

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH (Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh - 791112

Fax: 0360 - 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR M-TECH. (ELECTRONICS DESIGN & MANUFACTURING)

Education	NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH (ESTABLISHED BY MINISTRY OF HUMAN RESOURCE DEVELOPMENT, GOVT. OF INDIA)	Ethics
In GOD's own land, a fusion of scholastic students, innovative & motivated researchers & teachers and fast moving visionary leaders.	COURSE STRUCTURE & SYLLABUS FOR M-TECH IN ELECTRONICS DESIGN & MANUFACTURING	Steeping Stone and Sky reaching ladder to success
Research	PO- Yupia, Dist. – Papum Pare, Arunachal Pradesh, Pin – 791 112 Ph No: 0360-2284801/2001582 Fax No: 0360-2284972 Email – nitarunachal@gmail.com	Service to Society



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SYLLABUS FOR M-TECH. (ELECTRONICS DESIGN & MANUFACTURING)

Prof. (Dr.) Chandan Tilak Bhunia, Ph.D [Engg.], FIETE, FIE (I), SMIEEE

DIRECTOR



FORWARD

To achieve the target of being a global leader in the field of Technical Education, there is some sort of time bound urgency to work quickly, massively and strongly, in respect of National Institute of Technology, Arunachal Pradesh being an "Institute of National Importance" (by an Act of Parliament) and being established only in three years back in 2010. I have therefore adopted a 'B' formula as stated below to achieve the primary goal of producing world class visionary Engineers and Exceptionally brilliant Researchers and Innovators:

B-FORMULA

- Best for Teaching
- **Best for Research**
- > Best for Entrepreneurship & Innovation
- > Best for Services to Society

In implementing the 'B' formula in letter and spirit, the framing of syllabi has been taken as important legitimate parameter. Therefore, extraordinary efforts and dedications were directed for the last one year to frame a syllabi in a framework perhaps not available in the country as of today.

Besides attention on 'B' formula institute has given considerable importance to the major faults of current Technical Education while framing the syllabus. The major stumbling blocks in Technical Education today are:

- I. The present system is producing "Academic Engineers" rather than "Practical Engineers".
- II. The present system of education makes the **students to run after jobs rather than making them competent to create jobs.**
- III. There is lack of initiative to implement the reality of "Imagination is more important than knowledge".

Taking due consideration of the findings made above, to my mind a credible syllabi has been framed in the institute in which the major innovations are introduction of:

- I. I-Course (Industrial Course) one in each semester at least one, which is targeted to be taught by the Industrial Expert at least up to 50% of its component.
- II. Man making and service to society oriented compulsory credit courses of NCC/NSS, values & ethics.
- III. Compulsory audit course on Entrepreneurship for all branches.



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- IV. Many add-on courses those are (non-credit courses) to be offered in vacation to enhance the employability of the students.
- V. Many audit courses like French, German, and Chinese to enhance the communication skill in global scale for the students.
- VI. Research and imagination building courses such as Research Paper Communication.
- VII. Design Course as "Creative Design".

Further, the syllabi has been framed not to fit in a given structure as we believe structure is for syllabus and syllabus is not for structure. Therefore, as per requirement of the courses, the structure, the credit and the contact hours has been made available in case to case.

The syllabus is also innovative as it includes:

- I. In addition to the list of text and reference books, a list of journals and magazines for giving students a flexible of open learning.
- II. System of examination in each course as conventional examination, open book examination and online examination.

Each course has been framed with definite objectives and learning outcomes. Syllabus has also identified the courses to be taught either of two models of teaching:

- I. J.C.Bose model of teaching where practice is the first theory.
- II. S.N.Bose model of teaching where theory is the first practice.

Besides the National Institute of Technology, Arunachal Pradesh has initiated a scheme of **simple and best teaching** in which for example:

- I. Instead of teaching RL, RC and RLC circuit separately, only RLC circuit will be taught and with given conditions on RLC circuits, RL and RC circuits will be derived and left to the students as interest building exercise.
- II. Instead of teaching separately High Pass Filter, Band Pass Filter and Low Pass Filter etc.; one circuit will be taught to derive out other circuits, on conditions by the students.

I am firmly confident that the framed syllabus will result in incredible achievements, accelerated growth and pretty emphatic win over any other systems and therefore my students will not run after jobs rather jobs will run after my students.

For the framing of this excellent piece of syllabus, I like to congratulate all members of faculty, Deans and HODs in no other terms but "Sabash!".

Prof. Dr. C.T. Bhunia Director, NIT, (A.P.)



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TEACHING GUIDELINES

In order to achieve the desired goal of excellence and innovations in each and every function of National Institute of Technology, Arunachal Pradesh and to implement 'B' Plan in totality, I call upon my distinguished members of Faculty to invest some of their valuable business time in doing Research on Teaching. In this context, I put forward the following general guidelines for teaching practices in the institute:

- 1) **J.C. Bose Model of Teaching:** As an example, In the Basic Electronics course instead of first teaching the colour codes of the resistors in a theoretical class, teacher may carry few resistors to class and note down on the blackboard the colours of resistors and their values. Thereafter, the teacher may ask the students to device the color code creating enthusiasm among students. Similarly, instead of teaching the characteristics of PN junction diode, teacher may guide the students in a laboratory to draw the characteristics curve, then may advise the students to analyse the behaviour of characteristics. Thereafter, the teacher may teach the theory of PN junction diode.
- 2) **S.N. Bose Model of Teaching:** This is the conventional model of teaching where theory is first practice but even then I suggest some unique ideas to improve imaginative power and creativity of students in the subject. For example, instead of teaching two algorithms for conversion of decimal to binary, one for integral part and another for fractional part, I call upon the teachers to design a single algorithm for both the purposes for inspiring teaching.
- 3) I also believe that noble teaching will be simple and in simpler way. Therefore, I call upon the teachers not to teach bandpass filter, low pass filter, high pass filter separately. Teachers may design a single circuit for all filters and put on condition theron can derive separately circuits for separate filters. Similarly, instead of teaching RL, RC and RLC circuits separately, I call upon the teachers to teach only RLC circuit and then putting suitable condition on RLC circuit; RL and RC circuits may be derived and taught.
- 4) Last but not the least, I call upon the teachers to solve all the problems of all chapters of the main text book prescribed for a subject in a teaching-learning process 50% to be solved by teachers (may be of even ones) and 50% may be solved by students (may be odd ones).

I solicit and anticipate full cooperation from all my brilliant pool of young and energetic faculty members to practice the nobel and novel teaching procedures explained above without fail. Once procedures implemented by teachers are documented, we may proceed to file a patent on Research in Teaching on behalf of NIT, Arunachal Praesh.

Prof. Dr. C.T. Bhunia Director, NIT, (A.P.)



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In recent years, Electronics & Communication Engineering has made unprecedented growth in terms of new technologies, new ideas and principles resulting in extremely high rate of obsolescence of technologies. Researchers, academicians, industries and the society at large have to work in unison to meet the challenges of the rapidly growing discipline. The research organizations and industries that work in this frontier area are in need of highly skilled and scientifically oriented manpower. This manpower can be available only with flexible, adaptive and progressive training programs and a cohesive interaction among the research organizations, academicians and industries. The teaching program contains a proper blend of basic concepts and advances in technology. The faculty has succeeded in keeping a lively atmosphere among the students with innovative teaching techniques. The teaching is closely coupled with the research activities of the department. The ECE Department of NIT Arunachal Pradesh has been consistently working towards this goal. The Department of Electronics & Communication Engineering was established right from inception of the institute in 2010. The department offers a four year degree program in Electronics & Communication Engineering with an annual intake of 30 students & Doctoral program starts in 2013 July session. During these years, this department has diversified its activities in teaching and research. A continuous effort has been put forward towards setting up new laboratories and improves the facilities in the existing laboratories. Following are the laboratories developed with modern infrastructural facilities.

- 1. Advance Electronic Device & Circuit Lab
- 2. Electronics Measurement Lab
- 3. Modern Communication Engineering Lab
- 4.Embedded System Design Lab
- 5.Antenna & Propagations Lab
- 6.Microwave Engineering Lab
- 7. Digital Signal Processing Lab
- 8.Simulation Lab

At present research and development activities of department are in the following area:

- 1. Digital Signal and Image Processing
- 2. Microwave Patch Antenna
- 3. VLSI (Very Large Scale Integrated Circuit)
- 4. Mobile Communication
- 5. Microcontrollers based systems design.
- 6. Semiconductor Physics
- 7. Photovoltaics(PV) devices design

It is our objective to prepare our students to be successful in integrating all the field of engineering and science and to be able to pursue advanced studies in electronics engineering on a competitive global basis. The mission is a culmination of our effort to meet the mission of NIT Arunachal Pradesh, North East region and the nation at large.

1st year the student of ECE department learn about Basic Engineering subject with NCC and one Audit course of French / Korean and German / Chinese which meet Global Standard.2nd and 3rd year student also have Audit course which help to prepare them to face the challenged in Industry. Syllabus also include Industrial Trainings and Project work which help student to fit into industry and research area.



