

**NATIONAL INSTITUTE OF ELECTRONICS & INFORMATION TECHNOLOGY,
GORAKHPUR**

REVISED COURSE CONTENTS (M.Tech. ED&T)

Semester –I

- Power Electronics System Design
- Design of Digital Systems
- Electronics Product Design
- Electromagnetic & Radio Frequency Interference Compatible System Design
- Elective 1

Semester –II

- Analog And Data Conversion Systems
- Embedded System Design
- Reliability of Electronic Equipment's
- VLSI Design
- Elective 2
- Seminar I

Elective Papers 1

1. 3D Printing & Reverse Engineering
2. Design of Photovoltaic System
3. Wireless Communication
4. Advance Digital Signal Processing

Elective Papers 2

1. Optical Fiber Communication
2. Electronic System Packaging
3. Design of Control for Renewable Energy System Optimization
4. Embedded IOT System Design

Semester -III

- Seminar II and Project Work

Semester -IV

- Final Project Dissertation

COURSE AND EXAMINATION SCHEME
M.Tech (Electronics Design and Technology) Regular Semester I

S. N	Course Code	Subject	Periods			Credit	Evaluation Scheme					Subject Total
			L	Tut.	Pr.		Theory			Practical		
		Theory					CT	TA	ESE	TA	ESE	
1	MDT 101	Power Electronics System Design	3	0	0	3	20	10	70	-	-	100
2	MDT 102	Design of Digital Systems	3	0	0	3	20	10	70	-	-	100
3	MDT 103	Electronics Product Design	3	0	0	3	20	10	70	-	-	100
4	MDT 104	Electromagnetic & Radio Frequency Interference Compatible System Design	3	0	0	3	20	10	70	-	-	100
5		Open Elective 1	3	0	0	3	20	10	70	-	-	100
6	MDTL 151	Power Electronic Lab	0	0	3	2	-	-	-	20	30	50
7	MDTL 152	Digital System Design Lab	0	0	3	1	-	-	-	20	30	50
		Total	15	0	6	18	-	-	-	-	-	600

Semester II

S. N	Course Code	Subject	Periods			Credit	Evaluation Scheme					Subject Total
			L	Tut.	Pr.		Theory			Practical		
		Theory					CT	TA	ESE	TA	ESE	
1	MDT 201	Analog and Data Conversion Systems	3	0	3	3	20	10	70	-	-	100
2	MDT 202	Embedded System Design	3	0	0	3	20	10	70	-	-	100
3	MDT 203	VLSI Design	3	0	0	3	20	10	70	-	-	100
4	MDT 204	Reliability of Electronic Equipment's	3	0	0	3	20	10	70	-	-	100
5		Open Elective 2	3	0	0	3	20	10	70	-	-	100
6	MDTL 251	Embedded System Lab	0	0	3	2	-	-	-	20	30	50
7	MDTL 252	Seminar I	0	0	3	1	-	-	-	50	-	50
		Total	15	0	6	18	-	-	-	-	-	600

Semester III

S. N	Course Code	Subject	Periods			Credit	Evaluation Scheme					Subject Total
							Theory			Practical		
			L	Tut.	Pr.		CT	TA	ESE	TA	ESE	
1	MDTL 351	Seminar II	0	0	6	3	-	-	-	100	-	100
2	MDTL 352	Dissertation	0	0	30	15	-	-	-	200	300	500
		Total	0	0	36	18	-	-	-	-	-	600

Semester IV

S. N	Course Code	Subject	Periods			Credit	Evaluation Scheme					Subject Total
							Theory			Practical		
			L	Tut.	Pr.		CT	TA	ESE	TA	ESE	
1	MDTL 451	Dissertation (Final)	0	0	36	18	-	-	-	200	400	600
		Total	0	0	36	18	-	-	-	-	-	600

MDT-101

POWER ELECTRONICS SYSTEM DESIGN:

Characteristics & protection of power devices such as - GTOs, IGBTs, RCTs, MCTs, SITHs, LASCRs, MOSFET, Solar Renewable energy systems, Design of Transformers, selection of core material, insulating material and wires, Design of high frequency transformer, Design of inductors, Linear power supply, Switch Mode Power Supplies, Converter topology - buck, boost, buck-boost, derived converter topologies, flyback converter, forward converter, push-pull converter, half Bridge converter, full Bridge converter, special converters, PWM control techniques, study of PWM control ICs and driver IC's, design of base drive circuits, design of input section, output section & control section, protection circuit design for power supplies, design concept of uninterrupted power supplies, CVT.

