SYLLABI

OF

PhD (Electronics Engineering)

2019-2020

DEPARTMENT OF ELECTRONICS ENGINEERING

J.C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA, FARIDABAD

J.C. Bose University of Science and Technology, YMCA, Faridabad

PhD (Electronics Engineering)

Course No.	Course Title	Teaching Schedule			Marks for sessionals	Marks for End Term Examination	Total Marks	Credits
		L	T	P				
PHD-100A	Research Methodology	4	0	0	25	75	100	4
	Elective-I	4	0	0	25	75	100	4
	Total	8	0	0	50	150	200	8

Elective-I

PhEE-17O-01 Computational Control of Industrial Process

PhEE-17O-02 VLSI design circuits and systems

PhEE-17O-03 Solar Photovoltaic Technology and Applications

PhEE-17O-04 MEMS Sensor Design and Fabrication

PhEE-18E-01 Digital Image Processing

PhEE-18E-02 Securities in Communication Networks

PhEE-190-01 High Speed Electronic Devices and Circuits

PhEE-190-02 Embedded System and Internet of Things (IoT)

Note: The students will have to select one subject from list of Elective Courses. Exam duration will be 3 Hours.

PHD – 100A

RESEARCH METHODOLOGY

PhD (Common Subject)

No. of Credits: 4		Sessional:	25 Marks
L | T | P | Total		Theory:	75 Marks
4 | 0 | 0 | 4		Total:	100 Marks
		Duration of Exam:	3 Hours

Course Objectives:

- Understand research process in order to plan a research proposal
- Learn methods to devise and design a research set-up
- Plan and perform data collection methods and its analysis
- Conclude research in report writing

Course Outcomes: The research scholar shall be able to

CO1 Plan a research proposal and design the research.

CO2 Collect data through experiments or surveys as per research requirement.

CO3 Understand and apply sampling and sampling distributions.

CO4 Understand and perform quantitative and qualitative data analysis.

CO5 Write research report with proper citations.

Unit 1 **Introduction to Research**: Definition, need and purpose of research, types of research, research process, approaches to research, planning a research proposal, literature review.

Unit 2 **Measurement Scales**: Indexes vs. Scales, Types of Scale, construction of Scale, Bogardus social distance scale, Thurstone Scale, Likert Scale, Semantic Differential Scale, Guttmann Scale.

Unit 3 **Data Collection Methods:** Experiments and Surveys, Experiments: Classical Experiments, Independent & Dependent Variables, Pre Testing & Post Testing, Double Blind Experiment, Subject Selection, Variation on Experiment Design. Survey Research: Topics appropriate for survey research, Guidelines for asking questions, Questionnaire Construction, Strengths & Weakness of Survey Research,

Types of Surveys.

Unit 4 **Sampling**: Types of sampling methods: Non Probability Sampling, Probability Sampling, Theory & Logic of Probability Sampling, Sampling Distributions & Estimates of Sampling Error.

Unit 5 **Data Analysis**: Qualitative v/s Quantitative data analysis, Qualitative Data Analysis: Discovering Patterns, Grounded Theory Method, Semiotics, Conversation Analysis, Qualitative Data Processing. Quantitative Data Analysis: Quantification of Data, Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Regression Analysis, Description Analysis. Hypothesis. Multiple Attribute Decision Making.

Unit 6 **Report Writing, Ethical Issues and Outcomes**: Report Preparation, Structure of Report, Report Writing Skills, Citations, Research Papers, Intellectual Property Rights, Plagiarism, Patent, Commercialization, Ethical Issues.

References:

1. Research Methodology by R. Panneerselvam, 2nd Ed. PHI
2. Research Methodology by C.R. Kothari & Gaurav Garg, 3rd Ed. New Age Publishers
3. Research Methodology and Scientific Writing by C. George Thomas, Ane Books
4. The practice of social research by Earl Babbie, 14th Ed. Cengage
5. Multiple Attribute Decision Making, Gwo-Hshiung Tzeng and Jih-Jeng Huang, CRCPress

Computational Control of industrial Process (PhEE-17O-01)

L T P CR **Theory : 75**
4 0 0 4 **Class Work : 25**
Total : 100
Duration of Exam : 3 Hrs.

