NOTIFICATION

No. 202/2023 Dated : 23/11/2023

Subject : Implementation of new syllabus of Semester I to IV of the Course M.E. (Digital Electronics) as per CBCS Pattern from the Session 2023-2024 onwards.

It is notified for general information of all concerned that the authorities of the University have accepted to implement the new syllabus of Semester I to IV of the Course M.E. (Digital Electronics) in the Faculty of Science & Technology as per CBCS Pattern from the Session 2023-2024 onwards as mentioned below:

Sd/-
(Dr.T.R.Deshmukh)
Registrar

Syllabus prescribed for Two Year Post Graduate Degree Program in Master of Engineering
Branch: DIGITAL ELECTRONICS
Semester Pattern (Choice Based Credit Grade System)

SEMESTER I

1UMEF1 ADVANCED DIGITAL SIGNAL PROCESSING Maximum Marks: 80

Course Objectives:

1. To understand the basic concepts of signals.
2. To understand theory of different filters and algorithms.
3. To understand theory of multirate DSP, solve numerical problems and write algorithms
4. To know applications of DSP at block level.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Apply the fundamental concept of DSP and perform various operations on discrete signals.
2. Design digital filters.
3. Describe Multi-rate DSP and its applications.
4. Elaborate LMS & RMS algorithm.
5. Explain 2D transform and its application.
6. Describe DSP processor & its applications in signal processing.

	ADVANCED DIGITAL SIGNAL PROCESSING	L
Unit I	**Overview of discrete time signal and systems**: Convolution, correlation, Time bandwidth relationship, Different transforms and their properties, use of DFT in linear filtering, filtering of long data sequences, Algorithm for convolution and DIT-FFT and DIF-FFT algorithm.	06
Unit II	**Filter Design :** Analog filter design, Discrete time IIR filter from analog filter, IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives, HPF, BPF, BRF filter design using frequency translation, Structures of FIR, Linear phase, FIR filter, Filter design using windowing techniques and Frequency sampling techniques. Implementation of Filter using filter structure	06
Unit III	**Introduction to Multi-rate Digital Signal Processing**: Sample rate reduction, decimation by integer factors-sampling rate increase, interpolation by integer facto, Design of practical sampling rate converters, Filter Specification- filter requirement for individual stages, Determining the number of stages and decimation factors, Sampling rate conversion using poly-phase filter structure, poly-phase implementation of interpreters.	06
Unit IV	**Adaptive Signal Processing :** Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm	06
Unit V	**Introduction to two dimensional signal and Systems:2D,** Discrete Fourier Transforms, Properties and applications, Discrete Hilbert Transform and Discrete Cosine Transform, Properties and Applications, Short term Fourier Transform, Gabor Transform, Properties and Applications.	06
Unit VI	**General and special purpose DSP Processors**: Computer architecture for signal processing, Harvard Architecture, Pipelining, Hardware Multiply and Accumulate, Special Instructions, Replication, On-chip Memory Cache, Extended Parallelism, SIMD, Architecture and programming of TMS320 C67XX, Application of DSP to biomedical Signal Processing.	06
	Total	**36**

Text Books:

1. "Digital Signal Processing":Principles, Algorithms & Applications", John G. Proakis & Dimitris G.Manolakis, Fourth Pearson education / Prentice Hall, 2007.
2. "Digital Signal Processing – A Computer Based Approach", Sanjit K. Mitra, Tata McGraw Hill, Third Edition, 2007 .

References:

1. "Digital Signal Processing" Emmanuel C Ifeachor, Barrie W Jrevis, Pearson Education.
2. "Theory and Applications of DSP", L.R Rabiner and B. Gold
3. "Electronic Filter Design", Hand Book A .B Williams and FT Taylor, McGraw Hill
4. "Analog Devices & Texas Instruments", Users Manuel of TMS320C4X and ADSP 2106x.
5. "Discrete Time Signal Processing", Alan V. Oppenheim, Ronald W. Jchafer & Hohn. R. Back, PHI / Pearson Education, Second Edition, 2001.
6. "Digital Signal Processing", Andreas Antoniou, Tata Mc-Graw Hill.
7. "Digital Signal Processing using Matlab and wavelets", Michael weeks Infinity Science Press edition, Pearson education / Prentice Hall, 2007.