RECOMMENDED BOOKS:

- **George Chryssis**, "High Frequency Switching Power Supplies: Theory & Design" Mc Graw Hill Book Co., 1984.
- **K. Kitsum**, "Switch Mode Power Conversion - Basic Theory and Design" Marcel Deckker Inc., 1984.
- **N. Radhakrishnan and S.R. Bhat**, "Design and Technology of Low Power Transformers and Inductors" CEDT, July 1988.
- **Rashied**, Power Electronics Circuit Device and Application.

MDT-102

DESIGN OF DIGITAL SYSTEMS:

Introduction to Digital design; Variable entered mapping (VEM), plotting theory and reading theory, minimizing function of more than six variables, Hierarchical design, controller (FSM), case study, FSM issues, timing issues, pipelining, resource sharing, testability, synchronization, fault analysis in combinational circuit, setup/hold time of various types of flip-flops, synchronization between multiple clock domains, reset

recovery, proper resets. VHDL: different models, simulation cycles, process, concurrent and sequential statements, loops, delay models, library, packages, functions, procedures, coding for synthesis, test bench. FPGA: logic block and routing architecture, design methodology, special resources, programming FPGA, constraints, timing closure, case study.

RECOMMENDED BOOKS:

- **Wakerly, J. F.**, Digital Design: Principles and Practices 4th Edition, Pearson, 2008
- **Skahil, K.**, VHDL For Programmable Logic 1st Edition, Pearson, 2004
- **J. Bhasker**, VHDL Primer
- **David Pellerin, Edward A. Thibault Ph.D**, Practical FPGA Programming in C 22 Apr 2005

MDT-103

ELECTRONICS PRODUCT DESIGN:

Introduction to Industrial Design, the design process, product design methodology, product planning, anatomy of design process, Aesthetics, Elements of design, Ergonomics, ergonomic issues in designing electronic products, design of controls, design of display. Ergonomics & Aesthetics consideration for development of control panel, Engineering considerations for Control panel layouts, layout of components, control mountings, structural design, Overview of PCB design ,general considerations for PCB layout, rules and parameters, Design rules for analog circuit PCB, Design rules for digital circuit PCB, Design rules for PCBs

RECOMMENDED BOOKS:

- **Dan Cuffaro, Isaac Zaksenberg**, The Industrial Design 2013
- **A.K. Chitale, R.C. Gupta**, Product design and manufacturing, Prentice, Hall of India.
- **Kevin Otto, Kristin Wood**, Product Design.
- **C.H. Flurschiem**, Industrial Design in Engineering Design Council London and Springer Verlag, 1993.

MDT-104

ELECTROMAGNETIC & RADIO FREQUENCY INTERFERENCE COMPATIBIL SYSTEM DESIGN:

Introduction to electromagnetic interference and compatibility, Noise pickup modes and reduction techniques for analog circuits. Grounding Techniques, Near and Far fields impedance, Mechanism of EMI/RFI emission/ coupling in cables, Shield Factor, Use of fibers & co-axial cables, Conducted and radiated noise emission and control in power circuits. EMI/RFI induced failure, mechanisms in power circuits. Power supply and ground line distribution in digital circuits. Cross talk and reflection issues in digital circuits. Shielding of electronic equipment, Electrostatic Discharge (ESD) issues. EMC standards and test equipment.

RECOMMENDED BOOKS:

- **Paul, C.R.**, Introduction to electromagnetic compatibility, John Wiley and sons, Inc., 1991.
- **Henry W. Ott**, Electromagnetic Compatibility Engineering August 2009
- **Donald R. White**, Electromagnetic Interference and Compatibility Jun 1981
- **James S. Hill, Donald J. White**, A Handbook Series on Electromagnetic Interference and Compatibility Volume 6. Second Edition

MDT-201**ANALOG AND DATA CONVERSION SYSTEMS:**

Linear IC applications, Design and error budget analysis of signal conditioners for low level ac and DC applications. Analog to digital and digital to analog converters. SHA and analog multiplexers, Signal Conditioners with Instrumentation Auto-zero/chopper/isolation/charge amplifier, scaling & level shifting circuits, V to F & F to V converters, V to I & I to V converters. Design of analog circuits for capacitive and inductive transducers. Data transmission, General requirements, types of transmission, EIA standards in circuits design.

