wiley, 2008.
2. Michael D. Ciletti, Advanced Digital Design with the Verilog HDL", PHI, 2005.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, 2005.

EC 531

ELECTROMAGNETIC FIELD THEORY

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

UNIT I

Review of Basic Concepts. Maxwell's equations. Wave Equation. Plane waves in lossless and lossy media. Reflection and Refraction.

UNIT II

Vector potential. Scalar potential, source concept, duality. Uniqueness, Image theory. Equivalence principle, Induction and Reciprocity theorems, Mathematical formulation.

UNIT III

Plane wave functions. General solution of wave guide, Rectangular wave guide. Partially filled wave guide. Dielectric slab guide. Surface wave transmission lines.

UNIT IV

Cylindrical wave functions, circular wave guide, radial wave guide, source of cylindrical waves, two dimensional radiation. Scattering by cylinders. Spherical wave functions, the spherical cavity, wave transformation, scattering by spheres.

UNIT V

Slow wave structures, Floquet's theorem, Brillouin diagram.

Suggested Reading:

1. Harrington. RF., "Time Harmonic: Electromagnetic fields", McGraw Hill, 1961.

2. Collin. RE., Field Theory of guided Waves, McGraw Hill, 1960.

EC 532

MICROWAVE CIRCUITS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 circuit, D van nostrand co.,inc.,1964.
2. Collins. RE, Foundations for microwave engineering, John Wiley & Sons, inc 2nd edn,2009.
3. Ghosh.RN, Microwave circuit theory and analysis, McGrew hill.
4. Pozer.DM, Microwave engineering, 2nd edn., john wiley andsons,inc.,1999.

EC 533

MICROWAVE ANTENNAS

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

UNIT-I

Antenna parameters, theories of radiation, schelkunoff's equivalence theorem, image theory, integral transform method.

UNIT-II

Aperture antennas, slots, horns, lenses and reflector antennas, log periodic and helical antennas

UNIT-III

Linear arrays, Uniform and Non uniform amplitude distribution, Bionomial, chebyshev and Taylor's distributions.

UNIT-IV

Printed antennas: Rectangular and circular patch antenna design, Feeding techniques for micro strip antennas,Printed antenna arrays,Band width enhancement techniques.

UNIT-V

Radomes- Characteristics and types, Antenna synthesis Techniques, Antenna Measurements.

Suggested Reading:

1. Samuel Silver, Microwave Antenna - Theory and design, IEE Press, 1984.

2. Bahl IJ, and Bhartia, Microstrip Antennas, Artech House, 1982.

3. Constantine Balanis. A, Antenna Theory-Analysis and Design ,John wiley,2005.

4. James.JR.Hall PS.wood.C., Micro strip Antenna-Theory and Design, Peter Peregrinu.1981

EC 534

RADAR SYSTEMS ENGINEERING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 535

GLOBAL NAVIGATION SATELLITE SYSTEMS

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

UNIT 1

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

UNIT 2

GPS Signals:, Signal structure, C/A and P-Code, ECEF and ECI coordinate systems and WGS 84 and Indian datums, Important components of receiver and specifications, link budget.

UNIT 3

GPS Error Models: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, Antenna Phase center variation, multipath; estimation of Total Electron Content (TEC) using dual frequency measurements, Various DOPs, UERE. Spoofing and Anti-spoofing. : Future GPS satellites, new signals and their benefits GPS integration – GPS/GIS, GPS/INS, GPS/pseudolite, GPS/cellular.

UNIT 4

GPS data processing, DGPS and Applications: RINEX Navigation and Observation formats, Code and carrier phase observables, linear combination and derived observables, Ambiguity resolution, cycle slips, Position estimation. principle of operation of DGPS, architecture and errors,

UNIT 5

Other Constellations and Augmentation systems Other satellite navigation constellations GLONASS and Galileo IRNS System. : 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.

EC 536

MICROWAVE INTEGRATED CIRCUITS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 537-1

MICROWAVE SYSTEMS LABORATORY-I

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

1. Microwave source characteristics-Reflex Klystron and Gunn oscillator
2. Waveguide Discontinuities-Inductive and capacitive Diaphrams
3. Slide Screw Tuner-Equivalent circuit
4. S-matrix of Directional Coupler.Circulator.Magic Tee
5. Characterization of Waveguide Slotted Array
6. Frequency Scanned Array Characteristics
7. Measurement of Input Impedance of an Antenna
8. Optical Fibre Loss measurements
9. Communication through Optical Fibre
10. Measurements of Printer Antenna Characteristics
11. Measurements with Network Analyzer

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

EC 537-2

MICROWAVE SYSTEMS LABORATORY-II

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

I. To study the characteristics of Micro strip Filters, Couplers and Hybrids using Advanced Micro strip Trainer Kit (AMTK)

II. Software simulation and design of passive Microwave Components and printed antennas using
- Agilent Advanced Design System(ADS)
- AWR Microwave office
- SONNET High Frequency EM simulator
- Zeland IE3D

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

EC 538-1

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:

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 538-2

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:

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 538-3

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 539

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 540

ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

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

UNIT 1

Sources and effects of EMI-Intersystem and intrasystem: EMI predictions and modeling; Cross talk: cable wiring and coupling: shielding and shielding materials. Grounding and bounding.

UNIT 2

Transmitter models for EMI predictions: Types of emissions: Amplitude culling Frequency culling. Detail prediction and Performance prediction of various emissions.

Receiver models for EMI predictions: Receiver EMI functions. Receiver models for amplitude culling, frequency culling, Detail predictions and performance prediction.

UNIT 3

(a) Antenna models for EMI prediction:
Antenna EMI prediction considerations. Antenna models for amplitude culling, frequency culling and detail prediction.

(b) Propagation models for EMI prediction
Propagation considerations. Propagation models for amplitude culling, Propagation models and detail prediction.

UNIT 4

EMI measurement s-Open area test site measurements. Measurement precautions: Radiated and Conducted interference measurements; control requirements and test methods.

UNIT 5

EMI filters characters of LPF, HPF, BEF, EMI standards-Military and industrial standards. FCC regulations.

Suggested Reading:

1. William Duff G, and Donald RJ., Series on Electromagnetic interference and
2. Compatibility, vol 5, Emi prediction and Analysis Technique, 1972.
3. Dr. Prasad kodali V., Engineering Electromagnetic Compatibility, IEEE press, 1996.
4. Weston David. A., Electromagnetic Compatibility, Principles and applications, 2nd edition ,2001
5. Kaiser BE., Principles of Electromagnetic Compatibility,3rd edition, Norwood MA: Artech House, 1987.

EC 541

MICROWAVE MEASUREMENTS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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-1957.

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

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

EC 542

NUMERICAL METHODS IN ELECTROMAGNETICS

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

UNIT I

Solution of algebraic and transcendental equations. Bisection method. Iteration methods. Newton-Rapson method. Muller's method. Applications of above methods to EM scattering problems.

UNIT II

Numerical integration and differentiation. Trapezoidal and Simpson's method.

UNIT III

Quadrature integration formula. Numerical integration methods, Finite difference techniques. Solution of Laplace's equation.