Lab-Based on the syllabus of Advanced Digital signal Processing

1UMEF2 ADVANCED MICROCONTROLLER Maximum Marks: 80

Course Objectives: This Course Will Provide an Opportunity To The Students

1) To Learn ARM Architecture, Instruction Set and Programming

2) ARM is very popular for portable applications because of its high performance with low power consumption. Students will learn architecture, assembly language and C programming.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Differentiate between ARM processor family
2. Understand pipeline structure
3. Perform programmed based on assembly language of ARM processor.
4. Perform programmed based on C language for different peripherals of ARM processor.
5. Understand different memory management technique & Protection
6. Apply peripherals of ARM to various application

	Subject:-**Advanced Microcontroller**	L
Unit I	**ARM Introduction:-**,ISA's and ARM, Difference between RISC and CISC, RISC Design philosophy, ARM Design Philosophy, History of ARM microprocessor, ARM processor family, Embedded System Software and Hardware	06
Unit II	**ARM Architecture and pipeline structure:-** The Acorn RISC Machine, ARM Core data flow model, Architectural inheritance, The ARM7TDMI programmer's model: General purpose registers, CPSR, SPSR, ARM memory map, data format, load and store architecture, ARM 3 stage Pipeline, ARM 5 stage Pipeline, Pipeline Hazards, Data forwarding - a hardware solution, Stack implementation in ARM, Endianness, condition codes. Processor core Vs CPU core, ARM7TDMI Interface signal.	06
Unit III	**ARM7TDMI assembly language instructions and programming**:- Vector performance modeling, SIMD,Computer Organization, Static Vs Dynamic network, Parallel Algorithms for Array Processors ,	06
Unit IV	**Embedded C Programming for ARM:-** ARM Development Environment Embedded Software, Overview of C compiler and optimization, Basic C data types, C Looping structures, Register allocations, function calls, pointer aliasing, structure arrangement, bit-fields, unaligned data and Endianness, Division, floating point, Inline functions and inline assembly, Portability issues. C programs for General purpose I/O, general purpose timer, PWM Modulator.	06
Unit V	**Cache and Memory Management and Protection**: Memory Technologies, Need for memory Hierarchy, Hierarchical Memory Organization, Virtual Memory. Cache Memory, Mapping Functions. Cache Design, Unified or split cache, multiple level of caches, ARM cache features, coprocessor 15 for system control. Processes, Memory Map, Protected Systems, ARM systems with MPU, memory Protection Unit (MPU). Physical Vs Virtual Memory, Paging, Segmentation. MMU Advantage, virtual memory translation, Multitasking with MMU, MMU organization, Tightly coupled Memory (TCM).	06
Unit VI	**ARM Peripherals and versions:** AMBA Overview, Typical AMBA Based Microcontroller, AHB bus features, AHB Bus transfers, APB bus transfers, APB bridge. Overview of ARM Versions: ARMv5, ARMv6, ARM v7 (Cortex family R: Real time A: Application and M: Microcontroller), ARM big.LITTLE® Technology, ARMv8.	06
	Total	**36**

Text Book: ARM Assembly Language Programming & Architecture By. Muhammad Ali Mazidi, Kindle edition
References: 1. Arm System-on-chip Architecture, 2nd Edition, Steve Furber, Pearson publication 2. Arm Assembly Language, Fundamentals and Techniques, 2nd edition, William Hohl, Christppher Hinds, CRC Press.

Name of Subject (PR): Lab based on the syllabus of Advanced Microcontroller

1UMEF3 Program Specific Elective I-(i) ADVANCED COMPUTER ARCHITECTURE Max. Marks: 80

Course Objective: 1) To understand the advance hardware and software issues of computer architecture 2) To understand multi-processor memory management 3) To understand and appreciate architectural designs in past and present of computer system. 4) To gain experience in analyzing/solving architectural design problems.
Course Outcomes: After successfully completing the course, the students will be able to: 1) To make students know about the Parallelism & Design Challenge. 2) To give the students an elaborate idea about the different memory systems and buses. 3) To introduce the advanced processor architectures to the students. 4) Study And Analyze The High Performance Scalable Multithreaded And Multiprocessor 5) To study about data flow computer architectures 6) To understand parallel algorithm & different memory system