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SYLLABUS FOR M-TECH. (ELECTRONICS DESIGN & MANUFACTURING)

SEMESTER - I

Subject	Subject	P	T	L	Credit
Code					
MAS 901	Applied Engineering Mathematics	0	0	3	3
ECE 901	Digital System Design	2	0	3	4
ECE 902	Advance Semiconductor Devices Architecture	0	0	3	3
ECE 903	VLSI Design (Analog and Digital)	2	0	3	4
ECE 904	Robotics and Industrial Automation in Manufacturing	2	0	3	4
HSS 911	Research Methodology	0	0	3	3
	Total	6	0	18	21

SEMESTER - II

Subject	Subject	P	T	L	Credit
Code					
ECE 905	Micro and Nano Fabrication Technology	0	0	3	3
ECE 906	MEMS & RF based IC Design	2	0	3	4
ECE 907	DSP Based System Architecture	2	0	3	4
ECE 908	Advanced Embedded Systems Design	2	0	3	4
ECE 909	Elective Paper-I	0	0	3	3
ECE 910	Dissertation (Advanced Manufacturing & Systems	30	0	0	5
	Management)				
	Total	36	0	18	23

SEMESTER - III

Subject	Subject	P	T	L	Credit
Code					
ECE 911	UG Teaching Practice (Specified by Guide)	4	0	0	3
ECE 912	Seminar-I	5	0	0	3
ECE 913	Research Project (Continued to 4 th Semester)	24	0	0	10
	Total	36	0	0	16

SEMESTER - IV

Subject Code	Subject	P	T	L	Credit
ECE 914	Research Project	0	30	0	20
	Total	0		0	20



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ELECTIVE PAPER – I

(For M-Tech 2nd Semester)

Subject Code	Subject	P	T	L	Credit
ECE 915	System on Chip	0	0	3	3
ECE 916	Design of Semiconductor Memories	0	0	3	3
ECE 917	Computer Architecture & Parallel Processing	0	0	3	3
ECE 918	VLSI Design – II	3	0	2	4
ECE 919	Electronic Instrumentation Design	0	0	3	3

Teaching Methodology

M-Tech 1 st Semester							
J.C. Bose Model S.N. Bose Model							
Subject Code	Name of The Subject	Subject Code	Name of The Subject				
ECE 901	Digital System Design	ECE 902	Advance Semiconductor				
			Devices Architecture				
ECE 903	VLSI Design(Analog and						
	Digital)						
ECE 904	Robotics and Industrial	HSS 911	Advanced Research				
	Automation in		Methods				
	Manufacturing						
MAS 901	Applied Engineering						
	Mathematics						



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Name of the Module: Applied Engineering Mathematics

Module Code: MAS 901

SEMESTER:

Credit: 3 [P=0, T=0, L=3]

Module Leader:

No. of Lectures: 46 Hours

Objectives:

The course is designed to meet the objectives of:

- 1. To gather knowledge on differential equations, simple integrals, special functions.
- 2. To work linear partial differential equations, diffusion, wave.

Learning outcomes:

At the end of this module, students are expected to be able to

- 1. Understand higher order differential equations, green functions.
- 2. Knowledge about oscillatory integrals, evaluating integral transforms.

Subject Matter:

UNIT	COURSE CONTENT	Number of Lectures
	First order ordinary Differential Equations, Simple Integrals, Higher order	Lectures
	differential equations, Special Functions: Bessel and linear ODEs, Connections,	
UNIT I	Numerical and asymptotic, Nonlinear boundary value problems, Boundary Layers.	11
UNIT II	Linear Partial Differential Equations, Diffusion, wave, Laplace and random walks	
UNITI	and abstract final project, Green functions.	7
	Introduction and overview, Dominant balance and polynomial equations, Dimensions	
UNIT III	and Dimensional Analysis, Introduction to Numerical Asymptotics, Random	
	polynomial equations and eigen values.	12
	Integral transforms and oscillatory integrals, Integral transforms of linear equations,	
UNIT IV	Evaluating integral transforms: Colors of the rainbow, Stationary phase, Saddle	
	points.	16

Teaching/ Learning/ Practice Pattern:

Teaching: 40% Learning: 10% Practice: 50%

Examination Pattern:

1. Theoretical Examination: Open book / Regular Examination and on line.

Reading List:

A. Books:

- 1. Michael P. Brenner, Physical Mathematics.
- 2. G. F. Carrier, M. Krook and C. E. Pearson, Functions of a Complex Variable, McGrawHill, 1966.



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SYLLABUS FOR M-TECH. (ELECTRONICS DESIGN & MANUFACTURING)
Name of the Module: Digital System Design

Module Code: ECE 901

SEMESTER: 1st

Credit Value: 4 [P=2, T=0, L=3] Module Leader: Alak Majumder No. of Lectures: 48 Hours

Objectives:

The course is design to meet with the objectives of:

- 1. Design, testing of Clocked Sequential Circuits.
- 2. Understanding the importance ROM, PROM, CPLD & Xilinx
- 3. Gathering knowledge on FPGA & its prototyping.

Learning outcomes:

Upon completion of the subjects:

- 1. To provide a strong background in the basics of Verilog HDL.
- 2. To impart knowledge about the existing FPGA prototyping/ASIC implementation of Advanced Digital Systems

UNIT	COURSE CONTENT	Number of Lectures
UNIT I	Combinational Circuit Design: Multiplexer & Decoder Based Design of Combinational Circuits; Implementation of Full Adder using Multiplexer; Memory Cells - ROM, PROM, EPROM, Static & Dynamic RAM, Refreshing of Dynamic RAM. Sequential Circuit Design: Review of flip-flops with excitation table; Clocking of Flip-flops; Setup and Hold Times; Moore Circuit; Mealy Circuit; Sequential Circuit Design Basics; Full Adder using D Flip-flop. Programmable logic Devices: Advantages of PLDs. Classification of PLDs. Concept of PROM, PAL, PLA, Registered PAL, Configurable PAL, GAL – Architecture and Comparison. CPLD and FPGA architecture. Simulation and testing, Types of FPGAs, Xilinx solutions: Xilinx CPLDs and applications areas, JTAG Development and Debugging Support.	12
UNIT II	Introduction to state machines: Classification of State Machines. State Machine Applications. Analysis State Machine, State table, State Diagram, State Equation, State reduction and State assignment. Design of Synchronous State Machine (including Counter) and Asynchronous state machine. Design of Pattern Identifier and Vending Machine. System Design using ASM Chart: Top-down Design Methodology, ASM Chart, Rules of Drawing ASM Chart, Design of Bus Arbiter and its realization using Mux & D-FF, Implementation of Traffic Light Controller with its hardware realization using Mux, D-FF & ROM, Dice Game with its architecture and ASM Chart. Microprogrammed Design: Introduction to Microprogrammed Design, ASM Chart for a Microprogrammed Design, Microprogrammed ROM Table, Comparison of the Conventional ROM and the Microprogrammed ROM Approaches, Single Qualifier, Double address Design, Single Qualifier, Single Address (SQSA) System Design, ASM chart for SQSA Microprogrammed Implementation, Microprogrammed Table, Implementation of SQSA System using Microprogrammed ROM, MUX and a Counter, Dice Game using Microprogrammed SQSA System	10



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UNIT III	Verilog HDL: Modeling of combinational circuits. Top-down approach and bottom-up approach. Levels of Abstraction Realization of Combinational Circuits, Modules and ports, Data flow modelling, Gate level modelling, Behavioural modelling and switch level modelling. Verilog Code for Multiplexers and Demultiplexers, Realization of a Full Adder, Realization of a Magnitude Comparator Design Example, Design of a D Flip Flop, Realization of a Register, Realization of a Counter, Realization of a Non-retriggerable Monoshot, Realization of a Right Shift Register, Realization of a Parallel to Serial Converter, Realization of a Model State Machine, Pattern Sequence Detector as a Design Example	10
UNIT IV	RTL Coding Guidelines: Introduction Dos and Don'ts for Asynchronous and Synchronous Logic Circuit Design, RTL Coding Style, Separation of Combinational and Sequential Circuits, if - else if - else statements for MUX and Priority Encoder Realizations, Verilog Directives - Case Statements Operators Coding Organization: Introduction to Coding Organization, Design Module - a Model, Complete Code for Combinational and Sequential Circuits, Right Shift Register, Parallel to Serial Converter, Model State Machine, Pattern Sequence Detector Writing a Test Bench: Test bench for simple design - AND gate, Test bench for Combinational Circuits Test bench for Sequential Circuits Design of Memories: On-chip Dual ROM & Dual RAM Design, External RAM design	16

List of Practical: -

- 1. Design and Simulation of Full Adder.
- 2. Design and Simulation of Magnitude Comparator.
- 3. Design and Simulation of D Flip-flop, J-K Flip-flop & T-Flip-flop.
- 4. Design & Simulation of SISO, PIPO, SIPO & PISO registers.
- 5. Design and simulation of Universal shift register.
- 6. Simulation of Mealy Machine and Moore Machine.
- 7. Using Verilog coding perform the simulation of a vending machine.
- 8. Using Verilog coding perform the simulation of a Traffic Light Controller.
- 9. Using Verilog coding perform the simulation of a Pattern Sequence Detector.
- 10. Using Verilog coding perform the simulation of a Non-retriggerable monoshot.
- 11. Using Verilog coding perform the simulation of a Serial signed Design.
- 12. Using Verilog coding perform the simulation of a ROM, RAM & External RAM.

Teaching/Learning/Practice Practice Pattern:

Teaching: 40% Learning: 10% Practice: 50%

Examination Pattern:

1. Theoretical Examination: Open book/ Regular examination and on line test.

Reading List:

A. BOOKS:

- 1. R.P. Jain, "Modern Digital Design", TMH.
- 2. M. Morris Mano, "Digital Logic Design", PHI
- 3. Digital Logic and State Machine Design, Comer, OUP



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- 4. R.S. Sandige, "Modern Digital Design", MGH.
- 5. A. Anand Kumar, "Fundamentals of Digital Circuits" PHI
- 6. Clive "Max" Maxfield, "Design Warrior's Guide to FPGAs: Devices Tools and Flows", Elsevier Publication.
- 7. S. Trimberger, ed., Kluwer, "Field-Programmable Gate Array Technology", Academic Publishers.
- 8. S. Palnitkar, "Verilog HDL" Prentice Hall Professional
- 9. J. Bhaskar, "Verilog HDL Primer"

B. MAGAZINES:

- 1. IEEE Spectrum
- 2. Electronics for you
- 3. Electropages

C. JOURNALS:

- 1. International journal of computing and digital system.
- 2. International Journal of System design and Information Processing
- 3. AT&T Technical JOURNALS

Name of the Module: Advance Semiconductor Devices Architecture

Module Code: ECE 902

SEMESTER: 1s

Credit Value: 3 [P=0, T=0, L=3] Module Leader: Santanu Maity No. of Lectures: 45 Hours

Objectives:

The course is design to meet with the objectives of:

- 1. Imparting theoretical and practical knowledge to the students in the area of Heterostructure.
- 2. Providing teaching and learning to make students acquainting with advanced semiconductor devices.
- 3. Injecting the future scope and the research direction in the discipline of HBT & HEMT.

Learning Outcomes:

Upon completion of the subject:

- 1. Students will be adequately trained to research on HBT & HEMT.
- 2. Students will be skilled both theoretically and practically to use This subject for the application in wireless communication, optical communication and computers.