RECOMMENDED BOOKS:

- **Franco, S.**, Design with operational amplifiers and analog integrated circuits. Mc. Graw Hill book Co. 1988.
- **Horowitz, P., and Hill, W.**, The art of electronics (2nd edition), Cambridge University Press.1992
- **Jones, B.E.** Instrumentation, Measurement and Feedback, Tata Mc Graw Hill, New Delhi, 1978
- **DE Pippenger & EJ Tobuben**, Linear & Interface Circuits Applications, Mc Graw Hill

MDT-202**EMBEDDED SYSTEM DESIGN:**

Concept of embedded system design, embedded computing, RISC architecture, embedded software development, S/W Development environment – Cross Compiler, Linker, Debugger, Stand-alone systems. Introduction to ARM and Cortex architecture and ARM/THUMB instruction set, Memories, Interfacing memory with processor, Different Peripheral devices. Clocks and Power Management, Embedded system development process, Determine the requirements, Design the system architecture, Choose the operating system, Choose the processor, development platform and programming language, Testing and debugging.

RECOMMENDED BOOKS:

- **Hennessy, J.L.** and Patterson, D.A., Computer Architecture: A Quantitative Approach Computer Systems (5th edition), The Morgan Kaufmann Series Elsevier , 2012.
- **Furber, S.**, ARM System-on-Chip Architecture (2nd Edition), Pearson Education Limited. 2000.
- **Levine J. R.**, Linkers and Loaders, Morgan Kaufmann Publishers, 1999.
- The Definitive Guide to the ARM Cortex-M3, (2nd Edition), Newnes (imprint of Elsevier), 2009
- **Devid E Simon**, An Embedded software primer, Pearson education Asia, 2001

MDT-203**VLSI DESIGN:**

Basic electrical properties of MOS and Bi-CMOS circuits: MOS transistor operation in linear and saturated regions, MOS transistor threshold voltage, MOS switch and inverter, Bi- CMOS inverter, latch-up in CMOS inverter, inverter properties, Stick Diagram & Lay out - λ -rules, System Design - FSM - Model, ASM Chart. ASIC design flow, Partitioning, Floor planning, Placement, Routing, Field Programmable Gate Arrays (FPGA)

RECOMMENDED BOOKS:

- Pucknell & Eshraghian - Basic VLSI Desing, PHI, 1995.
- C. K. Wong & M. Sarrafzaden - An Introduction to VLSI Physical Design, McGraw Hills International Edition, 1996
- CMOS digital integrated circuits by Kang and Leblibici, TATA McGRAW HILL.
- CMOS: Circuit Design, Layout, and Simulation, R. Jacob Baker, John Wiley & Sons

MDT-204**RELIABILITY OF ELECTRONIC EQUIPMENTS:**

Introduction to concepts of reliability, nature of reliability problems in electronic equipment, series configuration, Parallel Configuration, Mixed Configuration, Methods of Solving Complex Systems, Mean Time to Failure (MTTF) and Mean Time between Failure (MTBF) of Systems, Maintainability, Availability Concepts, System Downtime, Mean time to Repair (MTTR), Trade Off, Reliability Improvement, Improvement of Components, Redundancy, element Redundancy, Unit Redundancy, Standby Redundancy, Reliability Prediction, Similar Equipment Techniques, Similar Complexity Techniques, Similar Function Techniques, Part Count Techniques, Part Stress Analysis Techniques, Fault Analysis Techniques, System Safety Analysis, Failure Modes and Effects Analysis, Fault Tree Analysis- Concepts and Procedures, Rules for Fault Tree Construction, Reliability Calculation through Fault Tree.

RECOMMENDED BOOKS:

- **Fquna**, Reliability Engineering for Electronic Design, Marcel Dekker, 1988.
- **Dr. R.K. Aggarwal**, Reliability Engineering
- **Dr. A.K. Govil**, Reliability Engineering
- **L.S. Srinath**: Reliability Engineering , 3rd ed. East-West Press,

ELECTIVE PAPERS 1**E-01 3D PRINTING & REVERSE ENGINEERING**

Introduction to Reverse Engineering, Reverse Engineering–The Generic Process, Scanning, Point Processing, Application Geometric Model Development.