UNIT IV

Solution of linear equations. Matrix Methods. Gaussian elimination. Introduction to method of moments, Eigen values and Eigen vectors.

UNIT V

Solution of differential equations with Runge-kutta methods.

Suggested Reading:

1. Scharborough. JB., Numerical method analysis, Jhons Hpkins Press-1962
2. Sastry. SS., Introductory methods of Numerical analysis, 4^{th} edition -2006.
3. Harrington. RF., Introduction to method of moments,McGrow-hills-1961.
4. Krishna murthy., EV and Sen. SK, computer based Numerical algorithms.-1976.

EC 543

PHASED ARRAY RADAR

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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,A.A, and G.H. knittel, Phased Array Antennas, Artech House, 1972.
2. Kahrilas, PJ, Electronic Scanning Radar Systems Design Handbook, Artech House, 1976.
3. Skolnik, MI, Radar Handbook, Mcgraw Hillso, NY,McGrow Hills-2007
4. Galati,G-(editor), Advanced Radar Technique and Systems, Peter Peregrims Ltd, London, 1993.

EC544

MICROWAVE SOLID STATE DEVICES

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

UNIT I

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.

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

Microwave Transistor: Wafer design. Equivalent circuit. Design compromises. Package design.

Suggested Reading:

1. Watson, “Microwave Semiconductor Devices and their applications”, McGraw Hill, 1969.
2. Sze. S.M, and Kwok K. Ng,“Physics of Semiconductor Devices”, John Weiley-3rd edition 2007.
3. Shurmer,H.V, “Microwave Semiconductors”, Wien Oldenbourg,1971.

EC545

RADAR SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 546

RADIO NAVIGATIONAL AIDS

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

UNIT I

Review of Navigational Systems: Aircraft navigational system. Geometry of the earth.

Navigation equation. Navigation errors. Radio navigation system types and Performance parameters. Hyperbolic navigation systems, Loran, Omega, Decca Radio direction finding, DME. TACAN and VORTAC.

UNIT II

Inertial navigation: Inertial navigation system. Sensing instruments: Accelerometer.

Gyro-scopes, Analytic and Gimbaled platforms. Mechanization. Error analysis, Alignment.

UNIT III

Global Positioning System (GPS) for Navigation: Overview of GPS, Reference systems. Satellite orbits, Signal structure, Geometric dilution of precision (GDOP), or Precision dilution of precision (PDOP), Satellite ephemeris, Satellite clock, Ionospheric group delay. Tropospheric group delay, Multipath errors and Receiver measurement errors.

UNIT IV

Differential GPS and WAAS: Standard and precise positioning service local area DGPS and Wide area DGPS errors. Wide Area Augmentation System (WAAS) architecture. Link budget and Data Capacity, Ranging function, Precision approach and error estimates.

UNIT V

GPS Navigational Application. General applications of GPS, DGPS, Marine. Air and Land Navigation, Surveying, Mapping and Geographical information systems, Military and Space.

Suggested Reading:

1. Myron Kavton and Walter Friend, R., “Avionics Navigation Systems”, Wiley, 1997
2. Parkinson. BW. Spilker, “Global Positioning System Theory and Applications”, Progress in Astronautics, Vol. I and II, 1996.
3. Hoffman. B., Wellenhof. H... Lichtenegger and J. Collins. “GPS Theory and Practice” , Springer Verlang Wien New York, 1992.
4. Elliot D. Kaplan, “Understanding GPS Principles and Applications”, Artech House. Inc., 1996.
5. Lieck Alfred., “GPS Satellite Surveying”, John Wiley, 1990.

EC 561

DIGITAL SPECTRAL ANALYSIS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 562

ADAPTIVE SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 563

DIGITAL CONTROL

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

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 564

MODERN DIGITAL SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 wavelet, Digital filter implementation of the Haar wavelet, Digital Filtering interpretation.

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 565

REAL TIME SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 567-1

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, sin…)

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 567-2

SYSYEMS AND SIGNAL PROCESSING LABORATORY –II

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

Section - 1:

Underatsatding the DSP memory architecture

Part (a): Declaring and initializing the variables.

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

ii. Setting up Circular buffering , hardwared loops

a. Adding the 10 consecutive numbers
b. Splitting he numbers
c. Bit level operations.

Underatsatding the DSP MAC capabilities

Windowing
Convolution
FIR filtering

Underatsatding the DSP parallel instaruction optimisation

FFT with out parllel instrauction
FFT with parallel instructions;

Interfacing the DSP processor in real time.

Initialization of Audio codec.
Interfacing with serial port.
Testing with loop back’

EC 568-1

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:

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 568-2

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:

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 568-3

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 569

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 570

OPTIMAL CONTROL THEORY

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

UNIT I

Introduction to optimization technique and control static optimization, constrained optima. Lagrange multipliers, Linear programming . Dynamic optimization. The optimal control problem and its formulation, state variable representation of system, performance measure of optimal control problem. Selection of performance measure.

UNIT II

Calculus of variation : Fundamental concepts. Functionals of single valued function. Functionals involving several independent functions. Piecewise smooth extremals constrained extrema

UNIT III

Variational approach to optimal control problem: Necessary conditions for optimal control problem, pontryagins minimum principle and state inequality constraints. Minimum time problem. Minimum control effort problem. (minimum fuel problem). Singular interval in optimal control problem.

UNIT IV

Dynamic Programming: The optimal control law, the principle of optimality, application of the principle of optimality in decision making. Dynamic Programming applied to a routing problem, optimal contol system. Recurrence relation of Dynamic Programming. Hamilton-Jacobi Bellman equation.

UNIT V

Numerical determination of optimal trajectories: Two point bound value problem.Method of steepest decent. Variation of Extremals. Quasilinearization.

Suggested Reading:

1. Donald E Kirk., Optimal Control Theory an Introduction., PHI,Englewood Cliff's New Jersy.
2. Sage. AP., Optimal Control Systems, PHI, 1968.
3. Rao. SS., Optimization Techniques, PHI,1989.

EC 571

ADAPTIVE CONTROL SYSTEMS

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

UNIT I

Introduction: Model Reference Adaptive systems. Gradient approach. MRAS based on stability theory, Direct MRAS, MIT rule.

UNIT II

Self tuning control: Introduction.MRAE. Identification.Problem,Parameter estimation.Principle of least squares. Weighted least squares. Recursive least squares algorithm. Minimum – Variance prediction, Minimum variance control.

UNIT III

Self tuning regulators: Indirect STR, Adaptive predictive control, Generalized predictive control, stochastic adaptive control. Problem for dual control and sub optimal strategies.

UNIT IV

Gain Scheduling: Principle, design, linear transformation & applications.

UNIT V

Perspective on adaptive control: Adaptive signal processing, extremum control, expert control, learning systems.

Suggested Reading:

1. Astrom. KJ & Wittenmark BJ, Adaptive Systems in Control and signal processing. Pergaman, 1987.
2. Gopal M., Digital Control, Wiley Eastern, 1988.