Course Objectives:

- To introduce the basic principles & importance of process control in industrial process plants
- To analyse First order, second order, and integrating systems including dead time are treated with basic controller algorithms.
- To introduce the dynamic behaviour of processes in different situations
- To introduce about defining controller structure with respect to controlled process and perform parameters tuning in order to assure required performance of the system.
- To introduce the concepts involved in multiple single loops in various applications.
- To introduce about theoretical and empirical mathematical models of different processes
- To introduce about the design of different types of controllers
- To introduce about the key concepts in adaptive control system
- To introduce about the Review of z transform, modified Z transform and Delta transform Relation between discrete and continuous transfer function
- To introduce about the Open loop and closed loop response of SDS design and implementation of different digital control algorithm
- Stability analysis of Discrete systems

Course Outcomes: The research scholar shall be able to

CO1	Understand the basic principles & importance of process control in industrial process plants.
CO2	Model and analyze first order and integrating systems including dead time and their characteristics.
CO3	Understand different types of controller, their tuning and their effect on system performance.
CO4	Describe different control values used in industrial applications.
CO5	Understand concept of single loop, multiple loop, single variable and multivariable controlled process.
CO6	Understand adaptive, self tuning, interaction and decoupling of loops.

Unit 1 **Historical prospective:** Incentives of process control, synthesis of control system, classification and definition of variables. Need and application of mathematical Modeling, lumped and distributed parameters, analogies, thermal, electrical and chemical systems, Modeling of CSTR, heat exchanger.

Unit 2 **Multicapacity Systems:** Interacting and non-interacting type of systems, dead time elements.

Unit 3 **Control modes:** Definition, characteristics and comparison of P, PI, PD, PID controllers. Dynamic behaviour of feedback-controlled process for different control modes, control system quality, IAE, ISE, IATE criterion, tuning of controllers, Ziegler-Nicholas, and Cohen coon methods. Realization of different control modes in electric and electronic controllers.

Unit 4 **Multi-loop and Multi-variables Systems:** Review and limitation of single loop control, need for multi loop systems. Principle, analysis and application of cascade, ratio, feed forward, feedback, override, split range, selective, auctioneering control.

Unit 5 **Introduction to adaptive and self-tuning control:** Interaction and decoupling of loops.

Unit 6 **Stability Analysis in Z domain:** Jury's criterion and Bilinear transformation, mapping between Z plane and S plane.

Text Books-

1. George Stephnopolous "Chemical Process Control" Prentice Hall
2. Peter Herriot, " Process control" Tata McGraw Hill
3. Donald R caughanowr " Process System Analysis and control" McGraw Hill international edition.
4. D.P.Eckmen " Industrial instrumentation" Wiley Eastern.
5. Katsuhiko Ogata , Discrete Time Control Systems, 2nd edition, printice hall international edition.
6. P. Deshponde and ash, computer controlled system ISA Press, USA
7. Richard H. Middieton Graham Goowin,, Digital control and estimation A unified Approach; prentice Hall NJ, 1999
8. Astrom A.J,Bjorn Witten mark ,Adaptive Control, Second Edition ,Prentice Hall of India , New Delhi, 1994

VLSI DESIGN CIRCUITS AND SYSTEMS (PhEE-17O-02)

L T P CR
4 0 0 4

Theory : 75
Class Work : 25
Total : 100
Duration of Exam : 3 Hrs.

COURSE OBJECTIVE

- To study the evolution of VLSI technology, VLSI Design Flow, Basic MOS Transistor, Multiple transistor amplifier stage, Enhancement and depletion mode, MOS structure, NMOS, PMOS and CMOS fabrication.
- To study the electrical properties of MOS Threshold voltage, MOSFET current voltage characteristics, second order effects, MOS inverters: VTC characteristics of NMOS inverter, CMOS inverter and Bi-CMOS inverter. Noise margins, Latch-up in CMOS circuits.
- To study the design process of Physical design of simple and complex logic gates using NMOS and CMOS technology, Stick diagrams, NMOS Design Style. CMOS Design Style, Lambda based Design Rules.
- To study the MOS transistor switching characteristics, Sheet resistance, area capacitance, inverter delay. Switching power dissipation of CMOS inverters. •
- To study the dynamic logic circuits CMOS Logic Structure, Complementary CMOS Logic, Pseudo NMOS Logic, Dynamic CMOS Logic, CMOS Domino Logic, Clocked CMOS Logic, Pass Transistor Logic, CMOS transmission gate Logic
- To study the scaling of MOS circuits,scaling models, scaling factor for device parameters, Advantages and Limitations of scaling.
- To study of subsystem design, Architectural issues in VLSI, Design of CMOS parity generator, Multiplexer, n-Bit Comparator, Incrementer/Decrementer, ALU subsystem