	Subject: Advanced Computer Architecture	L
Unit-I	**Parallel Processing & Computer Models :-** Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Multiprocessors and Multicomputer Shared –Memory Multiprocessors, Distributed Memory Multiprocessors, A Taxonomy of MIMD Computers, Multi vector and SIMD computers	06
Unit-II	**Pipeline Architecture and superscalar techniques**: Principles and implementation of Pipelining, Classification of pipelining, processors, Design aspect of Arithmetic and Instruction pipelining, Data buffering techniques, Multifunctional arithmetic pipeline, static arithmetic pipeline .	06
Unit III	**Unit 3 : Vector and Array Processor**:- Vector performance modeling, SIMD, Computer Organization, Static Vs Dynamic network, Parallel Algorithms for Array Processors ,	06
Unit-IV	**Scalable multiprocessors:-** Scalability,: bandwidth scaling, latency scaling, cost scaling, physical scaling, realizing programming models, Physical DMA; Cache coherency and bus snooping	06
Unit-V	**Multithreaded Architecture**: Multithreaded processors, Principles of multithreading, Issues and solutions, Parallel Programming Techniques: Message passing program	06
Unit-VI	**Parallel algorithms for multiprocessors:** Classification and performance of parallel algorithms, operating systems for multiprocessors systems, Message passing libraries for parallel programming interface, PVM (in distributed memory system), Message Passing Interfaces (MPI).	06
	Total	**36**

Text Books: 1. "Computer Architecture A Quantitative Approach ,Hennessey and Patterson 4th Edition, Elsevier, 2007 2. "Advanced Computer Architecture Parallelism, Scalability, Programmability, Kai Hwang Tata -McGraw Hill 2003.
References: 1.Computer architecture & organization , John P Hayes 1998 2. Parallel computers ,V rajaramanna , c s r murthy phi 2000.

1UMEF3 Program Specific Elective I (ii) ADVANCED OPTICAL COMMUNICATION Max. Marks: 80

Course Objective:

This course focus on-

1. Describe and analyze different optical fiber based systems and networks.
2. Explain network management aspects
3. Understand different optical fiber based systems and networks.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Understand fiber modes, configuration and structure
2. Analyze WDM optical network
3. Understand Wavelength Convertible Networks
4. Design Virtual Topology
5. Explain network management aspects.
6. Understand different optical fiber based systems and networks.

	Subject: Advanced Optical Communication	L
Unit-I	**Introduction**: Light propagation in wave guides, Basic optical laws and definitions, Optical fiber modes and configurations, Step index fibers, Graded index fibers, numerical aperture, Cutoff wavelength, fiber material, fiber fabrication	06
Unit-II	**WDM optical networks:** WDM networks architectures, issues in wavelength routed networks, Wavelength routing algorithms: Introduction, Classification of RWA algorithms, RWA algorithms, fairness and admission control, distributed control protocols, Homodyne of Heterodyne receiver derivation, BER, Q factor	06
Unit-III	**Wavelength Convertible Networks:** Need for wavelength conversion, wavelength convertible node architectures, converter placement and allocation problems, Wavelength rerouting algorithms, Benefits of wavelength rerouting-issues in wavelength rerouting, light path migration, rerouting schemes, rerouting in networks with sparse wavelength conversion, rerouting in multifiber networks.	06
Unit-IV	**Virtual Topology Design**: Virtual topology design problems, virtual topology design heuristics, need for virtual topology design reconfiguration, Optical multicasting: Introduction to multicast routing multicasting node architectures, multicast tree generation-source based tree generation-Steiner tree based generation H.264/65 for colour channel transmission, comparison of AWGN with optical channel.	06
Unit-V	**Control and Management:** Network management functions, management frame work and protocols, configuration management and adaptation management, Network survivability: failures and recovery, protection in SONET, benefits of optical layer protection-restoration schemes in WDM networks-multiplexing schemes-Traffic grooming in WDM, SONET/SDH.	06
Unit-VI	**Optical Burst Switching OBS Node Architecture**: Burst switching protocols, wavelength channel scheduling, Optical packet switching and access networks: Introduction, optical packet switching node architecture, contention resolution protocols, Enhanced HFCFTTC, PON architectures.	06
	Total	**36**

Text Books:

1. Gerd Kaiser, "Optical fiber Communication Systems", John Wiley, New York, 1997.
2. J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 1994.
3. Rajiv Ramswami and K. N. Sivarajan, "Optical Networks", Morgon Kauffman Publishers, 2000.