EC 572

OPTIMIZATION TECHNIQUES

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 573

NON LINEAR CONTROL THEORY

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

UNIT I

Nonlinearities in engineering systems. Characteristics of Nonlinear dynamic systems, Algebraic nonlinearities. Behaviour of nonlinear systems, common physical non linearities.

UNIT II

The Phase-plane Method: Basic Concepts, Singular points, Stability of Nonlinear System, Construction of Phase-trajectories, The Describing function method: Basic Concepts, Derivation of Describing Functions, Stability analysis by Describing Function Method, Jump Resonance, Optimal control systems.

UNIT III

Liapunov's stability analysis: Introduction, Liapunov's stability criterion, The Direct Method of Liapunov and the Linear System, Methods of Constructing Liapunov Functions for Nonlinear Systems.

UNIT IV

Robust control systems: Robust control systems and system sensitivity,Analysis of Robustness, Systems with uncertain parameters,Design of robust control systems, PID controllers.

UNIT V

Introduction to design: The design of FBCSs: Approaches to system design.,Cascade compensation networks, Phase lead and phase lag

Suggested Reading:

1. IJ Nagrath and M. Gopal, Control Systems Engineering, New age International Publiations, 2008
2. Richrd C. Dorf and Robert H. Bishop, 'Modern Control Systems' , AWL,8th ed., 1999.

EC 574

GUIDANCE AND CONTROL

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

UNIT I

Instruction to Missile guidance. Various types of guidance systems, command guidance, Beam riding systems. Homing systems including passive. Semi active and homing systems. Inertial guidance systems.

UNIT II

Target tracking, Missile servos. Missile control methods. Roll control. Lateral control. Polar versus Cartesian control. Thrust vector control.

UNIT III

Aerodynamic derivatives and Aerodynamic transfer functions, altitude and speed conversion factors for Aerodynamic derivatives, Wiener filter theory applied in guidance systems – Application of the Kalman filter.

UNIT IV

Missile Instruments – gyroscopes – Rate, position, Accelerometers, Resolvers, Altimeters.

UNIT V

Remote Sensing and Image sensors.

Suggested Reading:

1. Gamell IP & East DJ, Guided weapon control systems, Pergamon Press.
2. Locke, Guidance, Van Nostrand
3. Jerger, System Preliminary Design, Van Nostrand

EC 575

PATTERN RECOGNITION

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

UNIT I

Introduction and Basic concepts, Linear decision functions, Dichotomies, Classification by distance functions. Supervised learning.

UNIT II

Deterministic approach and statistical approach. Bayes decision theory and likelihood functions.

UNIT III

Feature selection. K - L expansion. Unsupervised learning.

UNIT IV

Clustering methods, Applications of pattern recognition.

UNIT V

Elements of synthetic pattern recognition. Sequential and fuzzy pattern recognition.

Suggested Reading:

1. Ton. JT & Gonzalez Re., Pattern Recognition, Addison Wesley Press, 1974.
2. Duda & Hart, Pattern Classification and Scene Analysis, Wiley, 1973.
3. ECE Dept., Recent developments in Pattern recognition and digital techniques, February, 1977.
4. FU KS, Sequential methods in pattern recognition and machine learning, Academic Press, 1968.

EC 576

SPEECH SIGNAL PROCESSING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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, Spectctrograms, 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 577

IMAGE PROCESSING AND VIDEO PROCESSING

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

UNIT I

Fundamentals of Image Processing and Image Transforms

Basic steps of Image Processing System, Sampling and Quantization of an image, 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.

Image Segmentation

Segmentation concepts, Point, Line and Edge Detection. Thresholding, Region Based segmentation.

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 concepts of Video Processing

Analog Video, Digital 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 Estimation, 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.

Suggested Reading:

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 578

NEURAL NETWORKS AND FUZZY LOGIC

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 579

SYSTEMS SIMULATION AND MODELING

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

Suggested Reading:

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

EC 580

NUMERICAL METHODS IN ENGINEERING

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 591

MODERN DIGITAL COMMUNICATION SYSTEMS

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

UNIT-I

Characterization of Communication signals and systems: Bandpass signals, Linear Bandpass systems and its response, Bandpass stationary stochastic processes, Power spectra of linearly modulated signals.

UNIT-II

Baseband Data Transmission: Correlative coding: Duobinary signaling, Duobinary decoding, Precoding, Duobinary equivalent transfer function, Comparison of Binary with Duobinary signaling Polybinary signaling, Inter symbol interference, Equalization.

UNIT-III

Bandpass Data Transmission: Coherent and non coherent modulation and detection of digital (binary and M-ary) signals, Optimum Receiver, MSK, Mary signaling and performances.

UNIT-IV

Encryption and Decryption: A model of the encryption and decryption process, cipher systems, stream encryption and public key encrypt systems.

UNIT-V

Fading channel characteristics: channel characteristics, channel classification, channel correlation function and power spectra, the effect signal characteristics on the choice of channel model, Mitigation techniques for multipath fading channel: space diversity, frequency diversity, time diversity, multipath diversity and RAKE Receiver, frequency selective and non selective fading, Example of Radio channels.

Suggested Reading:

1. John G. Proakis,Digital Communications, 4th edition, McGraw Hill international edition, 2001.
2. Bernard Sklar, Digital communications fundamentals and Application, 2nd edition, Pearson education, 2001.
3. Fuqin Xiong, Digital modulation Techniques, Artech House, 2000.
4. Stephen G. Witson,Digital modulation and coding, Prentice Hall, New Jessey, 1996.
5. Rodger E. Ziemer and Roger L Peterson, Introduction to Digital coomunication, 2nd edition, Prentice Hall International edition,2001.

EC 592

WIRELESS MOBILE COMMUNICATION SYSTEMS

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

UNIT I

Modern Over View wireless communication systems: 1G, 2G, 2.5G, 3G and 4G technologies WLL, WLAN, PAN and Bluetooth.

Cellular Concept: Frequency reuse, Channel assignment strategies, handoff strategies.

UNIT II

Interference and system capacity, near end and far end interference, effect of near end mobile units. Grade of service, improving coverage and capacity in cellular systems.

UNIT III

Mobile radio propagation : large scale propagation free space propagation model. Outdoor propagation models: longely Rice model, Durkin's model, A case study, okumura model, Hata model, PCS Extension to Hata 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.

UNIT IV

Small scale fading & multipaths: Factors influencing small scale fading, small scale multipath measurements, parameters of mobile multipath channel. Types of small scale fading. Spread Spectrum techniques,Multiple Access techniques: FDMA, TDMA, CDMA, CDMA Cellular radio networks.

UNIT V

Modulation techniques for mobile radio, constant enevelop modulation AMPS, and ETACS, GSM.Intelligent network for wireless communication advanced intelligent network (AIN), SS7 network for ISDN & AIN. Wireless ATM networks.