Course Outcomes: The research scholar shall be able to

CO1	Understand the VLSI design flow, enhancement & depletion type transistors and fabrication of NMOS, PMOS & CMOS..
CO2	Understand the electrical properties of MOS, VTC characteristics of NMOS inverter, CMOS inverter &BiCMOS inverter, Latch-up concept
CO3	Design & working of logic circuits using NMOS & CMOS technology & also understanding the concept of stick diagram & layout. Understand the concept & derivations of MOS switching characteristics i.e sheet resistance, capacitance & power dissipation.
CO4	Design of various dynamic circuits i.e Pseudo NMOS logic ,CMOS dynamic Logic etc & design of other complex structures using pass transistors & transmission gates. Understand the concept of scaling of MOS, Scaling factors & parameters.

CO5 Understand the architectural issues to design any subsystem & design of multiplexer, comparator, ALU & other complex circuits.

Unit 1 **REVIEW OF MOS TECHNOLOGY:** Evolution of VLSI technology, VLSI Design Flow, Basic MOS Transistor: Enhancement and depletion mode, MOS structure, NMOS, PMOS and CMOS fabrication.

Unit 2 **SMALL SIGNAL & LARGE SIGNAL MODELS :** Small Signal & large signal Models of MOS & BJT transistor. Analog MOS Process, MOS & BJT Transistor Amplifiers: Single transistor Amplifiers stages: Common Emitter, Common base, Common Collector, Common Drain, Common Gate & Common Source Amplifiers

Unit 3 **ELECTRICAL PROPERTIES OF MOS**: Threshold voltage, MOSFET current voltage characteristics, second order effects, MOS inverters: VTC characteristics of NMOS inverter, CMOS inverter and Bi-CMOS inverter. Noise margins, Latch-up in CMOS circuits.

Unit 4 **DESIGN PROCESS:** Physical design of simple and complex logic gates using NMOS and CMOS technology, Stick diagrams, NMOS Design Style. CMOS Design Style, Lambda based Design Rules.

Unit 5 **MOS TRANSISTOR SWITCHING CHARACTERISTICS:** Sheet resistance, area capacitance, inverter delay. Switching power dissipation of CMOS inverters.

Unit 6 **SCALING OF MOS CIRCUITS:** Scaling models, scaling factor for device parameters, Advantages and Limitations of scaling.

Unit 7 **SUBSYSTEM DESIGN:** Architectural issues in VLSI, Design of CMOS parity generator, Multiplexer, n-Bit Comparator, Incrementer/Decrementer, ALU subsystem.

TEXT BOOKS:

1. Kang and Leblebici “CMOS Digital integrated circuits” TMH 2003.

2. Pucknell D.A and Eshrachain K. “Basic VLSI Design Systems & circuits”(PHI)

3. Introduction to Digital Circuits: Rabaey (PH)

4. Paul B Gray and Robert G Meyer, “Analysis and Design of Analog Integrated Circuits”.

5. R Gregorian and G C Temes, Analog MOS Integrated Circuits for Signal Processing, John Wiley, 1986.

Solar Photovoltaic Technology and Application (PhEE-17O-03)

L	T	P
4	-	-

Total Credits: ____
External Marks: 75
Internal Marks: 25
Total Marks: 100

UNIT 1 **Solar Cell Fundamentals:** Historical development of PV systems. Overview of PV usage in the world, Solar energy potential for PV, irradiance, solar radiation and spectrum of sun, geometric and atmospheric effects on sunlight, Solar cells, basic structure and characteristics: Single-crystalline, multi-crystalline, thin film silicon solar cells, emerging new technologies, Various applications of solar PV system in rural India.

UNIT 2 **Electrical Characteristics of PV systems:** PV cells Material, Photovoltaic effect-Principle of direct solar energy conversion into electricity in a solar cell, Semiconductor properties, energy levels, basic equations, Solar cell, p-n junction, structure. Electrical characteristics of the solar cell, equivalent circuit, I-V characteristics of a PV module, maximum power point, cell efficiency, fill factor, effect of irradiation and temperature. Photo-voltaic array & its connections, arrangements of array according to the voltage, Module & its connections. Faults & their effects in photo-voltaic cell, array & module (connection of cell, connection of array, connection of module), PV Module, PV Array.