References:

1. P. E. Green, "Optical Networks", Prentice Hall, 1994
2. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.

1UMEF3 Prog. Specific Elect. I (iii) WIRELESS SENSOR NETWORKS & APPLICATIONS Max. Marks: 80

Course Objective:

1. To get the knowledge of wireless sensor network system for different applications.
2. To understand the hardware details of different types of sensors.
3. To get basic idea about radio standards and communication protocols to be used for wireless sensor network
4. To understand which type of operating systems and programming language used for wireless sensor nodes.
5. To understand performance of wireless sensor networks systems and platforms.

Course Outcomes:
After successfully completing the course, the students will be able to:

1. Identify wireless sensor network system for different applications under consideration.
2. Choose proper hardware for different types of sensors.
3. Choose proper programming tools for wireless sensor networks.
4. Implement the network protocol.
5. Utilize data storage & management system.
6. Identify technologies in wireless sensor.

	Subject: Wireless Sensor Networks & Applications	L
Unit-I	Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.	06
Unit-II	**Hardware:** Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS	06
Unit-III	**Programming tools:** C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet).	06
Unit-IV	**Overview of sensor network protocols (details of at least 2 important protocol per layer):** Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.	06
Unit-V	**Data dissemination and processing:** differences compared with other database management systems, data storage; query processing.	06
Unit-VI	**Specialized features:** Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.	06
	Total	36

References:

1. H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley& Sons, India, 2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1st Indian reprint, 2010.
3. F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.
4. YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.

1UMEF4 **Program Specific Elective II (i) DIGITAL COMMUNICATION TECHNIQUES** Max. Marks: 80

Course Objective:
1. To understand various signal space representation and types of modulation.
2. To learn source coding and channel coding.
3. To understand design of band limited signal for zero and controlled ISI.
4. To know various Spread Spectrum Techniques.

Course Outcomes:
After successfully completing the course, the students will be able to:
1. Understand signal space representation and modulation.
2. Learn coding of discrete and analog sources.
3. Apply and use channel coding and various codes.
4. Design band limited signal for zero and controlled ISI.
5. Understand Linear Equalization Techniques.
6. Differentiate various Spread Spectrum Techniques.

	PSE (Elective-II) Digital Communication Techniques	L
Unit-I	Characterization of Communication Signal and Optimum Receiver for AWGN Channel: Signal Space representation, Memory less Modulation methods, Linear and Non linear Modulation with memory, CPFSK & CPM, Power Spectra of Linear Modulated signal, Power Spectra of CPFSK & CPM Signals, Correlation Demodulator, Match Filter Demodulator, Optimum Detector, Probability of Error for Binary signals	6
Unit-II	Source Coding: Average mutual information & Entropy, Coding of discrete memory-less sources, Discrete Stationary Sources, Lempel-Ziv algorithm; Coding of analog sources, Rate distortion function, Scalar Quantization & Vector Quantization	6
Unit-III	Channel Coding: Temporal and Spectral Waveform Coding, BCH codes, Reed Solomon codes, Reed Muller Codes, Convolution Codes, Transfer function of convolution codes, Viterbi decoding algorithm, stack algorithm(No problems expected), trellis coded modulation.	6
Unit-IV	Signal Design for Band Limited Channel: Design of band limited signal for zero ISI, Nyquist Criterion, Design of band limited signal for controlled ISI, partial response signalling, Data detection for controlled ISI	6
Unit-V	Linear Equalization Techniques : Peak Distortion Criterion, Mean Square Error (MSE) criterion, Decision Feedback Equalization, Coefficient Optimization, Adaptive Linear Equalizer, Zero Forcing Algorithm, LMS Algorithm.	6
Unit-VI	Spread Spectrum Techniques: Generation of PN sequence, direct sequence spread spectrum system, processing gain, jamming margin, application of direct sequence spread spectrum signal, frequency hopped spread spectrum signal, time hopping spread spectrum signal, synchronization of spread spectrum signal – acquisition & tracking.	6
	Total	**36**

Text Books:

1. "Digital Communication Fundamentals and Applications", Bernard Sklar, 2nd Ed, Pearson Education Asia
2. "Digital Communication", J.G. Proakis, Fourth Ed, Mc Graw Hill
3. “Error Control Coding: Fundamentals & Applications”, Shu Lin & Costell , Addison Wessley Pub.