Suggested Reading:

1. Rappaport, "Wireless Communication", Pearson Education, 2nd edition, 2002.
2. William C. Y. Lee, "Mobile Cellular Telecommunications: Analog and Digital Systems", 2nd edition, McGraw-Hill Electronic Engineering Series, 1995.
3. William C.Y. Lee, "Mobile Communication Engineering", Mc-Graw Hill, 1997.
4. Mike Gallegher, Randy Snyder, "Mobile Telecommunications Networking with IS-41", McGraw Hill 1997.
5. Kernilo, Feher, "Wireless Digital Communications", PHI, 2002.

EC 593

PROBABILITY AND RANDOM PROCESSES

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

UNIT I

Probability and distribution: Joint and conditional probability, independent events, Combined sample space, events in the combined space, probabilities in combined experiments, concept of random variables, distribution and density functions: Gaussian, Binomial, Poison, Uniform, Exponential, Rayleigh, Rice and Chi-Square distributions, conditional distribution and density functions.

UNIT II

Operations in Random Variables: Expectation, moments, Chebychev's inequality and Markov's inequality. functions that give moments, characteristic functions, moment generating function, transformation of a random variable, computer generation of one random variable problems, vector random variables, joint distribution and joint density properties, condition distribution and density, statistical independent, sum of several variables, central limit theorem: unequal distribution, equal distribution.

UNIT III

Multiple Random Variables and Processes: Expected value of a function of Random variables, Joint moments about the origin, joint central moments, joint characteristic functions, jointly Gaussian random variables and properties, Linear transformation of Gaussian Random Variables. Sampling and Limit theorems: estimation of Mean, Power and Variance, Weak law of Large numbers and Strong law of Large numbers. Complex random variables.

UNIT IV

The random process and spectral characteristics: concept, stationery and independence, correlation functions, complex random processes.

Spectral Characteristics of Random Processes: Power density spectrum and its properties. Relationship between power spectrum and auto correlation function. Cross power density spectrum and its properties, Relationship between cross power spectrum and cross correlation. Power spectrums of complex processes.

UNIT V

Linear System with Random Inputs: Random signal response of linear systems, auto correlation of response and cross correlation functions of linear systems. System evaluation using random noise. White and colored noise. Spectral characteristic of a system response. Noise band width, band pass, band limited processes, narrow band processes, properties of band limited processes. Modeling of noise sources, an antenna as noise source.

Suggested Reading:

1. Peyton Z. Peebles JR., "Probability Random Variables and Random Signal Principles", Tata Mc Graw Hill, edition, 4/e, 2002.
2. Athanasios Papolis, "Probability, Random Variables and Stochastic Processes", McGraw Hill, Inc., 3rd edi., 1991.
3. Stark, "Probability & Random Process with Application to Signal Processing", Pearson Education, 3rd edition, 2002.

EC 594

CODING THEORY AND TECHNIQUES

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

UNIT – I

Introduction:

Digital communication system, Wireless channel statistical models, BER performance in AWGN and fading channels for different modulation schemes, BER performance of CDMA, FH – CDMA in AWGN and fading channels, capacity of fading channels with CSI, Diversity reception, channel coding Theorem, Channel coding gain.

UNIT – II

Block Coding:

Galois fields, polynomials over Galois fields, RS codes, Decoding Techniques for RS codes, LDPC encoder and decoder, Performance analysis of RS and LDPC codes. BCH codes.

UNIT – III

Convolution codes:

Linear convolution encoders, Structural properties of Convolution codes, Viterbi decoding technique for convolution codes – Soft / Hard decision, concatenation of block codes and convolutional codes, performance analysis, concept of Trellis coded modulation.

UNIT – IV

Turbo Codes:

Parallel concatenation, Turbo encoder, Iterative decoding using BCJR algorithm, Performance analysis.

UNIT – V

Space – Time Coding:

MIMO systems, MIMO fading channels, rate gain & diversity gain, transmit diversity, Alamouti scheme, OSTBC codes, Linear space – time codes, trellis space – time codes, Space – time codes with no CSI

Suggested Reading:

1. S.B. Wicker, Error control systems for Digital communication and storage, Prentice-hall 1995.
2. E. Biglieri, Coding for Wireless Channels, Springer,2007.
3. K.L.Du & M.N.S.Swamy, Wireless Communication Systems: From RF Subsystems to 4G Enabling Technoligies, Cambridge,2010.
4. J.G. Proakis & M. Salehi, Digital Communications, Mc Graw-Hill, 2008.

EC 597-1

COMMUNICATIONS LAB

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

1. Study of Phase Shifter, Multiplier and Integrate and Dump Filter
2. Measurement of noise figure
3. Analysis of error coding, parity check and hamming check.
4. Study of wavelength division multiplexing and de-multiplexing.
5. Establishment of Analog / Digital links on optical fibre communication systems, study of 4 channel TDM on optical fibre link
6. Serial communication using RS232C / Standard Asynchronous / Synchronous model
7. Characterization of Optical directional coupler.
8. Study of modulation schemes using Spectrum analyzer.
9. Simulation of Analog and Digital Communication Modulators / Demodulators using MATLAB and SIMULINK.
10. Simulation of Channel coding / decoding using MATLAB and SIMULINK

EC 597-2

COMPUTER COMMUNICATION NETWORKS LAB

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

1. Data communication protocols
   a) Stop & Wait protocol
   b) Go to back N-protocol
   c) Selective Retransmission
2. PC to PC file transfer
3. Error detection codes in data communications
4. Study of LAN fundamentals
5. Data encryption in data communication networks
6. Point – to – Point communication in communication networks
7. Multicast / Broadcast communication
8. Study of Token bus – IEEE 802.4 standard
9. Network / Token management
10. Client Sever Simulation
11. Study of wireless LAN

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

EC 598-1

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:

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 508-2

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:

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 508-3

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 599

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 600

SATELLITE AND MICROWAVE COMMUNICATION

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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, EIRP and conversion factors, CCITT modulation plan, loading of FDM system, pilot tones, noise calculation, through super group techniques, compandors, characteristics of carrier equipment.

UNIT II

Line-of-sight communication systems: Link engineering, propagation characteristics in free space, path calculations, feeding, diversity reception, noise power ratio and its measurements, frequency planning. Path and link reliability, rainfall and other precipitation attenuation, radio link repeaters, antenna towers and masts, plain reflectors as passive repeaters, noise planning on radio links.

UNIT – III

Tropospheric scatter communication system: Introduction, phenomenon of tropospheric scatter, tropospheric fading, path loss calculations, aperture to medium coupling loss take of angle, equipment configuration, isolation, inter modulation, typical tropospheric scatter parameters. Frequency assignment. Earth station technology: The satellite earth space window, path loss considerations of the up link and down path calculations.

UNIT- IV

Earth station, G/T, C/N , link calculation, C/N for the complete link, and design of communication systems via satellites, Modulation, Multiplexing and multiple access techniques: TDMA,FDMA, CDMA,SSMA, SPADE.

UNIT – V

Reliability, Redundancy, Quality assurance, Echo control and Echo suppression, introductory concepts of VSATS, GIS, GPS and Future trends, Pay load engineering – Definition, constraints, specification and configurations.

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 Edition, April 2003.