UNIT	COURSE CONTENT	Number of
		Lectures
	Introduction: Need for high speed devices and circuits, High Speed = Short transit time,	
	Short Review of Quantum theory, Bohr theory of atoms, quantum mechanics' postulates,	
	Quantum mechanical understanding of a particle in potential wells, Block theorem and	15
UNIT I	Kronig Penney model of periodic potential wells, energy band theory of solids, E-K	
	diagrams, Brillonim zones, idea of Holes and effective mass, Mobility of carriers,	
	intervalley electron transfer or Gunn effect, Ballistic transport, Density of states in energy	
	bonds and carrier statistics, Generation - Recombination process, Diffusion and carrier	
	transport	



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UNIT II	Introduction to heterostructure devices, Semi-classical Theory, HBT, Quantum theory of Heterostructure and quantum heterostructure devices (Quantum Well, RTD, Superlattice), Scattering processes and scattering assisted tunneling in heterostructure devices and high frequency response of quantum devices (RTD, Infrared Laser).	10
UNIT III	Charge Control of the Two-Dimensional Electron Gas in HEMT, High Electric-Field Transport in Semiconductor Devices, Current Voltage Models of the Short-Channel MOSFET, HEMT,SOI and LDMOS, Ultra high-speed transistors: ballistic transistors, vertical FETs, Negative Differential Resistance effects in Semiconductors and NDR devices.	10
UNIT IV	MOSFET Wave-Equation. Microwave Modeling and Electro-thermal effects, Noise modeling. On wafer microwave measurement, High-Frequency Heterojunction Bipolar Transistors, Non-linear RF measurement and modeling. Impact of thermal and electrical memory effect on linearization.	10

Teaching/Learning/Practice Pattern:

Teaching: 70% Learning: 30% Practice: 0%

Examination Pattern:

1. Theoretical Examination: Regular Written Examination

Reading List:

A. BOOKS:

- 1. P. Roblin and H. Rohdin, "High-Speed Heterostructure Devices", Cambridge University Press, 2002
- 2. S. M. Sze, "High speed Semiconductor Devices", John wiley & Sons.
- 3. M. Shur, "Physics of semiconductor Devices", Prentice Hall.
- 4. S. M. Sze, "Modern Semiconductor Device Physics", John wiley & Sons.
- 5. Giovanni Ghione, "Semiconductor Devices for high speed optoelectronics", Cambridge university press.
- 6. H. Beneking, "High Speed Semiconductor Devices: circuit aspects and fundamental behavior", Chapman & Hall.
- 7. Donald A. Neamen, "Semiconductor device and physics", McGraw Hill.

B. MAGAZINES:

- 1. IEEE magazines on Semiconductor manufacturing.
- 2. IEEE Solid State Circuits Society newsletter.

C. Journals:

- 1. IEEE transactions on solid states circuits
- 2. IEEE transactions on VLSI
- 3. Journal of Circuits, systems and computers, world scientific publisher
- 4. Applied Physics Letter
- 5. Journal of Nanoscience and Nanotechnology.



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Name of the Module: VLSI Design (Analog and Digital)

Module Code: ECE 903

SEMESTER: 1st

Credit Value: 4 [P=2, T=0, L= 3] Module Leader: Abir Jyoti Mondal

No. of Lectures: 40 Hours

Objectives:

The course is designed to meet with the objectives of

- 1. To understand the basics of MOS in different regions of operation and to understand how to apply proper bias voltages so as to operate as a switch or amplifier.
- 2. To understand the operations of CAD tools in the design and analysis of MOS circuits.

Learning Outcomes:

Upon Completion of the topics:

- 1. Students will be able to bias MOS transistors depending on requirements.
- 2. Knowledge about operations of MOS circuits.

UNIT	COURSE CONTENT	
UNIT I	Introduction: Historical Perspective, Classification of CMOS Digital Design, VLSI Design Flow, Design Hierarchy. Basic MOS Device Physics: General Considerations, MOS I/V Characteristics, Second Order Effects, MOS Device Models. MOS Transistor: The Metal Oxide Semiconductor Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor, MOSFET Current Voltage Characteristics, MOSFET Scaling and Small Geometry Effects, MOSFET Capacitance. MOS Inverter: Introduction, Resistive Load Inverter, Inverters with n-Type MOSFET Loads, CMOS Inverter.	
UNIT II	MOS Inverter Switching Characteristics: Introduction, Delay Time Definition, Calculation of Delay Times, Inverter Design with Delay Constraints, Power Dissipation of CMOS Inverters. Combinational MOS Logic Circuits: Introduction, MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, CMOS Transmission Gates.	10
Sequential MOS Logic Circuits: Introduction, Bahavior of Bistable Elements, Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D Latch and Ed Triggered Flip Flop. Analog CMOS Subcircuits: MOS Switch, Current Sinks and Sources, Current Mirro Current and Voltage References. Single Stage Amplifiers: Common Source Stage, Source Follower, Common G Stage, Cascode Stage.		10
UNIT IV	Differential Amplifiers: The MOS Differential Pair Small Signal Operation of the MOS Differential Pair, Non Ideal Characteristics of the Differential Amplifier, The Differential Amplifier with Active Load. Frequency Response of Amplifiers: General Considerations, Common Source Stage, Source Followers, Common gate Stage, Cascode Stage, Differential Pair.	10



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List of practical:

- 1. Study of Tanner EDA tool and to explore the operations of T Editor and S Editor.
- 2. N-MOS and P-MOS transistors are taken from library and appropriate voltages is applied at gate and drain terminals to obtain the desired current versus voltage waveforms.
- 3. A CMOS inverter is designed using n-MOS and p-MOS transistors and an appropriate voltage is applied at the input to verify the inverter operation.
- 4. NAND and AND gates are designed using MOS transistors and an appropriate input is applied to verify the corresponding logic.
- 5. NOR and OR gates are designed using MOS transistors and an appropriate input is applied to verify the corresponding logic.
- 6. XOR and XNOR gates are designed using MOS transistors and an appropriate input is applied to verify the corresponding logic.
- 7. Half adder and Full adder are designed using MOS transistors and an appropriate input is applied to verify the output expression.
- 8. Half subtractor and Full subtractor are designed using MOS transistors and an appropriate input is applied to verify the output expression.
- 9. Common Source, Common Drain and Common Gate amplifiers are designed using MOS and an appropriate voltage is applied at the input to verify their output waveforms.
- 10. A basic Current Mirror is designed using MOS and its output waveform is obtained to verify the relation $I_{out} = I_{ref}$.
- 11. A Cascoded Current Mirror is designed using MOS and its out waveform is obtained to verify the minimum overdrive voltage.

Teaching/Learning/Practice Practice Pattern:

Teaching: 40% Learning: 10% Practice: 50%

Examination Pattern:

1. Theoretical Examination: Open book/ Regular examination and on line test.

READING LIST:

A. Text Books:

- 1. Microelectronic Circuits Theory and Application by Adel S Sedra and Kenneth C Smith, Oxford.
- 2. CMOS VLSI Design A Circuits and Systems Perspective by Neil H E Weste, David Harris and Ayan Banerjee, Pearson.
- 3. CMOS Digital Integrated Circuits Analysis and Design by Sung Mo Kang and Yusuf Leblebici, Mc Graw-Hill.
- 4. Design of Analog CMOS Integrated Circuits by Behzad Razavi, TMH.

B. Reference Books:

- Digital Integrated Circuits A Design Perspective by Jan M Rabey, Anantha Chandrakasan and Borivoje Nikolic, Pearson.
- 2. CMOS Analog Circuit Design by Philip E Allen and Douglas R Holberg, Oxford.
- 3. Analysis and Design of Analog Integrated Circuits by Grey, Hurst, Lewis and Meyer, Wiley.
- 4. Digital Integrated Circuits by Demassa and Ciccone, Wiley.



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C. Magazines:

- 1. IEEE magazines on Semiconductor manufacturing.
- 2. IEEE Solid State Circuits Society newsletter.
- 3. IEEE magazines on Consumer electronics.

D. Journals:

- 1. IEEE journal of selected topics in Quantum Computing.
- 2. IEEE transactions on Computer Aided Design of Integrated Circuits and Systems.
- 3. IEEE transactions on VLSI systems.
- 4. IEEE proceeding of Computer and Digital techniques.

Name of the Module: Robotics and Industrial Automation in Manufacturing

Module Code: ECE 904

SEMESTER: 1st

Credit Value: 3 [P=2, T=0, L=3] Module Leader: Sahadev Roy No. of Lectures: 40 Hours

Objectives:

The course is design to meet with the objectives of:

- 1. To understand the basic concepts associated with the design and functioning and applications of Robots.
- 2. To study about the drives and sensors used in Industry.
- 3. To learn about analyzing robot kinematics and dynamics.

Learning outcomes:

At the end of this module, students will be able to do

- 1. Utilization of Robots and automatic system in the industry.
- 2. Design electronics circuits for automatic manufacturing process.

UNIT	COURSE CONTENT	
1	Fundamentals of robotics and industrial automation: robot – definition – robot anatomy – co-ordinate systems, work envelope, types and classification – specifications – pitch, yaw, roll, joint notations, speed of motion, pay load – robot parts and functions – need for robots–inspection, identification, visual serving and navigation. Different applications related to manufacturing. Economic analysis of robots – pay back method safety considerations for robot operations.	10
2	Kinematics and dynamics of robotics: forward kinematics, inverse kinematics and differences; forward kinematics and reverse kinematics of manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – deviations and problems. Micro robotics architecture.	10
3	Drives & Robot Sensors: pneumatic drives – hydraulic drives – mechanical drives – electrical drives – d.c. Servo motors, stepper motor, a.c. Servo motors features, applications and comparison of drives end effectors – grippers –	10



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	mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers; two fingered and three fingered grippers; internal grippers and external grippers. Robot sensor like motion, vision, sonar, joint movement etc for planning and industrial automation.	
4	Electronics Circuit Design for Industrial Automation: Design consideration for circuit. Hard ware software co design technique. I/O interfacing with different drives, sensor. Different controller circuit design for automatic manufacturing process.	10

Teaching/Learning/Practice Practice Pattern:

Teaching: 50% Learning: 30% Practice: 20%

Examination Pattern:

1. Theoretical Examination: Regular examination

List of practical:

- 1. Design of Control driver of Robot Design of Control panel for Robot Gripper
- 2. Controller design of Robot link
- 3. Design of End effectors of Robot
- 4. Different type of Gripper Design
- 5. Design of wheel Robot
- 6. Study application of different sensor for Industrial Robot
- 7. Any innovative design practices

Reading List:

A. Books

- 1. M.P.Groover, "Industrial Robotics Technology, Programming and Applications", McGraw-Hill, 2001
- 2. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987
- 3. Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 1992
- 4. Janakiraman.P.A., "Robotics and Image Processing", Tata McGraw-Hill, 1995
- 5. 8051 microcontroller: Architecture, Programming and Application Ayala Kenneth J, West Publishing Company, 1996.
- 6. Microcontroller Architecture, Implementation & Programming", Kenneth Hintz & Danniel, McGraw Hill, New York
- 7. Programming and Customizing the 8051 microcontroller Predko, Myke McGraw Hill International.
- 8. 8051 Microcontroller: Hardware, software and Interfacing 2nd edition, Stewart

B. MAGAZINES

- 1. International Metal Working News.
- 2. Industrial Distribution

C. JOURNALS

- 1. International Journal of Machine Tools and Manufacture
- 2. Journal of Manufacturing Science and Engineering, Transactions of the ASME
- 3. Journal of Manufacturing Technology and Research
- 4. Robotics and Autonomous Systems, Elsiver, Netherlands
- 5. International Journal of Advanced Robotic Systems, Open Access .