UNIT 3 **Equivalent Circuit Modeling of PV & System Component:** Modeling of solar cells including the effects of temperature, irradiation and series/shunt resistances on the open-circuit voltage and short-circuit current, Photovoltaic hierarchy: Cell, Module and Array, PV equivalent circuit modeling, single diode model, double diode model, PV array model, partial shading condition System components - PV arrays, inverters, batteries, charge controls, net power meters. PV array installation, operation, costs, reliability.

UNIT 4 Design of PV Systems: Design of solar PV systems, Process flow diagram for PV system, Simulation tools for PV system, Life cycle assessment, Estimation of carbon credit, Financial assessment of the plant, Life Cycle Cost Assessment, Feasibility study of PV system, Case study of design of solar PV, Stand alone PV system & its various applications**.**

UNIT 5 **PV System Applications:** Building-integrated photovoltaic units, grid-interacting central power stations, stand-alone devices for distributed power supply in remote and rural areas, solar cars, aircraft, space solar power satellites. Socio-economic and environmental merits of photovoltaic systems, Issues, and barriers in deployment of Solar PV system, Interpretive Structural Modeling, Application of Solar Photovoltaic system in agriculture, Government Initiatives and polices.

UNIT 6 **Power Calculation:** Power conditioning and maximum power point tracking (MPPT) based on buck- and boost-converter topologies, Module Cost per Watt, Module Efficiency (Watts per Area)

UNIT 7 **Storage System**: Energy storage alternatives for PV systems. Storage batteries, lead-acid, nickel-cadmium, nickel-metal-hydride and lithium type batteries. Small storage systems employing ultracapacitors, charging and discharging properties and modeling of batteries.

REFERENCE BOOKS

1. Chetan Singh Solanki., Solar Photovoltaic: Fundamentals, Technologies and Application, PHI Learning Pvt., Ltd., 2009.
2. R. Messenger, J. Ventre, Photovoltaic Systems Engineering, 2nd ed., CRC Press, 2004.
3. R. J. Komp, Practical photovoltaics: electricity from solar cells, 3rd ed., Aatec Publications, 2001.
4. 4. M. R. Patel, Wind and Solar Power Systems, CRC Press, 1999.
5. 5. R. H. Bube, Photovoltaic Materials, Imperial College Press, 1998.
6. 2. Jha A.R., Solar Cell Technology and Applications, CRC Press, 2010.
7. John R. Balfour, Michael L. Shaw, Sharlave Jarosek., Introduction to Photovoltaics, Jones & Bartlett Publishers, Burlington, 2011.
8. Luque A. L. and Andreev V.M., Concentrator Photovoltaic, Springer, 2007.
9. Partain L.D., Fraas L.M., Solar Cells and Their Applications, 2nd edition. Wiley, 2010.
10. S.P. Sukhatme, J.K.Nayak., Solar Energy, Tata McGraw Hill, New Delhi, 2010.

PhEE-17O-04
MEMS Sensor Design and FabricationPhD Course

No. Of Credits: 4	**Sessional: 25 Marks**
L | T | P | Total	**Theory: 75 Marks**
4 | 0 | 0 | 0	**Total: 100 Marks**
	Duration of Exam: 3 Hours

Unit 1 **Introduction:** Concepts of Micro miniaturisation by micro fabrication. Mechanical Properties of Micro components. Various Mechanisms of Transduction. Concept of MEMS based Sensors and Actuators. Role of Substrate used for Micro fabrication. Concept of Technology Cost for IoT Applications

Unit 2 **Thermal Sensing and Actuation:** Introduction,Thermal Expansion based Sensors and Actuators. Examples - Thermocouples, Thermal Resistors, Micro heaters. Sensors for Flow/IR/Inertial Measurements

Unit 3 **Piezo resistive Sensors:** Piezo resistive Materials. Stress Analysis. Applications: Inertia/Pressure/Tactile/Flow

Unit 4 **Piezo electric Sensors and Actuators:** Piezo electric Materials. Applications: Acoustic/Inertia/Tactile/Flow/SAW

Unit 5 **Polymer and Other Low Cost MEMS Sensors and Actuators:** Polymers in MEMS. Materials – Polyimide, SU-8, PDMS, PMMA, Parylene, Papers, Applications: Acceleration, Pressure, Flow, Tactile Sensors

Unit 6 **MEEMS Design:** Analytical Design of Cantilever. ANSYS Software Applications

References:

1. Foundations of MEMS – Chang Liu
2. Fundamentals of Micro fabrication and Nanotechnology – M. J. Madou
3. Strength of Materials – S. Timoshenko
4. Semiconductor Sensors – S. M. Sze

DIGITAL IMAGE PROCESSING (PHEE-18E-01)

No. of Credits: 4	**Sessional: 25 Marks**
L | T | P | Total	**Theory: 75 Marks**
4 | 0 | 0 | 4	**Total: 100 Marks**
	Duration of Exam: 3 Hours

Unit 1 **Digital Image Fundamentals**: Visual Perception, Image Models, concept of uniform and non- uniform sampling &quantization, Relationships between pixels-neighbours of pixel, connectivity labelling of connected components. Relations, equivalence and Transitive closure, Distance measures, Color models

Unit 2 **Image Transforms:** Discrete Cosine transform, Discrete Fourier transform, Fast Fouriertransform, Discrete Wavelet Transform

Unit 3 **Image Enhancement:** Spatial and frequency domain methods, intensity transformation, Histogram processing and Averaging spatial filtering, Low pass and high pass filters, Color image processing.

Unit 4 **Image Restoration:** Degradation model, digitalization of circulate and block circulate metrics, Algebraic approved invoice filtering, wiener filter, constrained least square restoration, Interactive restoration in spatial domain geometric transformation.

Unit 5 **Image Segmentation:** Detection of Discontinuity, Edge detection, Boundary detection, Thresholding, Regional oriented segmentation uses of motion in segmentation.

Unit 6 **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Some Basic Morphological Algorithms- Boundary Extraction, Hole Filling.

Unit 7 **Compression:** Lossy and Lossless Compression, Basic Compression Methods- Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-Length Coding

TextBooks:

1.Anil K Jain, "Fundamentals of Digital Image Processing", PHI Edition 1997.

2.Keenneth R Castleman, " Digital Image Processing", Pearson

Reference Books:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Chanda&Majumder,

SECURITIES IN COMMUNICATION NETWORKS (PHEE-18E-02)

No. of Credits: 4	**Sessional: 25 Marks**
L | T | P | Total	**Theory: 75 Marks**
4 | 0 | 0 | 4	**Total: 100 Marks**
	Duration of Exam: 3 Hours

Unit 1 **Introduction to cryptography**: Classical Cryptosystem, Cryptanalysis on Substitution Cipher (Frequency Analysis), Play fair Cipher, Block Cipher. Security trends, The OSI security architecture, Security attacks, Security services, Security mechanisms, Models of Internetwork security.

Unit 2 **Symmetric Encryption and Message Confidentiality:** Symmetric encryption principles, Algorithms, Stream ciphers and RC4, Cipher block modes of operation, Location of encryption devices, Key distribution.

Unit 3 **Public Key Cryptography and message Authentication:** Different approaches to message authentication, HMAC, public key cryptography principles and algorithm, Digital signature, Key management.

Unit 4 **Network Security Application:** Electronic Mail Security, IP security overview, Architecture, Authentication Header, Encapsulating Security payload, Combining Security Association, Key management.

Unit 5 **Web Security Requirement:** Secure Socket layer and transport layer security, Secure Electronic Transaction, Network management Security.

Unit 6 **Information Hiding:** Steganography, and Watermarking. Importance and applications of Digital Watermarking and Steganography. Properties of Watermarking and steganography Systems, Embedding Effectiveness, Fidelity, Data Payload.

Unit7 **Classification of Steganography and Watermarking Techniques. Different basis of classification:** Spatial domain Steganography and Watermarking (LSB substitution, Pseudorandom LSB substitution, Distortion) Frequency domain Steganography and Watermarking (DCT, DWT, DFT, FRFT) along with associated algorithms.

Reference Books

1. Network Security Essentials: Application and standard, William Stalling(Third edition).
2. Computer network and data communication by Frozen.
3. Digital Watermarking and Steganography, Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, JessicaFridrich, and Ton Kalker. 2nd Edition, Morgan Kaufmann Publishers, 2008.

HIGH SPEED ELECTRONIC DEVICES AND CIRCUITS

PhEE-19O-01	**Theory**	**:**	**75**
L T P CR	**Class work**	**:**	**25**
3 0 0 3	**Total**	**:**	**100**
	Duration of Exam	**:**	**Hrs.**

Course Objectives:
Students will try to learn:

- The issues associated with high performance of devices and circuits.
- The materials requirements for high speed devices and circuits.
- The energy band diagram in Metal semiconductor contacts, MESFET and MESFET characteristics
- The principle of operation and features of HEMT.