EC 601

OPTICAL FIBRE COMMUNICATION SYSTEMS

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

UNIT I

Optical Fibres: Fibre Structures, Wave-guiding and fabrications, 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 and fabrication. Attenuation, Dispersion, Signal distortion in optical wave-guides, Mode coupling, Design optimization of single mode couplers.

UNIT II

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

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, Eye pattern, Noise effects on digital transmission system performance. Overview of analog links, Carrier noise ratio in analog systems. Power budget, Time budget, Maximum link length calculations.

UNIT IV

Opto-Electronic Integrated Circuits (OEICs): Basic concepts of OEICs. Optical Planar and Strip waveguides. Principles of Electro-Optic Effect. Guided wave devices – Phase modulator, Mach-Zehnder Interferometer modulator and switch, Optical directional coupler and switches.

UNIT V

Multi channel transmission techniques, Classification of coherent optical Fibre systems, Modulation techniques, polarization control requirements, WDM. Application of optical Fibre in Local Area Networks, Introduction of optical amplifiers.

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 602

STATISTICAL SIGNAL PROCESSING

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

UNIT I

Optimum Linear Filters: Representation of stationary random process – Rational power spectra, Filter parameters and autocorrelation sequence. Forward and backward predictors, Reflection coefficients, AR Process and Linear Prediction. Solution of normal equations – Levinson & Durbin Algorithms, Schur Algorithm. Properties of linear prediction error filters. AR Lattice and ARMA Lattice – Ladder filters. FIR and IIR Wiener filtering and prediction.

UNIT II

Power Spectrum Estimation: Estimation of Spectra from finite duration observation of a signal. Periodogram. DFT in power spectrum estimation. Non-parametric methods – Bartlett's welch's and Blackman-Turkey methods; Computational requirements and performance characteristics. Parametric methods – Relation between auto correlation sequence and model parameters. Methods for AR model parameters. Yule – walker, Burg and unconstrained, Least squares methods. Sequential estimation methods. Selection of AR model order; Moving average (MA) and ARMA models.Capon's minimum variance method. Pisarenko's harmonic decomposition method. Eigen structure methods – Music and ESPIRIT. Order selection criteria.

UNIT III

Array Signal Processing: Array fundamentals – Spatial signals, Signal models, Spatial sampling. Conventional beam forming-Spatial matched filter, Tapered Beam forming. Optimum Beam forming, Eigen Analysis, Interference cancellation, sidelobe canceller. Performance considerations for optimum beam forming.Basic ideas of direction of arrival estimation using a uniform linear array. Maximum likelihood estimate. Pisaxenko's method. MUSIC.

UNIT IV

Adaptive Filters: Applications of adaptive filters-Prediction, System modeling, Interference cancellation, Channel equalization. Adaptive direct form FIR filters – MMSE extension, LMS algorithm, properties of LMS algorithm, Recursive Least Squares (RLS) algorithm and its properties. Adaptive Lattice – Ladder filters, properties of lattice – Ladder algorithm.

UNIT V

Introduction. Moments, cumulant and polyspectra. Higher Order Moments (HOM) and LIT systems, HOM's of linear signal methods. Blind deconvolution. Blind equilization algorithm. Conventional estimators for HOS. Parametric method for estimation of HOS – MA, AR & ARMA methods. Ceptra of HOS. Phase and magnitude retrival from the bispectrum.

Suggested Reading:

1. John G. Proakis et.al, "Introduction to Digital Signal Processing", PHI, 1997.
2. D.G. Manolakis, Ingle & S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, Int. edition, 2000.
3. John G. Proakis, Rader, et.al, "Algorithms for Statistical Signal Processing", Pearson Education, Asia Publishers, Indian edition, 2002.
4. S. Kay: Modern Spectral Estimation, "Theory & Applications", PH publication, 1st edition, 1987.
5. Simon Haykins, "Array Signal Processing", P.H. Publication 1985. (Chapters 2,3 and 4).

EC 603

SMART ANTENNAS FOR MOBILE COMMUNICATIONS

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

UNIT I

Cellular Radio concepts – Spread Spectrum CDMA – Antenna Systems – Radio wave propagation – fading – Cellular CDMA – IS-95 CDMA system work – Reverse Traffic Transmission – Forward Channel Signal – Evaluation of CDMA 2000.

UNIT II

Introduction to Smart Antennas – Spatial processing for wireless systems – Fixed beam forming networks – Switched beam systems – Adaptive Antenna Systems – Wide band Smart Antennas – Digital Radio Receiver techniques - Array calibrations.

UNIT III

Smart Antennas Techniques for CDMA: Non Coherent CDMA – Coherent CDMA –Multi user spatial processing – Re sectoring using Smart Antennas – Down link beam forming for CDMA.

UNIT IV

CDMA System Range and Improvements using Spatial Filtering – Range extensions in CDMA – Spatial filtering at IS-95 base station – Reverse channel performance – Spatial filtering at WLL subscriber unit – Range and Capacity Analysis.

UNIT V

Optimal Spatial Filtering and Adaptive Algorithms – Array performance in Multipath – under loaded , over loaded adaptive arrays – Adaptive algorithms for CDMA – Multi Target Decision Directed Algorithms – Estimation Algorithms – RF position location systems.

Suggested Reading:

1. Joseph C. Liberti Jr., Theodore S Rappaport, “Smart Antennas for wireless communications IS-95 and third generation CDMA applications”, PTR – PH publishers, 1st edition, 1989.
2. T.S Rappaport, “Smart Antennas Adaptive arrays algorithms and wireless position location”, IEEE press 1998, PTR – PH publishers 1999.
3. Garg, “IS-95 CDMA and CDMA 2000, “Cellular / PCs systems implementation”, Pearson Education, 2002.

EC 604

VOICE OVER INTERNET PROTOCOLS

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

Unit-I:

Overview of IP Protocol Suite

The internet protocol, the Transmission control Protocol(TCP), The User Datagram Protocol(UDP), The Real–time Transport Protocol(RTP), IP multicast, IP version 6 (IP v6),Internetworking IPv4 and IPv6, The VoIP Market, VoIP Challenges.

Unit-II:

H.323 and H.245 Standards

The H.323 Architecture, Call Signaling-Call Scenarios, H.245 Control Signaling Conference Calls- The Decomposed Gateway.

Unit-III:

The Session Initiation Protocol (SIP)

SIP-Architecture- Overview of SIP Messaging syntax- Examples of SIP Message Sequence- Redirect Servers- Proxy Servers. The Session Description Protocol (SDP)-Usage of SDP with SIP.

Unit- IV:

Quality of Services (QoS)

Need for QoS- End-to end QoS, Overview of QoS Solutions- The Resource reservation Protocol (RSVP) - Diffserv – The Diffserv Architecture- Multi-Protocol Label Switching (MPLS)-The MPLS Architectures- MPLS Traffic Engineering- Label Distribution Protocols and constraint- Based Routing.