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6. International journals of robotics research publisher, Sage Publications, United State

Name of the Module: Research Methodology

Module Code: HSS 911

SEMESTER:

Credit: 3 [P=0, T=0, L=3]

Module Leader:

No. of Lectures: 36 Hours

Introduction:

In the last two decades, emerging theories in qualitative research have drawn attention to the complexities inherent in research. In light of these theories, research can no longer be regarded unproblematic, objective, or value free, where data is neutrally and naturally collected, interpreted and textualized by disinterested researchers. Rather, research methodology has become a problematized and contested terrain depicting a double crisis of representation and legitimation. What is (and why) this double crisis? And what implications might it have for the field of qualitative research and for the researcher working (in) that field? Attempting to answer those questions and the various issues underlying them is the primary objective of this course. We will do this by combining a theoretical and practical approach to the study of qualitative methodology in order to "learn to attend to the politics of what we do and do not do (as researchers)" (Lather, P. 1991: 13) and "to 'read out' the epistemologies in our various practices" (Hartsock, 1987: 206). The second objective of the course is to explore both the "hows" or research (providing ample opportunities for you to "practice" them) and, at the same time, examine the underlying assumptions and values of qualitative research practices —your own as well as a variety of other strategies and orientations. The third and overarching objective of this course is to examine not only how one goes about "doing" those aspects of one's work but also delve into a variety of ethical, epistemological, ontological and (naturally) methodological issues inherent in that "doing.".

Learning outcomes:

At the end of this module, students are expected to be able to

- 1. Increased awareness of ethnographic work, including conceptualizing a study, observations, interviewing, analysis, and textualization.
- 2. To learn to attend to the politics of what we do and do not do (as researchers).
- 3. Increase critical thinking skills. Demonstrate this by seriously considering multiple viewpoints and perspectives in class discussions, in-class writing, group work, and the final paper.
- 4. Apply course material to your own research. Demonstrate this through participation in in-class discussions and activities, and in applying course concepts to class assignments.
- 5. Become active in the process of seeking, analyzing, and synthesizing information.

UNIT	COURSE CONTENT	Number of Lectures
	Five reading responses/reflective journal entries: You are required to write a set of	
	five short (3-5 pages) reading responses to a group of readings that will be	
UNIT I	used/shared in class. With the exception of the Becker book it is up to you to chose	7
	the set of readings that you will respond to. These on-going short assignments may	
	include either (a) a response to a, several, or all the readings assigned for class; (b) a	
	commentary on readings for the previous class (following our class discussion) or (c)	
	a response to reflection on an of the class interactions/discussions, etc. about issues	
	relating to course topics. The focus of a Reading Response (which should go beyond	
	summary to include commentary and questions you are left with having engaged the	



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reading/s) can be directed either toward a particular reading assigned for that day's class or to the readings as a whole—comparing them and possibly relating them to other readings, etc. Journal entries should be a critical reflection on a class discussion or interaction or on one (or a combination of several) of the course readings following our discussion in a previous class. Journal entries could relate to your own academic area of interest and/or (or as they pertain) to what you find to be significant	
issues addressed by the readings and/or during our in-class discussions—in a way, deconstructing, deepening, or extending them. Responses are to be handed in at the beginning a class.	
description of the person/people you interviewed, why you interviewed them, and what you hope to achieve through this interview (what you hoped to learn); (b) an	11
interview protocol; (c) a transcript of the interview; (d) an analysis of the interview. The analysis should include two dimensions: 1) what you learned about the topic you were inquiring about through this interview, and 2) what you learned methodologically from this interview. That is, what you learned as a researcher about interviewing from this experience and how might you use what you learned in your future research.	
Critiquing a dissertation's methodology: (not simply its methods but its	
of those in the library) and, using what we have learned in the course, provide a critique of its methodology. By critique I do not mere criticism (this is what is bad with this dissertation) but rather a way to explore—conduct a critical conversation with—the politics of knowledge production in that dissertation: what is the dissertation about? How did the researcher go about producing and making claims to knowledge? What methods did the researcher use? Do you believe those methods	6
were conducive to answer the study's particular questions and make its particular claims to knowledge and knowing? If so, how? If not, why? To what degree do you believe the methods used in this study matched/enhanced/contradicted the epistemological understandings underlying the topic being studied (in other words, did the study produce a methodology or merely a set of methods)? What do you believe are some of the methodological strengths of this study (and why do you believe that?)? What do you believe are some of the methodological weaknesses of this study (and why do you believe that?)? What did you learn from this critique about conducting qualitative about conducting qualitative research? How might this knowledge direct you in thinking about your own study? What are some of the	
silent? Why? With what consequences? How, if at all, does this study deal with the ethical	
and those pertaining to power?	
Final paper: The purpose of this assignment is to "consolidate" your learning in/from this course. The intent is for you to use this assignment to begin writing (or	22
to consolidate) your research proposal. Your research proposal should include the following: 1) an explanation of the "problem" to be studied; 2) your research questions; 3) a review of the literature that contextualizes the "problem" and indentified gaps in the literature your study hopes to fill in; 4) the ontological, epistemological, and methodological lenses and frames you are bringing to your research; 5) explanation of your choice of location, participants, etc. and the methods (strategies) to be applied in your study (those ought to correlate with what you	22
	class or to the readings as a whole—comparing them and possibly relating them to other readings, etc. Journal entries should be a critical reflection on a class discussion or interaction or on one (or a combination of several) of the course readings following our discussion in a previous class. Journal entries could relate to your own academic area of interest and/or (or as they pertain) to what you find to be significant issues addressed by the readings and/or during our in-class discussions—in a way, deconstructing, deepening, or extending them. Responses are to be handed in at the beginning a class. Interview Assignment: For this assignment you will select a person (or a group of people) and conduct an interview with them. Your paper should provide: (a) a brief description of the person/people you interviewed, why you interviewed them, and what you hope to achieve through this interview (what you hoped to learn); (b) an interview protocol; (c) a transcript of the interview; (d) an analysis of the interview. The analysis should include two dimensions: 1) what you learned about the topic you were inquiring about through this interview, and 2) what you learned methodologically from this interview. That is, what you learned as a researcher about interviewing from this experience and how might you use what you learned in your future research. Critiquing a dissertation's methodology: (not simply its methods but its methodology). For this assignment, you should select a dissertation (there are various of those in the library) and, using what we have learned in the course, provide a critique of its methodology. By critique I do not mere criticism (this is what is bad with this dissertation) but rather a way to explore—conduct a critical conversation with—the politics of knowledge production in that dissertation: what is the dissertation about? How did the researcher go about producing and making claims to knowledge? What methods did the researcher use? Do you believe those methods were conducive to answer the stud



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and power issues pertaining to your study.

Teaching/ Learning/ Practice Pattern:

Teaching: 40% Learning: 40% Practice: 20%

Examination Pattern:

1. Theoretical Examination: Open book / Regular Examination and on line.

Reading List:

A. Books:

- Van Maanen, John. 1899. Tales of the Field: On Writing Ethnography. Chicago: University of Chicago Press.
- 2. Becker, Howard. 1998. Tricks of the Trade. How to Think About Your Research While Doing It. Chicago: University of Chicago Press.

Teaching Methodology

M-Tech 2 nd Semester					
J.C. Bose Model S.N. Bose Model			Bose Model		
Subject Code Name of The Subject Subject Code Name of The Subject					
ECE 907	DSP based System	ECE 905	Micro and Nano-		
	Architecture		Fabrication Technology		
	Advanced Embedded	ECE 906	MEMS and RF based IC		
	Systems		Design		
ECE 908		ECE 910	Self defined project for		
			three months		

NAME OF THE MODULE: Micro and Nano-Fabrication Technology

Module Code: ECE 905

SEMESTER: 2nd

Credit Value: 3 [P=0, T=0, L=3] Module Leader: Dr. T. D. Das No. of Lectures: 40 Hours

Objectives:

The course is designed to meet the objectives of:



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- 1. This course introduces the theory and technology of micro/nano fabrication. Because of the interdisciplinary nature of the subject, its content includes concepts from many disciplines in engineering (electrical, materials, mechanical, chemical) and science. In lecture, we will discuss the theory of basic processing techniques, such as diffusion, oxidation, photolithography, chemical vapor deposition, physical vapor deposition, etching, and metallization.
- In the labs section of this course, we will be fabricating three different devices; an MOS capacitor, a microcantilever, and a microfluidic device. You will test each device in the lab and prepare a laboratory report for each device.
- 3. At the end of this course, one should have a good understanding of the various processing techniques used to micro/nano fabricate. One should understand the theory of the individual processes, how they are characterized, and the interrelationship of these processes when combined to fabricate devices.