Methodologies and Techniques for Reverse Engineering– The Potential for Automation with 3-D Laser Scanners, Computer-aided Reverse Engineering, Computer Vision and Reverse Engineering, Structured-light Range Imaging, Scanner Pipeline, Reverse Engineering Hardware, Reverse Engineering Software, Selecting a Reverse Engineering System, Introduction to Rapid Prototyping, Relationship Between Reverse Engineering and Rapid Prototyping, Legal Aspects of Reverse Engineering, Barriers to Adopting Reverse Engineering

RECOMMENDED BOOKS:

1. Product Design: Techniques in Reverse Engineering and New Product Development by K. Otto and K. Wood Prentice Hall, 2001.
2. Reverse Engineering: An Industrial Perspective by Raja and Fernandes. Springer-Verlag 2008

E-02 DESIGN OF PHOTOVOLTAIC SYSTEM:

Introduction to photovoltaic energy conversion, Solar radiation and measurement, Solar cell and their characterization, Influence of insolation and temperature, Maximum power point tracking, Electrical storage with Batteries, controllers, DC power conditioning, AC power conditioners for grid connection, Solar power drives, Applications for pumping/refrigeration, Economic analysis of PV system, Energy analysis of PV system.

RECOMMENDED BOOKS:

- Chenming, H. and White, R.M., Solar Cells from B to Advanced Systems, McGraw Hill Book Co, 198: Ruschenbach, HS, Solar Cell Array Design Hand Varmostrand, Reinhold, NY, 1980.
- Chetan Singh Solanki, Solar Photovoltaic Technology and Systems, 2013
- S. Sukhatme, J Nayak, SOLAR ENERGY : PRINCIPLES OF THERMAL COLLECTION AND STORAGE 17 Jun 2008

E-03 WIRELESS COMMUNICATION:

Wireless Communication Systems, Evolution of mobile radio communications; the cellular concept; frequency reuse; channel assignment strategies; handoff strategies; interference and system capacity; improving capacity in cellular systems. Mobile Radio Propagation, free space propagation model; basic propagation mechanisms; outdoor propagation models; indoor propagation models . Frequency modulation vs. amplitude Modulation; amplitude modulation; angle modulation, digital modulation; BPSK, DPSK, QPSK; RAKE Receiver; characteristics of speech signals; quantization techniques; adaptive differential pulse code modulation; linear predictive coders; FDMA; TDMA; Wireless Networking, fixed network transmission hierarchy; traffic routing in wireless networks; wireless data services.

RECOMMENDED BOOKS:

- Theodore & Rapport, by Wireless Communications: Principles & Practices PHI 2nd ed.-2001
- William Stallng, Wireless Communications & Networks: PHI 1st Edn.
- Andreas F. Molisch, Wireless Communications, 2nd Edition

E-04 ADVANCE DIGITAL SIGNAL PROCESSING:

Review of fourier transform, Z- transform, discrete fourier transform, first fourier transform, Modeling of Filters, Minimum delay property spectral factorization theorem. Linear Estimation, Linear Prediction, Auto representative model, Analysis and synthesis of lattice filters, Spectrum Estimation, Adaptive Filter, Adaptive implementation of Wiener filter, Adaptive linear combiner, Adaptive FIR Wiener filter, Adaptive Channel equalizer, Adaptive echo cancellers, Adaptive noise canceling, Adaptive linear prediction.

RECOMMENDED BOOKS:

- Sphoclas J Orfanidis, Optimum Signal Processing, McGraw Hill, 1990
- J.G. Proakis, C.M. Rader, F. Ling and C.L. Nikis, Advanced Digital Signal Processing Maxwell Macmillan International Edition, 1992.
- J.V. Candy, Signal Processing, McGraw Hill, New York, 1986.
- B. Mulgrew and Colin F.N. Cowan, Adaptive Filters & Equalisers, Kuluwer Academic Publishers, Boston, 1998

ELECTIVE PAPERS 2

E-01 OPTICAL FIBER COMMUNICATION

Introduction to EM theory, wave propagation in conductors & Dielectrics, boundary conditions.

Optical fibers: Dielectric slab waveguides, optical fiber structures, optical fiber modes & configurations, mode theory for circular waveguides, single mode fibers, manufacturing of optical fibers & cables.

Signal degradation in optical fibers: Attenuation, dispersion-intramodal & intermodal, Design optimization of SM fibers.

Optical Sources: Light Emitting diodes, Laser diodes, reliability consideration, Materials, performance parameters and specifications.

Power Launching and Coupling: Source to fiber power launching, Lensing schemes for coupling improvement, Fiber to Fiber joints, LED coupling to single mode fibers, fiber splicing, optical fiber connectors.

Photodetector: Physical principles of photodiode- PIN, APD performance parameters and specifications.