Unit-V:

VoIP and SS7

The SS7 Protocol Suit- The Message Transfer Part (MTP), ISDN User Part (ISUP) and Signaling connection control part (SCCP), SS7 Network Architecture- Signaling Points (SPs)- Single Transfer Point (STP),- Service Control Point (SCP),- Message Signal Units (MSUs)- SS7 Addressing, ISUP, Performance Requirements for SS7, Sigtran –Sigtran Architecture- SCTP- M3UA Operation-M2UA Operations-M2PA Operations- Interworking SS7 and VoIP Architectures-Internetworking Soft switch and SS7- Internet working H.323 and SS7.

Suggested Reading:

1. Daniel Collins, Carrier Grade Voice over IP, 2nd ed., TMH.
2. MPEG-4, part 2: ISO/IEC 14496-2: coding of audio- visual objects-part2, visual, Third Edition, May 2004

EC 605

DETECTION & ESTIMATION THEORY

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

UNIT I

Classical Detection Theory: Binary hypothesis testing; Baye's, Minimax and Neyman – Pearson tests. Composite hypothesis testing.

UNIT II

Signal Detection in Discrete Time : Models and Detector structures; Detection of deterministic signals in independent noise; Detection in Gaussian noise. Detection of signals with random parameters. Detection of stochastic signals. Performance evaluation of detection procedures.

UNIT III

Parameter Estimation: Bayesian Parameter Estimation; MMSE, MMAE and MAP estimation procedures. Non random parameter estimation, general structure. Exponential families; completeness theorem. The information inequality. Maximum likelihood Estimation (MLE). Asymptotic properties of MLE's

UNIT IV

Signal Estimation in discrete – Time: The discrete – time kalman – Bucy filter. Linear estimation; Orthogonality Principle. Wiener – Kolmogrov filtering; Causal and non-causal filters.

UNIT V

Signal Detection in Continuous Time : Detection of deterministic signals in Gaussian noise; Coherent detection. Detection of signals with unknown parameters.

Suggested Reading:

1. H.V. Poor, "An Introduction to Signal Detection and Estimation", Springer – Verlag, 2nd edition, 1998.
2. M.D. Srinath & P.K. Rajasekaran, "An introduction to statistical signal processing with applications", Prentice Hall, 2002.
3. H.L. Vantrees, "Detection, Estimation & Modulation Theory", Part-I, John Wiley & Sons, 1968.

EC 606

EMBEDDED SYSTEM DESIGN

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

UNIT – I

Introduction to Embedded Systems: An Embedded system, Classification, processor in the system, other hardware units, structural units in a processor, processor selection for an embedded system, memory devices, memory selection for an embedded system, introduction to ARM processors.

UNIT – II

Devices and Buses: I/O devices, Serial communication using IIC and CAN buses, advanced I/O buses between the networked multiple Devices, Device drivers: Classification, Parallel port device drivers in a system, Serial port device drivers in a system.

UNIT – III

Interprocess communication and synchronization of processes, Task and Threads: Multiple processes in an application, problem of sharing data by multiple tasks and routines, Embedded programming in C++ and Java.

UNIT – IV

Real time Operating Systems: Operating system services, Real time operating system services, interrupt routines in RTOS Environment, RTOS Task scheduling, embedded Linux internals, OS Security issues, Mobile OS.

UNIT – V

Hardware-Software Co-Design in an Embedded System: Embedded system project Management, Embedded system Design and Co-Design issues in system development process. Design cycle in system development phase for an embedded system, Emulator and ICE, Use of software tools for development of Embedded systems, Case studies of programming with RTOS(Examples: Automatic chocolate vending machine, vehicle tracking system, Smart card).

Suggested Reading:

1. Raj Kamal,"Embedded Systems" Architecture, Programming and Design, TMH, 2006.
2. Jonathan W Valvano, "Embedded Micro Computer Systems" Real Time Interfacing, Books / cole, Thomson learning 2006.
3. Arnold S Burger, "Embedded System Design" An Introduction to Processes, Tools and Techniques by CMP books, 2007.
4. David.E. Simon, "An Embedded Software Primer", Pearson Edition, 2009.
5. Andrew N.sloss, Dominic Symes, Chris Wright, "ARM System Developer's guide", Elsevier publications 2005.

EC 607

DIGITAL SYSTEM DESIGN USING VHDL

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

UNIT – I

Review of logic Design Fundamentals
Design of Mealy & Moore sequential network– synchronous Design – Tristate logic and busses.– VHDL language constructs - VHDL description of combinational networks – Flip flops modeling using VHDL process – Modeling of combinational circuits using VHDL

UNIT – II

Design of Networks for Arithmetic Operations– Design of serial adder with accumulator –State Graphs for control networks– Design of Binary Multiplier– Multiplication of signed binary numbers – Binary divider – Design of FIFO – Test benches.

UNIT – III

Design with PLD – ROM – PLAs – PAL – PLDs – Design of a keypad scanner
Synthesis and fitting – Area, Speed and Device resource utilizations
Design with programmable Gate arrays and CPLDs: FPGAs – Designing with FPGAs – CPLDs – Designing with CPLDs.

UNIT –IV

Digital design with SM charts – state machine charts – Implementation of the PN sequence generator - linked state machines

Optimizing data paths – pipelining
Floating point Arithmetic – floating point multiplications

UNIT – V

CMOS Technology– Architecture Design– Logic Design– Physical Design– Design Rules– Stick Diagrams– Layout Styles– Layouts of simple logic gates– Floor planning– Placement and Routing Techniques– Fabrication Process and steps: Oxidation– Photolithography– Ion Implantation– Metallization.

Suggested Reading:

1. CH Roth .Jr, "Digital System Design using VHDL", PWS publishing company ,2000.
2. Dueck, "Digital Design with CPLD Applications and VHDL", Delmar Thomson learning 2001.
3. Kevin Skahill, "VHDL for programmable logic", 2nd Edition, pearson education, 2006.
4. Neil H.E Weste, Kamran Eshraghian "Principles of CMOS VLSI Design", 3rd Edition, Addison Wesly, 2005
5. Wayne Wolf "Modern VLSI design", 3rd Edition, Pearson Education, 2002

EC 608

DATA COMPRESSION

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

UNIT I

Data Compression: Entropy coding – Huffmann Run length, arithmetic and Ziv-Lemple coding

UNIT II

Speech & Image waveform characterization – source models, Quantization, Optimal & adaptive waveform coders for speech & images.

UNIT III

Predictive coding – DPCM, Linear prediction, prediction for video, adoptive prediction, motion compensation for video.

UNIT IV

Transform Coding: Orthogonal transforms – Fourier, Cosine, wavelet based approaches to speech & image compression.

UNIT V

Subband coding, VQ based compression, Fractal coding of images.
High quality video & audio compression for digital broadcasting.
Standards for digital signal compression-data, speech, audio, image & Video.

Suggested Reading:

1. M. Nelson, "The data compression book", 2nd edition, BPB publications, 1997.
2. Jananth & Noll, "Digital coding of waveforms-Principles and applications to speech & video", PHI, 1984.
3. K.R. Rao & Hwang. JJ, "Techniques & standards for image, video & audio coding", Prentice Hall, 1996.
4. Elliot, "Handbook of Digital Signal Processing", Academic Press, 1985.
5. Ning Lu, "Fractal Imagin", Academic Press, 1997.