Learning outcomes:

At the end of this module, students are expected to be able to:

- 1. To develop knowledge and an understanding of micro and nano fabrication technologies, processes and their applications
- 2. appreciate the difference between micro- and nano-fabrication in the context of CMOS scaling
- 3. describe a range of nanoscale fabrication and characterisation technologies
- 4. demonstrate understanding of specific nanofabrication approaches
- 5. explain image formation in a number of high-resolution microscopies
- 6. identify some major issues and developments at the frontiers of nano-engineering

UNIT	COURSE CONTENT	Number of Lectures	
UNIT I	JNIT I Introduction: Overview and comparison of micro fabrication and nano-structuring processes and applications for micro/nano technology. Equipment subsystems: Oxidation furnace ,Chemical vapor deposition ,Plasma etching ,Ion implantation		
UNIT II	Basic Nanofabrication Processes: p-n junction diode process flow ,n-p-n bipolar transistor process flow , CMOS transistor process flow , Power device process flow , MEM process flow , Biomedical device fabrication		
UNIT III	Deposition Process: Thin film deposition processes-Chemical vapor deposition (CVD) processes: Nitride deposition ,Oxide deposition , Polysilicon deposition , Plasma enhanced CVD , Physical vapor deposition-sputtering , Physical vapor deposition-thermal and e-gun evaporation Etching Processes: Wet chemical etching , Plasma etching ,Reactive ion etching (RIE), High ion density reactors ,Dielectrics ,Polymers , MEMS deep silicon	12	
UNIT IV	Characterization, Packaging, and Testing of Nanofabrication Structures: Process monitoring techniques- Residual gas analysis (RGA), Optical emission spectroscopy (OES), Laser interferometry Surface analysis techniques- Ellipsometry, Profilometery Oxide electrical characterization; Transistor characterization; Yield analysis techniques; Electron Microscopy; MEM and biomedical devices characterization and testing; Interconnect metalization; Planarization; Packaging; Reliability issues	12	



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Teaching/Learning/Practice Practice Pattern:

Teaching: 40% Learning: 10% Practice: 50%

Examination Pattern:

1. Theoretical Examination: Regular examination and on line test. 2. Practical Examination: Conducting Experiment and Viva-Voice.

Reading List:

A. BOOKS:

- 1. Lindsay SM, Introduction to Nanoscience, Oxford University Press 2009 (e-book available)
- 2. Huff H, Into the Nano Era: Moore's Law Beyond Planar Silicon CMOS, Springer 2008
- 3. S.M. Sze (Ed), VLSI Technology, McGraw Hill, 1988.
- 4. Cui Z, Nanofabrication: Principles, Capabilities and Limits, Springer 2008 (e-book available).
- 6. Franssila S, Introduction to Microfabrication, 2nd Ed., Wiley 2010 (e-book available).
- 7. Waser R, Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, 3rd Ed, Wiley 2012
- 8. Di Ventra M, Evoy S, Heflin JR (Eds.), Introduction to nanoscale science and technology, Springer 2004

B. MAGAZINES:

- 1. IEEE Magazine for Consumer Electronics
- 2. I-Micronews
- 3. Magazine on Solid state Technology
- 5. CMM internationals

C. JOURNALS:

- 1. IEEE journal of Micro-electromechanical Systems.
- 2. Journal of Micro / Nanolithography, MEMS and MOEMS
- 3. Journal of Microlithography, Microfabrication, and Microsystems
- 4. Microsystems Technology
- 6. IEEE International Conference on Solid State Sensors and Actuators Transducers

NAME OF THE MODULE: MEMS and RF based IC Design

Module Code: ECE 906

SEMESTER: 2nd

Credit Value: 3 [P=2, T=0, L=3] Module Leader: Santanu Maity No. of Lectures: 48 Hours

Objectives:

The course is designed to meet the objectives of:

- 1. To gather knowledge on MEMS and its fabrication
- 2. To work on MEMS Simulators
- 3. To provide a clear foundation of Sensor design

Learning outcomes:

At the end of this module, students are expected to be able to

3. Design RF MEMS Switch for its application in different microwave frequescies.



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4. Design and develop consumer products such as accelerometers used in cars to activate the airbags and in smart phones to flip images and play video games.

Subject Matter:

UNIT	COURSE CONTENT	Number of Lectures
UNIT I	Introduction: Micro sensors and MEMS, Evolution of Micro sensors & MEMS, Micro sensors & MEMS applications, Bulk Micromachining: wet etch-based, dissolved wafer process, SOI MEMS, Scream, Hexsil MEMS, sealed cavity deep RIE, Process Integration: interleaved, MEMS-first, MEMS-last, bonded integration, wafer-to-wafer transfer, fluidic assembly.	
UNIT II	Mechanics of Materials for MEMS: stress, strain, material properties, measurement & characterization of mechanical parameter. Microstructural Elements: bending moment and strain, flexural rigidity, residual stress, boundary conditions, spring combinations.	
UNIT III	Energy Methods I: application to clamped-clamped beam under axial load. Energy Methods II: resonance frequency determination, free-free beam, disk, ring, lumped-element mechanical equivalent circuits	8
UNIT IV	Phase-locked loops, low voltage frequency synthesizers, printed circuit board design for RF applications. Antennas and signal propagation, design of an on-chip antenna.RF filters, oversampling (Sigma Delta) A/D converters, impact of substrate noise and other mixed-signal IC issues.RF/Analog integrated circuit design based on high frequency BiCMOS technology.	12

Teaching/Learning/Practice Practice Pattern:

Teaching: 40% Learning: 10% Practice: 50%

Examination Pattern:

- 3. Theoretical Examination: Regular examination and on line test.
- 4. Practical Examination: Conducting Experiment and Viva-Voice.

Reading List:

A. BOOKS:

- 1. Tai-ran Su, MEMS and Microsystems: design and Manufacture, Tata McGraw Hill.
- 2. S.K. Ghandhi, VLSI Fabrication Principles, John Wiley Inc., New York, 1983.
- 3. S.M. Sze (Ed), VLSI Technology, McGraw Hill, 1988.
- 4. Julian W. Gardner, V. K. Varadan, Osama O. Awadelkarim, Microsensors, MEMS, and Smart Devices, ISBN: 047186109X John Wiley and Sons.
- 5. Gere & Timoshenko, Mechanics of Materials, PWS-KENT, 1990.
- 6. Gregory T. A. Kovacs, Micromachined Transducers Sourcebook, WGB/McGraw-Hill, 2000, ISBN: 0072907223.
- 7. M. Madou, Fundamentals of Microfabrication, CRC Press, 2002, ISBN: 0849308267
- 8. M. Elwenspoek & H. Jansen, Silicon micromachining, Cambridge, 1998, ISBN: 052159054
- 9. S. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001, ISBN: 0792372468



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- 10. S.Sze, Semiconductor Sensors, John Wiley & Sons, 1994 ISBN: 0471546097
- 11. Marc Madou, Fundamentals of Microfabrication, CRC Press, 1997. 12. Edited by William S. Trimmer, Micromechanics and MEMs, IEEE Press, 1997.
- 13. Richard S. Muller, Microsensors, IEEE Press, 1991.
- 14.P.Rai-Choudhury, Handbook of Microlithography, Micromachining, and Microfabrication, SPIE-The International Society for Optical Engineering, 1997.
- 15. "Journal of Microelectromechanical Systems", Joint IEEE/ASME Publication.
- 16. Kovacs, Micromachined Transducers, McGraw Hill.
- 17.T. H. Lee, Planar Microwave Engineering, Cambridge, 2004 Luong and Leung, Low Voltage CMOS RF Frequency Synthesizers, Cambridge, 2004 Carusone, Johns, and Martin, Analog Integrated Circuit Design, 2nd ed., Wiley, 2012.
- 18.T. H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, Cambridge, 2004
- 19.C. Coleman, An Introduction to Radio Frequency Engineering, Cambridge, 2004
- 20.B. Razavi, RF Microelectronics, Prentice Hall, 1998
- 21.D. M. Dobkin, RF Engineering for Wireless Networks, Elsevier, 2005

B. MAGAZINES:

- 1. IEEE Magazine for Consumer Electronics
- 2. I-Micronews
- 3. Magazine on Solid state Technology
- 4. MEMS' Trends: Magazine on MEMS technology and Markets
- 5. CMM internationals

C. JOURNALS:

- 1. IEEE journal of Micro-electromechanical Systems.
- 2. Journal of Micro / Nanolithography, MEMS and MOEMS
- 3. Journal of Microlithography, Microfabrication, and Microsystems
- 4. Microsystems Technology
- 5. Microfluidics and Nanofluidics, Springer
- 6. IEEE International Conference on Solid State Sensors and Actuators Transducers

Name of the Module: DSP Based System Architecture

Module Code: ECE 907 SEMESTER: 2nd

Credit Value: 4 [P=2, T=0, L=3] Module Leader: Yang Saring No. of Lectures: 42 Hours

Objectives:

- 1. To make the students to understand different types of digital signal processing techniques and tools
- 2. To make students familiarization about advanced transform, namely discrete Z transform, Fast Fourier transform and Filters using MATLAB
- 3. To make students to apply transform and DSP techniques to design systems of coding & decoding

Learning outcomes:

At the end of this module, students are able to

- 1. Utilize the DSP tools and Techniques, Discrete Z transform, Fast Fourier Transform to design system & analysis
- 2. To design important filters FIR, IIR for systems and analysis.