Optical phenomena: Wave propagation in isotropic media, in crystals, Birefringence, Linear & quadratic Electro- Optic effect, Acousto-optic effect, Magneto-Optic devices, nonlinear optics.

Integrated Optics: Optoelectronic Integrated Circuits, Application of OEITCTS, Materials for optics, Integrated transmitters & Receivers, guided wave devices.

Optical Fiber Sensors: Multimode passive, Multimode active, single mode fiber sensors.

RECOMMENDED BOOKS:

- **Gerd Keiser (McGraw Hill)**, Optical Fiber Communication
- **John Gowar (PHI 1993)**, Optical Communications System
- **Pallale Bhattacharya**, Semiconductor Optoelectronic Devices. Prentic Hal of India (EEE), 1995 Edition:
- **J.wilson-J.F.B. Hawkes** “ Opto Electronics, an Introduction”

E-02 ELECTRONIC SYSTEM PACKAGING:

Electronic systems and needs, physical integration of circuits, packages, boards and complete electronic systems; system applications like computer, automobile, medical and consumer electronics with case studies and packaging levels. Electrical design considerations – power distribution, signal integrity, RF package design and Power delivery in systems. CAD for Printed Wiring Boards (PWBs) and Design for Manufacturability (DFM). PWB Technologies, Single-chip (SCM) and Multi-chip modules (MCM), flex circuits. Recent trends in manufacturing like microvias, sequential build-up circuits and high-density interconnect structures. Materials and processes in electronics packaging, joining methods in electronics; lead-free solders. Surface Mount Technology– design, fabrication and assembly. Embedded passive components; thermal management of PWBs, thermo-mechanical reliability, design for reliability, electrical test and green packaging issues.

RECOMMENDED BOOKS:

- **Rao R. Tummala**, Fundamentals of Microsystems Packaging, McGraw Hill, NY, 2001.
- **Brown, W.D.**, Advanced Electronic Packaging, IEEE Press, 1999.
- **Charles Harper**, Electronic Packaging and Interconnection Handbook 4/E 4th Edition
- **Prof. G.V. Mahesh**, An Introduction to Electronics Systems Packaging.

E-03 DESIGN OF CONTROL FOR RENEWABLE ENERGY SYSTEM OPTIMIZATION:

Introduction, fundamentals of automatic control, automatic control principle, design aspects of proportional, integral, derivative and PID controllers and their tuning. Advance control techniques: batch, cascade, ratio, feed forward, adaptive and their applications to industry. Design aspects of digital control system. Case study on process control systems i.e. sugar, fertilizer, steel, power and chemical industries.

RECOMMENDED BOOKS:

- **Donald P. Eckman**, “Automatic Process Control”, Willey Eastern Ltd.
- **E.A. Parr**, “Industrial Control Handbook” - BSP Professional Books.
- **Bela. G. Liptak**, “Instrument Engineers Handbook - IIIrd Edition” : Chilton book company.
- **Patranabis**, Automatic Process Control
- **F.G. Shinskey**: Process Control System, MC Graw Hill.

E-04 EMBEDDED IOT SYSTEM DESIGN:

Rise of embedded systems and their transition to intelligent systems and to Internet of Things - RFIDs, NFC, Web of Things - Network of interconnected and collaborating objects. Embedded systems architecture: Key hardware and software elements, typical embedded processors like ATOM. Low power and very low power embedded systems, peripherals and sensors in embedded systems, peripheral interfacing - SPI and I2C, Hardware and software protocol stacks - MAC, Routing and application layers, performance considerations. Embedded Systems Design: Partitioning to hardware and software; principles of co-design; performance of these systems estimation of speed, throughput, power and energy consumption; hardware design elements design, validation, and testing tools; software platforms OS and applications, code optimization, validation and robust code generation; system integration, debugging and test methodology; tools for coding, debugging, optimization, and documentation; measurement of system performance, Linux distributions for embedded systems using tools from Yocto project; Creating virtual prototypes - hardware software emulation. Applications: Healthcare and home automation examples.

RECOMMENDED BOOKS:

- **Barry, P., and Crowley, P.**, Modern Embedded Computing, Morgan Kaufmann, 2012
- **Wolf, M.**, Computers as components Third edition, Morgan Kaufmann, 2012
- **Adrian McEwen, Hakim Cassimally**, Designing the Internet of Things, 8 Nov 2013
- **Cuno Pfister**, Getting Started with the Internet of Things, 17 May 2011