EC 631

DIGITAL IC DESIGN

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

UNIT I

Building blocks for digital design: multiplexer, demultiplexer, decoder, encoder, comparator, adders, building blocks with memory: clocked building blocks, register-building blocks, ram, rom, pla, pal.

UNIT II

Hardware description languages: hierarchical modelling concepts, modules, module instances, design and stimulus blocks: gate level, data flow, behavioural modelling techniques (vhdl & verilog), switch level modelling, delays.

UNIT III

Emitter coupled logic gates, emitter coupled differential pairs, terminating emitter coupled logic, temperature sensitivity, current mode logic gates, current mode logic latches.

UNIT IV

Differential cmos circuits. static cmos digital latches, static random-access memory cell, d-ram cell, dynamic cmos latches, synchronous system design techniques, gray – code counter, bicmos 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 V

Top down design, finite state machine (fsm), case studies(traffic signal controller), synchronization failure and meta stability, algorithmic state machines (asms), synthesis and test benches- using vhdl & verilog.

Suggesting Reading:

1. Ken Martin, “Digital Integrated Circuit Design”, Oxford University Press 2000.
2. John F Wakerly, “Digital Design Principles & Practices”, Pearson Education & Xilinx Design Series, 3rd Ed., 2002.
3. Samir Palnitkar, “Verilog HDL- A Guide to Digital Design and Synthesis”, Prentice Hall India, 2000.
4. PROSSER AND WINKEL, The Art of Digital Design, Prentice Hall, 1994.

EC 632

ANALOG AND MIXED SIGNAL IC DESIGN

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

UNIT I

Brief Review of Small Signal and Large Signal Model 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 degenerated current mirrors. High out impedance – current mirrors, cascode gain stage Wilson current mirror, MOS differential pair and gain stage. Bipolar current mirrors – bipolar gain stages. Differential pairs with current mirror loads MOS and bipolar widlar current sources, supply insensitive biasing, temperature insensitive biasing, band gap reference, band gap reference circuits.

UNIT II

Operational amplifiers, Basic two stage MOS Operational amplifier–Characteristic parameters, two stage MOS Op-Amp with Cascodes. MOS Telescopic-cascode Op-Amp. MOS Folded cascode op-amp. MOS Active Cascode Op-Amp. Fully differential folded cascode op-amp. Current feedback op-amps. Stability and frequency compensation of op-amps. Phase margin and noise in op-amps.

UNIT – III

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 – IV

Data converter fundamentals - performance characteristics, ideal D/A and A/D converters, quantization noise. Nyquist rate D/A converters – decoder based converter, binary-scaled converters. Thermometer code converters, current mode converters.
Nyquist rate A/D Converters: Integrated converters – successive approximation converters, cyclic A/D converters, Flash or parallel converters, Two step A/D converters, pipelined A/D converters.

UNIT – V

Over sampling converters. Over sampling without noise shaping over sampling and with noise shaping, system architecture – digital decimation filters.
Phase locked loops: Basic loop architecture. PLLS with charge pump phase comparators – dynamics of PLLS. Voltage controlled oscillators, characteristics of PLLS. Applications of PLLS.

Suggested Reading:

1. Paul.R. Gray & Robert G. Major, Analysis and Design of Analog Integrated Circuits, John Wiley & sons. 2004
2. David Johns, Ken Martin, Analog Integrated Circuit Design, John Wiley & sons. 2004
3. Behzad Razavi, Design of Analog CMOS Integrated Circuits, Tata Mc Grah Hill. 2002
4. Jacob Baker.R.et.al., CMOS Circuit Design, IEEE Press, Prentice Hall, India, 2000.

EC 633

PRINCIPLES OF VLSI SYSTEM DESIGN

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

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 IV

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

UNIT V

CMOs System case study: Core of RISC Micro Controller ALU address architectures, Instructioin sets pipelining major blocks of the processor. and 6 Bit Flash A/D Converter – high speed comparators and thermometer code converter.

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

EC 634

VLSI PHYSICIAL DESIGN

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 – Wein-berger 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, silicon compilers, modeling and extraction of circuit parameters from physical layout.

Suggested Reading:

1. Preas, M. Lorenzatti, “Physical Design and Automation of VLSI Systems”, The Benjamin – Cummins Publishers, 1998.
2. M. Shoji, “CMOS Digital Circuit Technology”, Prentice Hall, 1987.
3. John P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley & sons, Inc.
4. Modern VLSI Design (System on Chip), Woyne Wolf, Pearson Education, 2002.
5. R. Jacob Baker; Harry W.Li., David E. Boyce, CMOS Circuit Design, Layout and Simulation, IEEE Press, Prentice Hall of India.

EC 635

REAL TIME OPERATING SYSTEMS

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

UNIT I

Brief Review of Unix Operating Systems (Unix Kernel – File system, Concepts of – Process, Concurrent Execution & Interrupts. Process Management – forks & execution. Programming with system calls, Process Scheduling. Shell programming and filters).

Portable Operating System Interface (POSIX) – IEEE Standard 1003.13 & POSIX real time profile. POSIX versus traditional Unix signals, overheads and timing predictability.

UNIT II

Hard versus Soft Real-time systems – examples, Jobs & Processors, Hard and Soft timing constraints, Hard Real-time systems, Soft Real-time systems. Classical Uniprocessor Scheduling Algorithms – RMS, Preemptive EDF, Allowing for Preemptive and Exclusion Condition.

UNIT III

Concept of Embedded Operating Systems, Differences between Traditional OS and RTOS. Real-time System Concepts, RTOS Kernel & Issues in Multitasking – Task Assignment, Task Priorities, Scheduling, Intertask Communication & Synchronization – Definition of Context Switching, Foreground ISRs and Background Tasks. Critical Section – Reentrant Functions, Interprocess Communication (IPC) – IPC through Semaphores, Mutex, Mailboxes, Message Queues or Pipes and Event Flags.

UNIT IV

VxWorks – POSIX Real Time Extensions, timeout features, Task Creation, Semaphores (Binary, Counting), Mutex, Mailbox, Message Queues, Memory Management – Virtual to Physical Address Mapping.

UNIT V

Debugging Tools and Cross Development Environment – Software Logic Analyzers, ICEs.

Comparison of RTOS – VxWorks, µC/OS-II and RT Linux for Embedded Applications.

Suggested Reading:

1. Jane W.S.Liu, Real Time Systems, Pearson Education, Asia, 2001.
2. Betcnhof, D.R., Programming with POSIX threads, Addison - Wesley Longman, 1997.
3. Wind River Systems, VxWorks Programmers Guide, Wind River Systems Inc.1997.
4. Jean.J.Labrosse, MicroC/OS-II, The CMP Books.
5. Real Time Systems, C.M.Krishna and G.Shin, McGraw-Hill Companies Inc., McGraw Hill International Editions, 1997.

EC 637-1

Design and Simulation 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 637-2

Design and Simulation 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 638-1

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:

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 638-2

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:

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 638-3

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 639

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 640

CPLD & FPGA ARCHITECTURES AND APPLICATIONS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 641

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 μp 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 642

DESIGN FOR TESTABILITY

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

Suggesting 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, Englehood Cliffs, 1998.