UNIT	COURSE CONTENT	Number of



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		Lectures
UNIT I	Introduction: Overview of digital signal processing, Multichannel and multidimensional signals, Sequences: classification based on length, symmetry, periodicity, energy, power, Discrete signal, Time linear system, Sequences, arbitrary sequences, linear time invariant system, causality, stability, Difference equation, relation between continuous and discrete system, Classifications of sequence, recursive and non-recursive system. Z-transform: Definition, relation between Z transform and Fourier transform of a sequence, properties of Z transform, mapping between S-plane and Z-plane, UNIT circle, convergence and ROC, Inverse z-transform, solution of difference equation using the one sided Z-transform with MATLAB examples	12
UNIT II	Discrete Fourier Transform: Definition, inverse discrete Fourier transform (IDFT) Twiddle factor, linear transformation, basic properties, circular convolution, multiplication of DFT, linear filtering using DFT, Fast Fourier Transform (FFT), FFT algorithm, Radix 2 algorithm. Decimation-in-time and decimation-in-frequency algorithm, signal flow graph, butterflies, Chirp z-transform algorithm, MATLAB examples.	8
UNIT III	Digital filter realization: Principle of digital filter realization, structures of All-zero filters, Design of Finite Impulse Response (FIR) filters, linear phase, windows-rectangular, Berlitt, Hamming and Blackman. Design of infinite impulse response(IIR) filters from analog filters, Bilinear transformation, Butterworth, Chebyshev, Elliptic filters. Optimization method of IIR filters. Some example of practical filters design. Computer aided filter design, MATLAB examples.	10
UNIT IV	Real-time Implementation: Implementation of Real-time FIR Digital filter using DSP. Implementation of Real-time Fast Fourier Transform applications using the DSP Implementation of DTMF Tone Generation and Detection. Implementation of Speech processing applications. FPGA Technology DSP Technology Requirements Design implementation Multiply Accumulator (MAC) and Sum of Product (SOP) Implementation of Serial/Parallel Convolver using FPGAs FPGA Based DSP System Design FIR filters FIR Theory Designing FIR filters, Direct Window Design method Constant Coefficient FIR Design Direct FIR Design Cooley-Tukey FFT Algorithm implementation using FPGA.	12

List of Practical:

- 1. Generate discrete sinusoidal signal, exponential, unit step sequence, ramp sequence, impulse sequence.
- 2. Carry out multiple operations such as addition, Multiplication, Shifting and Folding on the above generated signal.
- 3. Developed a methodology to correlate signals for Aircraft.
- 4. Compute Z-Transform of the above correlated signal.
- 5. Find the DFT of the above correlated signal and study the spectrum of the signal.
- 6. Design and implement a FIR filter, and test the filter as LPF.
- 7. Design and implement a IIR filter, and test the filter as LPF and compare with FIR filter.
- 8. Generate signals using DSP processor TMS320C64xx kit.
- 9. Perform sampling, quantization on DSP processor kit by integrating DSP codec & MATLAB code to study the effects of aliasing on sound signals.
- 10. Perform Convolution and Correlation of given signals on DSP processor kit.
- 11. Perform signal processing techniques: Z-Transform, DCT, DFT using DSP processor kit, to study spectral density of given signals.
- 12. Design FIR filter using DSP processor.
- 13. Design IIR filter using DSP processor



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SYLLABUS FOR M-TECH. (ELECTRONICS DESIGN & MANUFACTURING)

Teaching/Learning/Practice Pattern

Teaching: 40% Learning: 10% Practice : 50%

Examination Pattern

1. Theoretical Examination: Written

2. Practical Examination: Conducting experiments and viva-voce.

Reading list:

A. BOOKS

- 1. L R Rabiner& B Gold, "Theory and Application of Digital Signal Processing" Prentice Hall of India
- 2. J G Proakis& D G Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", Pearson Edu.
- 3. Chen, "Digital Processing", Oxford University Press,
- 4. Meyar-Basse U, "Digital Signal Processing with FPGA", Springer India,
- 5. S K Mitra, "Digital Signal Processing A Computer based approach" Tata McGraw-Hill,
- 6. Emmanual C. Ifeachor et al, "Digital Signal Processing: A Practical approach", Pearson Education, 2nd edition.

B. MAGAZINES:

- 1.IEEE Signal Processing Magazine.
- 2. Electronics Business Magazine.
- 3.IEE ASSP Magazine

C. JOURNALS:

- 1. IEEE journal on selected Areas in communication.
- 2. Springer
- 3. IEEE Spectrum
- 4. Bell Systems Technical Journal
- 5. AT&T Bell Laboratory Technical Journal
- 6. Electronics Letter

Name of the Module: Advanced Embedded System

Module Code: ECE 908

SEMESTER: 2nd

Credit Value: 4 [P=2, T=0, L=3] No. of Lectures: 40 Hours

Objectives:

The course is design to meet the objectives of:

- 1. Define the class and its goals
- 2. Provide a general overview of Embedded Systems and RTOS
- 3. Learn to design and development of an embedded system, including hardware and embedded software development.
- 4. Give examples of Embedded Systems
- 5. Show current statistics of Embedded Systems

Learning outcomes:

Upon Completion of the subjects:

1. Know about Embedded systems and the interface issues related to it.



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- 2. Know about different techniques on embedded systems
- 3. Know about the real time models, languages and operating systems
- 4. To analyze real time examples, obstacles and solutions.

Subject Matter:

UNIT	COURSE CONTENT	
		Lecturs
I	Introduction to Embedded systems different embedded processor like 8051, ARM, PIC,	7
	DSP, FPGA based processor, Fuzzy logic. Hardware/Software Co-Design, Co-Design	
	for System Specification and modeling. Single-processor Architectures and Multi-	
	Processor architectures. The Co-Synthesis Problem, State Transition Graph.	
II	Models of Computation, Requirements for Embedded System Specification,	7
	Hardware/Software Partitioning Problem, Hardware/Software Cost Estimation,	
	Generation of Partitioning by Graphical modeling, External peripherals - Type of	
	memory – Memory testing , memory management. Case study.	
III	Introduction to RTOS: OS in embedded systems, multi tasking using priority based	12
	preemptive schedulers are covered. RTOS- Inter Process communication, Interrupt	
	driven Input and Output - Nonmaskable interrupt, Software interrupt; Thread - Single,	
	Multithread concept; Multitasking sequential circuit Handling of interrupts in RTOS and	
	timing analysis. Case study.	
IV	Embedded system design, Embedded C, Role of Infinite loop instruction sequencing,	14
	Compiling, State Machine, Pattern Sequence Detector, different type of embedded	
	multitasking sequential switching circuit design and optimization. Case study.	

List of Practical:

- 1. Design an embedded controller for automatic room temperature control.
- 2. Design an embedded system for automatic washing machine.
- 3. Design an embedded system for auto-pilot mechanism.
- 4. Design an embedded system for industrial automation.
- 5. Design an embedded system for AUV.
- 6. Design an embedded system for Robot gripper.
- 7. Design an embedded system for wheel mechanism of mobile robot.
- 8. Design an embedded system for obstacle avoidance by an assembly line robot.
- 9. Any innovative embedded system design as mini project.

Teaching/ Learning/ Practice Pattern:

Teaching: 70% Learning: 30% Practice: 0%

Examination Pattern:

1. Theoretical Examination: Regular Examination

Reading List:

A. TEXT BOOK

- 1. GNU/Linux application programming, Jones, M Tim, Dreamtech press, New Delhi
- 2. Embedded /Real-Time Systems: concepts, Design and Programming—The Ultimate reference, Prasad K.V.K.K, DREAMTECH PRESS, NEW DELHI



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- Beginning J2ME-From Novice to Professional-3rd Edition , Sing Li and Jonathan Knudsen, Dreamtech Press, New Delhi
- 4. The Complete reference Java2, 5th Edition, Herbert Schildt, TMH
- 5. Data structures Through 'C' Language, Samiran Chattopadhyay, Debarata Ghosh Dastidar, Matangini Chattopadhyay, DOEACC Society
- 6. C Programming Language, Kernighan, Brian W, Ritchie, Dennis M, PHI publications.
- 7. C and the 8051 Programming Volume II, Building efficient applications, Thomas W Schultz, Pretice hal

B. REFERENCE BOOKS:

- 1. UNIX NETWORK PROGRAMMING, STEVENS, W RICHARD, PH, New Jersey
- 2. Linux Device Drivers, 2nd Edition, By Alessandro Rubini & Jonathan Corbet, O'Reilly
- 3. Data Structures Using C- ISRD group, TMH
- 4. Data structures –Seymour Lipschutz, Schaums Outlines
- 5. Let us C, Yashwant Kanetkar
- 6. C Programming for Embedded systems, Zurell, Kirk
- 7. C and the 8051 Programming for Multitasking Schultz, Thomas W
- 8. C with assembly language, Steven Holzner, BPB publication
- 9. C and the 8051: Hardware, Modular Programming and Multitasking Vol 1 Schultz, Thomas W
- 10. Embedded C, Pont, Michael J
- 11. Art of C Programming, JONES, ROBIN, STEWART, IAN
- 12. Kelley, A & Pohl, I;, " A Book on C", Addison Wesley
- 13. Advanced Linux Programming Mark Mitchell, Jeffrey Oldham, and Alex Samuel,
- 14. Embedded/ real-time systems: concepts, design and programming black book, Prasad, K V K K, Dreamtech press, New Delhi.
- 15. P H Winston Artificial Intelligence Pearson Education
- 16. Artificial Intelligence: A Modern Approach by stuart Russell and Peter Norving, Prentice Hall.
- 17. Computational Intelligence: A logical Approach, by Davin Poole, Alan Mackworth, and Randy Goebel, Oxford University Press.

C. Magazines:

- 1. Embedded Systems Design magazine archive, South Tower San Francisco, CA 94107
- 2. Embedded Innovator Newsletter and magazines, Intel, Santa Clara, CA.
- 3. Embedded Computing Design, Saint Clair Shores, MI 48082
- 4. AI Magazine Association for the Advancement of Artificial Intelligence, AAAI Press, USA
- 5. IEEE Intelligent Systems Magazine, Computer Society, United State

D. Journals:

- 1. International Journal of Embedded Systems, Inder Science Publishers, ISSN online: 1741-1076, ISSN print: 1741-1068
- 2. International Journal of Reconfigurable and Embedded Systems (IJRES), ISSN: 2089-4864, IAES
- 3. Journal of Embedded Computing, ISSN 1740-4460, IOS Press
- 4. Journal of Embedded Systems, Science and Education Publishing.
- 5. Applied Soft Computing Journal Elsevier, Netherland

B. Journals:

- 1. Group and Organization Management.
- 2. Journal of Organizational Behavior.
- 3. Journal of Management



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SYLLABUS FOR M-TECH. (ELECTRONICS DESIGN & MANUFACTURING)

Name of the Module: Dissertation (Advanced Manufacturing & Systems Management)

Module Code: ECE 910

SEMESTER:

Credit: 5 [P=30, T=0, L=0]

Module Leader: No. of Lectures:

Overview:

Students carry out an individual project of about three month's duration in an area related to the preceding taught programme Units. Depending on the subject chosen, this work can be experimental in nature or can involve modelling and simulation, or can be a combination of both. The work is then written up in the form of a Dissertation

Aims:

The aim of this module is to carry out a substantial piece of research work in a specific technological area and report on this work in the form of a Dissertation.