Course Outcomes: The research scholar shall be able to

CO1 Understand the material requirements and issues associated with high performance of devices and circuits.

CO2 Analyse MESFET characteristics and energy band diagram.

CO3 Learn HEMT based high speed devices.

Unit 1 **Materials and parameters governing the high speed performance of devices and circuits Parameters which limit high speed performance of circuits:** Transit time/frequency of charge carriers, junction capacitances, ON-resistances, carrier mobility and temperature, how cut off frequency differs from transit frequency. Material requirements for high speed devices and circuits, Compound Semiconductor: II-VI, III – V(GaAs,InP) and IV-IV compounds, Ternary compound semiconductors and their applications(AlGaAs, GaAsP, GaInAs,etc). Dopant and impurities in GaAs and InP, Overview of GaAs Technology for High Speed Devices: Epitaxial Techniques for GaAs High Speed Devices (VPE, LPE and MBE), Device fabrication approach (Epi-layer approach, Implantation approach, Epi-layer with proton implantation), Can MOSFET be realized with GaAs and InP.

Unit 2 **Metal semiconductor contacts and MOS devices:** Native oxides issue for MOS devices, Metal semiconductor contacts Energy band diagram

of MS contacts under thermal equilibrium, forward bias and reverse bias, Effect of interface states on the barrier height and the I-V characteristics. MS contacts for MESFET: Energy band diagram of Rectifying contacts under thermal equilibrium, forward bias and reverse bias, Effect of interface states on the barrier height and the I-V characteristics. Fermi level pinning. Comparison of I-V characteristics of GaAs an Si Schottky diode, Comparison of (Si and GaAs) Schottky barrier and (Si and GaAs) pn junction.

Unit 3 **Metal semiconductor Field Effect Transistors (MESFETs):** MESFET operation & I-V characteristics, I-V Characteristics Shockley's Model, Pinch off voltage and threshold voltage of MESFETs. D.C. characteristics and analysis of drain current. Velocity overshoot effects and the related advantages of GaAs, InP and GaN based devices for high speed operation. Sub threshold characteristics, short channel effects and the performance of scaled down devices.

Unit 4 **High Electron Mobility Transistors (HEMT):** Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT. InGaAs/InP HEMT structures.

Textbooks:

1. High-Speed Devices and Circuits with THz Applications, Jung Han Choi, CRC Press
2. CMOS Analog Integrated Circuits: High-Speed and Power-Efficient Designs,Tertulien Ndjountche, CRC Press.
3. Handbook of III-V High Electron Mobility Transistors Technologies, D. Nirmal and J, Ajyan, CRC Press
4. J. Lindmayer and C. Y. Wringley, Fundamentals of Semiconductor Devices, Affiliated East-West Press Pvt. Ltd.
5. S. M. Sze, ed., *High-Speed Semiconductor Devices*
6. C.Y. Chang, F. Kai, *GaAs High-Speed Devices: Physics, Technology, and Circuit Applications* , Wiley, 1994

This course will mostly follow the lines of NPTEL course whose link is given below.
https://nptel.ac.in/courses/117106089/#

EMBEDDED SYSTEM & INTERNET OF THINGS (IOT)

PhEE-19O-02	**Theory**	**:**	**75**
L T P CR	**Class work**	**:**	**25**
3 0 0 3	**Total**	**:**	**100**
	Duration of Exam	**:**	**3Hrs.**

Unit 1 **Fundamental of 8051:** Introduction to microcontroller, pin diagram, architecture, timer/ counter, interrupts, addressing modes, instruction set.

Unit 2 **Programming for 8051:** Assembly programming model, programming for arithmetic & logical operation, generation of digital signals of different duty cycle, interfacing with LCD, interfacing with DC motor, interfacing with stepper motor.

Unit 3 **PIC Microcontroller:** Introduction to PIC microcontroller, characteristics description of PIC, architecture description of PIC 18XXX Series, Pin description of PIC18XXX series microcontroller, instruction set explanation and planning for basic mathematical functions.

Unit 4 **ARM Processor:** Introduction to ARM processor, architecture of ARM processor, ARM Processor-Modes, ARM CPU registers, Introduction set description.

Unit 5 **Internet of Things (IOT):** Introduction to IOT, architectural model for internet of things (IOT) based system, component for Internet of Things system, application for IOT devices.