EC 643

GRAPH THEORY & ITS APPLICATIONS TO VLSI

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

UNIT I

Introduction: Basic definitions, results and examples relating to Graph theory, self-complementing graphs and properties of graphs, Trees, Spanning tree & directed graphs.

UNIT II

Definitions of strongly, weakly, unilaterally connected graphs and deadlocks. Metric representation of graphs. Classes of graphs: standard results relating to characterization of Hamiltonian graphs, standard theorems

UNIT III

Self-centered graphs and related theorems. Chromatic number vertex and edge – application to coloring, linear graphs, Euler's formula.

UNIT IV

Graph algorithms: DFS – BFS algorithms, min. spanning tree and max. spanning tree algorithm. Directed graphs algorithms for matching, properties flow in graph and algorithms for max flow. PERT-CPM, complexity of algorithms, P-NP – NPC – NP hard problems and examples.

UNIT V

Linear integer and dynamic programming : Conversions of TSP, max. flow, shortest path problems. Branch bound methods, critical path and linear programming conversion. Floor shop scheduling problem, personal assignment problem, dynamic programming - TSP – best investment problems.

Suggested Reading:

1. C. Papadimitriou & K. Steiglitz, Combinational Optimization Prentice Hall, 1982.
2. H. Gerej, Algorithms for VLSI Design Automation, John Wiley, 1992.
3. B. Korte & J. Vygen, Combinational Optimization, Springer Verilog, 2000.
4. G.L. Nemhauser & AL Wolsey, Integer & Combinatorial Optimization, John Wiley,1999.
5. W.J. Cook et al, "Combinational optimization", John Wiley,2000.

EC 644

ALGORITHMS ANALYSIS & DESIGN

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

UNIT I

Algorithm definitions, correctness time and space complexity, average and worst case analysis, optimality, P and NP complete problems.

UNIT II

Algorithmic languages and data structures. Numerical and non-numerical, combinational and log algorithms, Polynomial metrics, and vector manipulations

UNIT III

FFT and Signal processing algorithms, algorithms for linear and non-linear, integer and dynamic programming problems

UNIT IV

Searching, Sorting, merging sorted listed, string matching, trees, decision trees, game trees, branch and bound algorithms,

UNIT V

Set representation and components of a graph, shortest path problems, traveling salesman problem, parallel algorithms and distributed processing. NP complete algorithms.

Suggested Reading:

1. Horowitz, Sahni, “Fundamental of Computer Algorithms”, Galgotia Publications.

EC 645

SCRIPTING LANGUAGES FOR VLSI DESING AUTOMATION

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

UNIT I

Overview of scripting languages-PERL, file handles, operators, control structures, regular expressions, built in data types, operators, statements and declarations- simple, compound, loop statements, global and scoped declarations.

UNIT II

Pattern matching - regular expression, pattern matching operators, character classes, positions, capturing and clustering.

UNIT III

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,.

UNIT IV

Threads- process model, thread model, perl debugger- using debugger commands, customization, internals and externals, internal data types, extending perl, embedding perl, exercises for programming using perl.

UNIT V

Other languages: Broad features of other scripting languages SKILL, CGI, java script, VB script.

Suggested Reading:

1. Larry Wall, Tom Christiansen, John Orwant, “programming perl”, oreilly publications, 3rd edition.
2. Randal L, Schwartz Tom Phoenix, “Learning PERL”, Oreilly publications.

EC 646

PHYSICS OF SEMICONDUCTOR DEVICES

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

UNIT I

Properties of Semiconductors: Crystal Structure Energy Bands, Carrier Transport Phenomena. (Mobility of Carriers, Resistivity and Hall Effect, Generation – Recombination Processes). High Field Phenomena. Gunn Effect and Negative Resistance Characteristics. Basic Equation for Describing Current Flow.

UNIT II

Bipolar Devices: Ideal P-N Junctions, V-I Characteristics, Effect of Generation – Recombination Processes. Effect of High Injection. Junction Breakdown, Depletion and Diffusion Capacitance. Hetero Junctions. Bipolar Transistor – Characteristics – Equivalent Circuit - Ebers - Moll Model – Gummel Poon Model, Microwave and High Frequency Transistor Structures – Breakdown of Transistors including Secondary Breakdown.

UNIT III

Field Effect Transistors – JFET, MESFET – Characteristics.

MOSFET and MISFET: MOS Diode – Capacitance Vs Voltage Curves. Interface Trapped Charges – oxide Charge. V-I Characteristics of MIS Diodes with Thin Insulating Films. MOS/MISFET – Different Types – Basic device Characteristics – Sub-threshold Region Characteristics – Buried Channel Devices.

UNIT IV

Short Channel Effects – On sub-threshold Current, On Threshold Voltage – On the Structures – Shallow Junctions – Breakdown Voltage – Band Gap Engineering – Thin Film Transistor – Silicon On Insulator (SOI) Devices.

UNIT V

Floating Gate Devices for Non-volatile Memories. MIOS Devices – Gallium Arsenide Devices – Gunn Devices (or Transferred Electron Devices TEDS) – Functional Devices for Microwave Oscillators. LEDS and Laser Diodes.

Suggested Reading:

1. S.M. Sze, Physics of Semiconductor Devices, John Wiley & Sons, 1981.
2. Dewitt G. ONG., Modern MOS Technology: Processes, Devices and Design,Mc. Graw Hill Book Company. 1984.
3. CHEN , VLSI Hand book, CRC Press, IEEE Press, 2000.

EC 647

VLSI TECHNOLOGY

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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 – Mechanical Operations, Chemical Operations – Prefabrication Processes.

Epitaxy: Growth Dynamics – Process Steps. Vapour phase, Solid phase and Molecular Beam Epitaxial Processes. Epitaxial Reactors.

Oxide Growth: Structure of SiO_2, Growth Mechanism and Dynamics – Oxide Growth by Thermal method.

UNIT IV

Deposition techniques Chemical Vapour Deposition (CVD) and associated methods like LPCVD and PECVD. PVD thermal evaporation and sputtering. Step coverage issues.

Lithography: Steps involved in Photolithography – Quality of the Pattern – photo resists and their characteristics, optical exposure systems contact and projection systems, steppers, 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.

Clean rooms and their importance in VLSI technology

Suggested Reading:

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

EC 648

LOW POWER VLSI DESIGN

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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. Kaushik Roy and Sharat Prasad, Low-Power CMOS VLSI Circuit Design, Wiley Inter-science Publications, 2000.
2. Christian Piguet, Low Power CMOS Circuits Technology, Logic Design and CAD Tools, 1st Indian Reprint, CRC Press, 2010.
3. J. Rabaey,Low Power Design Essentials, 1st Edition, Springer Publications, 2010.

EC 649

MEMS

Instruction	3 Periods per week	University Examination - Duration	3 Hours
Sessionals	20 Marks	University Examination - Marks	80 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, Compatability 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. Thimo Shenko, Strength of Materials, 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.

EC 650

VLSI SIGNAL PROCESSING

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