ELECTIVE PAPER – I

(For M-Tech 2nd Semester)

Subject Code	Subject	P	T	L	Credit
ECE 915	System on Chip	0	0	3	3
ECE 916	Design of Semiconductor Memories	0	0	3	3
ECE 917	Computer Architecture & Parallel Processing	0	0	3	3
ECE 918	VLSI Design – II	3	0	2	3
ECE 919	Electronic Instrumentation Design	0	0	3	3

Name of the Module: System on Chip

Module Code: ECE 915 SEMESTER: 1st

Credit Value: 3 [P=0, T=0, L=3]

Module Leader: Abir Jyoti Mondal / Alak Majumder

No. of Lectures: 36 Hours

Objectives:

The course is designed to meet with the objectives of

- 1. Provide students with specialised knowledge that covers all levels of abstraction from electronic systems to the actual construction of a circuit.
- 2. The programme is characterised by a holistic view of circuit design which gives a qualification which is directly applicable in industry.

Learning Outcomes:

Upon Completion of the topics:

- 1. To gain knowledge of the data structures and algorithms used in modern logic synthesis tools
- 2. To learn advanced techniques for logic circuit optimization
- 3. To develop skills in evaluating different data structures for target applications
- 4. To understand merits and limitations of logic synthesis.



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Subject Matter:

UNIT	COURSE CONTENT	Number of Lectures
UNIT I	Introduction to Interconnection Networks: Questions about Interconnection Networks, Uses of Interconnection Networks, Network Basic. A Simple Interconnection Network: Network Specifications and Constraints, Topology, Routing, Flow Control, Router Design, Case Study. Topology Basics: Nomenclature, Traffic Patterns, Performance, Case Study.	8
UNIT II	Butterfly Networks: The Structure of Butterfly Networks, Isomorphic Butterflies, Performance, Case Study. Torus Networks: The Structure of Torus Networks, Performance, Building Mesh and Torus Networks, Case Study. Non Blocking Networks: Non Blocking vs. Non Interfering Networks, Crossbar Networks, Clos Networks.	10
UNIT III	Routing Basics: Taxonomy of Routing Algorithms, The Routing Relation, Deterministic Routing, Oblivious Routing, Adaptive Routing, Routing Mechanics. Flow Control Basics: Resources and Allocation Units, Bufferless Flow Control, Circuit Switching, Buffered Flow Control. Deadlock and Livelock: Deadlock, Deadlock Avoidance, Adaptive Routing, Deadlock Recovery, Livelock.	10
UNIT IV	Router Architecture: Basic Router Architecture, Router Datapath Components, Arbitration, Allocation. Network Interfaces: Process Network Interface, Shared Memory Interface. Buses: Bus Basics, Bus Arbitration, Bus to Network.	8

Teaching/Learning/Practice Practice Pattern:

Teaching: 40% Learning: 10% Practice: 50%

Examination Pattern:

1. Theoretical Examination: Open book/ Regular examination and on line test.

READING LIST:

A. Books:

- 1. Principles and Practices of Interconnection Networks by William J Dally and B Towles, Morgan Kaufmann Publishers.
- 2. Synthesis and Optimization of Digital Circuits by G. De Micheli, McGraw-Hill, 1994.
- 3. Interconnection Networks by Jose Duato, Sudhakar Yalamanchili and Lionel Ni, Morgan Kaufmann Publishers.
- 4. Embedded System Design: Modeling, Synthesis, Verification by D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, Springer, 2009.

B. Magazines:

- 1. ACM/IEEE international symposium on networks-on-chip.
- 2. International Conference on VLSI and System on Chip.
- 3. IEEE Conferences on Very Large Scale Integration.



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4. IEEE Workshop in Signal Processing Systems Design and Implementation.

C. Journals:

1. IEEE Transactions on Computers.

2. IET Computer and Digital Techniques.

3. IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems.

Name of the Module: Design of Semiconductor Memories

Module Code: ECE 916

SEMESTER: 1st

Credit Value: 3 [P=0, T=0, L=3]

Module Leader: Dr. Pinaki Chakraborty

No. of Lectures: 40 Hours

Objectives:

1. To understand how a semiconductor memory works

2. Application of SRAM, DRAM & RRAM in industry

3. To study testing and fault modeling of different types of memory

Learning Outcomes:

After finishing of this course the students will be able to -

- 1. Solve problems occurs in different industry graded memories.
- 2. Solve application specific memory testing
- 3. Discuss the high density memory packaging.
- 4. Students will be substantially prepared to take up prospective research assignments.

Unit	COURSE CONTENT	Number of
		Lectures
UNIT I	SRAM: SRAM Cell Structures-MOS SRAM Architecture-MOS SRAM Cell and Peripheral Circuit Operation-Bipolar SRAM Technologies- SOI Technology-Advanced SRAM Architectures & Technologies- Application Specific SRAMs. DRAM: DRAM Technology Development-CMOS DRAMs - DRAMs Cell Theory and Advanced Cell Structures -BiCMOS, DRAMs - Soft Error Failures in DRAMs - Advanced DRAM Designs and Architecture-Application Specific DRAMs.	10
UNIT II	ROM: Masked Read-Only Memories (ROMs)-High Density ROMs-Programmable Read-Only Memories (PROMs)-Bipolar PROMs-CMOS PROMs-Erasable (UV) - Programmable Road-Only Memories (EPROMs)-Floating-Gate EPROM Cell-One-Time Programmable (OTP) EPROMs-Electrically Erasable PROMs (EEPROMs) - EEPROM Technology And Architecture-Nonvolatile SRAM-Flash Memories (EPROMs or EEPROM)-Advanced Flash Memory Architecture.	10
UNIT III	Testing & Reliability Issues : RAM Fault Modelling, Electrical Testing, Pseudo Random Testing-Megabit DRAM Testing-Non-volatile Memory Modelling and Testing-IDDQ Fault Modelling and Testing-Application Specific Memory Testing General Reliability Issues-RAM Failure Modes and Mechanism-Non-volatile Memory Reliability. Reliability Modelling and Failure Rate Prediction-Design for	10



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	Reliability-Reliability Test Structures-Reliability Screening and Qualification. RAM Fault Modelling, Electrical Testing, Pseudo Random Testing-Megabit DRAM Testing- Non-volatile Memory Modelling and Testing-IDDQ Fault Modelling and Testing-Application Specific Memory Testing.	
UNIT IV	Emerging memory architectures: Radiation Effects-Single Event Phenomenon (SEP)-Radiation Hardening Techniques-Radiation Hardening Process and Design Issues-Radiation Hardened Memory Characteristics-Radiation Hardness Assurance and Testing - Radiation Dosimetry-Water Level Radiation Testing and Test Structures. Ferroelectric Random Access Memories (FRAMs)-Gallium Arsenide (GaAs) FRAMs - Analog Memories-Magneto resistive Random Access Memories (MRAMs)-Experimental Memory Devices. Memory Hybrids and MCMs (2D)-Memory Stacks and MCMs (3D)-Memory MCM Testing and Reliability Issues-Memory Cards-High Density Memory Packaging Future Directions.	10

Teaching/Learning/Practice Practice Pattern:

Teaching: 40% Learning: 10% Practice: 50%

Examination Pattern:

1. Theoretical Examination: Open book/ Regular examination and on line test.

READING LIST:

A. Text Books:

1. Ashok K. Sharma, "Semiconductor Memories Technology, Testing and Reliability", Prentice-Hall of India Private Limited, New Delhi, 1997.

B. Reference Books:

- 1. Luecke Mize Care, "Semiconductor Memory design & application", Mc-Graw Hill.
- 2. Belty Prince, "Semiconductor Memory Design Handbook".
- 3. Brent Keeth, R. Jacob Baker, "DRAM Circuit Design: A Tutorial", Wiley-IEEE Press, 2000.
- 4. Betty Prince, "High Performance Memories: New Architecture DRAMs and SRAMs Evolution and Function", Wiley, 1999.

C. Magazines:

- 1. Electronics and Power Magazines.
- 2. Electron Devices magazines.

D. Journals:

- 1. IBM Journal of Research and Development.
- 2. IEEE Transactions of Semiconductor Manufacturing.
- 3. IEEE Transactions on Magnetics.

Name of the Module: Computer Architecture & Parallel Processing

Module Code: ECE 917

SEMESTER: 1st

Credit Value: 3 [P=0, T=0, L=3]

Module Leader:



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SYLLABUS FOR M-TECH. (ELECTRONICS DESIGN & MANUFACTURING)

No. of Lectures: 38 Hours

Objectives:

The course is designed to meet with the objectives of

1. The course will focus primarily on fundamental parallel computer architectures; their evaluation and the tradeoffs made in their design, but will also touch on how the machines are used.

Learning Outcomes:

Upon Completion of the topics:

- 1. Develop a new architectural idea and evaluate its effectiveness by implementing a simulator.
- 2. Write a parallel application. Study the application's synchronization or communication behaviour.

Subject Matter:

Unit	COURSE CONTENT	Number of Lectures
UNIT I	Parallel Computer Models : Multiprocessors and Multi-computers – Multi-vector and SIMD Computers - PRAM and VLSI Models - Conditions of Parallelism - Program Partitioning and scheduling-program flow mechanisms - parallel processing applications - speed up performance law.	8
UNIT II	Hardware Technologies: Advanced processor technology – Superscalar and vector processors- Memory hierarchy technology-Virtual memory technology- Cache memory organization- Shared memory organization. Pipelining and Superscalar Techniques: Linear pipeline processors- Non linear pipeline processors- Instruction pipeline design- Arithmetic design-Superscalar and super pipeline design- Multiprocessor system interconnects- Message passing mechanisms.	10
UNIT III	Multivector and SIMD Computers: Vector Processing principle- Multivector Multiprocessors- Compound Vector processing- Principles of multithreading-fine grain multicomputer-scalable and multithread architectures — Dataflow and hybrid architectures.	10
UNIT IV	Parallel Programming: Parallel programming models- parallel languages and compilers- parallel programming environments synchronization and multiprocessing modes- message passing program development- mapping programs onto multicomputer- multiprocessor UNIX design goals- MACH/OS kernel architecture-OSF/1architecture and applications.	10

Teaching/Learning/Practice Practice Pattern:

Teaching: 40% Learning: 10% Practice: 50%

Examination Pattern:

2. Theoretical Examination: Open book/ Regular examination and on line test.

READING LIST:

A. Text Books:

1. Kai Hwang, "Advanced Computer Architecture", TMH, 2003.



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2. William Stallings, "Computer Organization and Architecture", Pearson Education India, 2008.

B. Reference Books:

- 1. M.J. Quinn, "Designing Efficient Algorithms for Parallel Computer", McGraw-Hill International, 1994
- 2. John Hennessy and David Patterson, Computer Architecture: A Quantitative Approach, Morgan Kauffman Publisher.
- 3. David E. Culler and Jaswinder Pal Singh, with Anoop Gupta. Parallel Computer Architecture: A Hardware/Software Approach. Morgan Kaufmann, 1998. ISBN: 1558603433.

C. Magazines:

- 1. IEEE ASSP Magazine.
- 2. IEEE Magazines on Parallel and Distributed Systems.

D. Journals:

- 1. IEEE Transactions on Computers.
- 2. IEEE Transactions on Plasma Science.
- 3. IEEE Transactions on Visualizations and Computer Graphics.

Name of the Module: VLSI Design - II

Module Code: ECE 918

SEMESTER: 2nd

Credit Value: 4 [P=2, T=0, L=3] Module Leader: Abir Jyoti Mondal

No. of Lectures: 40 Hours

Objectives:

The course is designed to meet with the objectives of

- 1. To understand the basics of MOS in different regions of operation and to understand how to apply proper bias voltages so as to operate as a switch or amplifier.
- 2. To understand the operations of CAD tools in the design and analysis of MOS circuits.

Learning Outcomes:

Upon Completion of the topics:

- 1. Students will be able to bias MOS transistors depending on requirements.
- 2. Knowledge about operations of MOS circuits.

UNIT	COURSE CONTENT	Number of Lectures
UNIT I	Dynamic Logic Circuits: Introduction, Basic Principle of Pass Transistor Circuits, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits. Semiconductor Memories: Introduction, Dynamic Random Access Memory, Static Random Access Memory, Non-volatile Memory, Flash Memory, Ferroelectric Random Access Memory.	10



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UNIT II	CMOS Operational Amplifiers: One Stage Op amps, Two Stage Op amps, Gain Boosting, Common Mode Feedback, Stability and Frequency compensation. Phase Locked Loops: Simple PLL, Charge Pump PLLs, Non ideal Effects in PLLs, Delay Locked Loops.	10	
UNIT III	Switch Capacitor Circuits: Introduction, Switched Capacitor Amplifiers, Switched Capacitor Integrators. D/A and A/D Converters: Parallel D/A Converters, Extending the Resolution of Parallel D/A Converters, Serial D/A Converters, Serial A/D Converters, Medium Speed A/D Converters, High Speed A/D Converters.	10	
UNIT IV	Noise: Types of Noise, Representation of Noise in circuits, Noise in Single Stage Amplifiers, Noise in Differential Pairs. Feedback: General Considerations, Feedback Topologies, Effect of Loading, Effect of Feedback on Noise.Band gap Reference Nonlinearity and Mismatch: Nonlinearity, Mismatch.	10	

List of Practical's:

- 1. Study of Tanner EDA tool and to explore the operations of T Editor and S Editor.
- 2. N-MOS and P-MOS transistors are taken from library and appropriate voltages is applied at gate and drain terminals to obtain the desired current versus voltage waveforms.
- 3. A CMOS inverter is designed using n-MOS and p-MOS transistors and an appropriate voltage is applied at the input to verify the inverter operation.
- 4. NAND and AND gates are designed using MOS transistors and an appropriate input is applied to verify the corresponding logic.
- 5. NOR and OR gates are designed using MOS transistors and an appropriate input is applied to verify the corresponding logic.
- 6. XOR and XNOR gates are designed using MOS transistors and an appropriate input is applied to verify the corresponding logic.
- 7. Half adder and Full adder are designed using MOS transistors and an appropriate input is applied to verify the output expression.
- 8. Half subtractor and Full subtractor are designed using MOS transistors and an appropriate input is applied to verify the output expression.
- 9. Common Source, Common Drain and Common Gate amplifiers are designed using MOS and an appropriate voltage is applied at the input to verify their output waveforms.
- 10. A basic Current Mirror is designed using MOS and its output waveform is obtained to verify the relation $I_{out} = I_{ref}$.
- 11. A Cascoded Current Mirror is designed using MOS and its out waveform is obtained to verify the minimum overdrive voltage.

Teaching/Learning/Practice Practice Pattern:

Teaching: 40% Learning: 10% Practice: 50%



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SYLLABUS FOR M-TECH. (ELECTRONICS DESIGN & MANUFACTURING)

Examination Pattern:

3. Theoretical Examination: Open book/ Regular examination and on line test.

READING LIST:

A. Books:

- 1. Microelectronic Circuits Theory and Application by Adel S Sedra and Kenneth C Smith.
- 2. CMOS VLSI Design A Circuits and Systems Perspective by Neil H E Weste, David Harris and Ayan Banerjee, Pearson.
- 3. CMOS Digital Integrated Circuits Analysis and Design by Sung Mo Kang and Yusuf Leblebici, McGraw-Hill.
- 4. Design of Analog CMOS Integrated Circuits by Behzad Razavi, TMH.

B. Reference Books:

- Digital Integrated Circuits A Design Perspective by Jan M Rabey, Anantha Chandrakasan and Borivoje Nikolic, Pearson.
- 2. CMOS Analog Circuit Design by Philip E Allen and Douglas R Holberg, Oxford.
- 3. Analog Design for CMOS VLSI Systems by Maloberti F, Springer.
- 4. Analog Integrated Circuits Design by John and Martin, Wiley.

C. Magazines:

- 2. IEEE magazines on Semiconductor manufacturing.
- 3. IEEE Solid State Circuits Society newsletter.
- 4. IEEE magazines on Consumer electronics.

Journals:

- 5. IEEE journal of selected topics in Quantum Computing.
- 6. IEEE transactions on Computer Aided Design of Integrated Circuits and Systems.
- 7. IEEE transactions on VLSI systems.
- 8. IEEE proceeding of Computer and Digital techniques.

Name of the Module: Electronic Instrumentation Design

Module Code: ECE 919

SEMESTER: 2nd

Credit Value: 3 [P=0, T=0, L=3]

Module Leader:

No. of Lectures: 40 Hours

Objectives:

The course is design to meet with the objectives of:

- 1. Imparting theoretical knowledge to the students about errors in active & passive transducers.
- 2. Making student competent enough to construct transducer based application specific device.
- 3. Giving students theoretical knowledge of inter sample error and interpolation.

Learning Outcomes:

Upon completion of the subject:

- 1. Students will have strong visualising capability in their mind about transducer based temperature or weather sensor.
- 2. Students will be able to design smart sensor busses and interface circuits.



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UNIT	COURSE CONTENT	Number of Lectures
UNIT I	Architecture of Instrumentation scheme: Static and dynamic characteristics, errors, standards and calibration. Principle and design of various active and passive transducers. Introduction to semiconductor sensors and its applications. Electrical I/O characteristics of sensors/transducers for measurement of temperature, flow, level, pressure, position and motion. Specifications and selection of sensors/transducers for measurement of temperature, flow, level, pressure, position and motion. Introduction to smart sensors.	10
UNIT II	Amplification, attenuation, isolation, multiplexing, filtering, linearization, compensation, simultaneous sampling & transducer excitation. Operational and Instrumentation Amplifiers. Instrumentation amplifiers and Error Budgets, Noise in low level Amplification.	10
UNIT III	Analog Signal Acquisition, Conditioning and Processing, Input grounding, Shielding and Termination Practice. Signal conditioning Error Analysis. DC, Sinusoidal and Harmonic Signal Conditioning, Analog Signal Processing, Devices for Data Conversion – Analog Multiplexers, Sample – Holds, D/A and A/D. Sampled Data, Inter sample Error and Interpolation, Aliasing of Signal and Noise, Inter sample and Aperture Error, Signal Recovery and Interpolation. Conversion System Design with Computer – Assisted Analysis, System Design Considerations, Computer Assisted Interface Analysis Software.	12
UNIT IV	Introduction to manufacturing Processes, National and International Standards (BIS, DIN, ISO etc.), Product Design Fundamentals- boards/modules, sub-systems, cabinet, user interface, Design for manufacturability, Design for testability, Creating user's manual and maintenance manual.	8

Teaching/ Learning/ Practice Pattern:

Teaching: 70% Learning: 30% Practice: 0%

Examination Pattern:

1. Theoretical Examination: Regular / open book examination.

Reading List:

A. Text Books

- 1. Measurement and Instrumentation Principles, by: Alan S. Morris, Butterworth-Heinemann
- 2. Advanced Instrumentation and Computer I/O Design, by: Patrick H. Garrett, IEEE Press
- 3. Data Acquisition and Signal Processing for Smart Sensors, by: Nikolay V. Kirianaki et al.John Wiley & Sons.
- 4. Microsensors MEMS and Smart Devices, by: Julian W. Gardner, Vijay K. Varadan, et al. John Wiley & Sons.

B. Reference Books

- 1. Industrial Instrumentation Principles and Design, 1st edition; by:Tattamangalam, R.Padmanabhan, Springer Verlag.
- 2. Measurement Systems Application and Design, by: Ernest O. Doebelin, McGraw-Hill.
- 3. Handbook of Transducers, 1st edition; by: Harry N.Norton, Prentice Hall.
- 4. Advances in Distributed Sensor Technology; by: S.S.Iyengar, L.Prasad, Hla Min; Prentice Hall PTR.



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SYLLABUS FOR M-TECH. (ELECTRONICS DESIGN & MANUFACTURING)

- 5. Standard Recommended Practises for Instrumentation & Control, Vol 1-3,11th edition; Instrument Society of America.
- 6. Microsensors: Principles and Applications; by: Gardner, J W, Wiley (1994)
- 7. Measurement Systems, Application and Design, 4th edition; by: Ernest O.Doebelin, McGraw-Hill.
- 8. Practical Design Techniques For Sensor Signal Conditioning; Seminar. http://www.analog.com.

C. MAGAZINES:

- 1. IEEE Instrumentation & Measurement Magazine.
- 2. Magazine on sensors and measurements

C. JOURNALS:

- 1. International Journal of Instrumentation Science
- 2. Journal of Instrumentation
- 3. Journal of Sensors and Instrumentation.
- 4. Journal of Instrumentation Technology and Innovations.
- 5. International Journal of Instrumentation, Control and Automations.