References:

1. "Digital Communication Techniques", Simon Haykin, John Wiley & Sons.
2. "Advanced Digital Communication System and Signal Processing Techniques", Dr. Kemilo Feher Prentice Hall International.
3. .K S Shanmugan; “ Digital & Analog Communication System” John Wiley & Sons

1UMEF4 Program Specific Elective (ii) DIGITAL DESIGN AND VERIFICATION Max. Marks: 80

Course Objective:

1. To understand concept of Combinational Circuits and Sequential Circuits.
2. To learn VHDL and Verilog for Digital System design.
3. To understand current challenges in Physical designing.
4. To get familiar with Programmable Logic Devices.

Course Outcome:

At the end of this course, students will be able to:

1. Differentiate between Combinational Circuits and Sequential Circuits.
2. Apply the VHDL and Verilog code to design Combinational and Sequential circuits.
3. Connect the test bench waveforms and design.
4. Understand current challenges in physical design flow and roots of challenges.
5. Compare operation of various Programmable Logic Devices
6. Perform testing and verification of logic circuits.

	PSE (Elective II) Digital Design and Verification	L
Unit-I	Revision of basic Digital systems: Combinational Circuits, Sequential Circuits, Logic families. Synchronous FSM and asynchronous design, Metastability, Clock distribution and issues, basic building blocks like PWM module, pre-fetch unit, programmable counter, FIFO, Booth's multiplier, ALU, Barrel shifter etc.	6

Unit-II	Verilog/VHDL Comparisons and Guidelines, Verilog: HDL fundamentals, simulation, and testbench design, Examples of Verilog codes for combinational and sequential logic, Verilog AMS	6
Unit-III	System Verilog and Verification: Verification guidelines, Data types, procedural statements and routines, connecting the test bench and design, Assertions, Basic OOP concepts, Randomization, Introduction to basic scripting language: Perl, Tcl/Tk	6
Unit-IV	Current challenges in physical design: Roots of challenges, Delays: Wire load models Generic PD flow, Challenges in PD flow at different steps, SI Challenge - Noise & Crosstalk, IR Drop, Process effects: Process Antenna Effect &Electro-migration	6
Unit-V	Programmable Logic Devices: Introduction, Evolution: PROM, PLA, PAL, Architecture of PAL's, Applications, Programming PLD's, FPGA with technology: Antifuse, SRAM, EPROM, MUX, FPGA structures, and ASIC Design Flows, Programmable Interconnections, Coarse grained reconfigurable devices	6
Unit-VI	IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, and Use of external hard IP during prototyping, Case studies, and Speed issues. Testing of logic circuits: Fault models, BIST, JTAG interface	6
	Total	**36**

References:

1. Douglas Smith, “HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog”, Doone publications, 1998.
2. Samir Palnitkar, “Verilog HDL: A guide to Digital Design and Synthesis”, Prentice Hall, 2nd Edition, 2003.
3. Doug Amos, Austin Lesea, Rene Richter, “FPGA based Prototyping Methodology Manual”, Synopsys Press, 2011.
4. Christophe Bobda, “Introduction to Reconfigurable Computing, Architectures, Algorithms and Applications”, Springer, 2007.
5. Janick Bergeron, “Writing Testbenches: Functional Verification of HDL Models”, Second Edition, Springer, 2003.

1UMEF4 Prog. Specific Elect. II (iii) WIRELESS AND MOBILE COMMUNICATION Max. Marks: 80

Course Objective:

This course focus on-

1. Understand cellular concept to improve capacity of the system.
2. Study different types of Equalizers and Diversity techniques
3. Understand latest trends in wireless technologies, a path towards 5G

Course Outcomes:

After successfully completing the course, the students will be able to

1. Design appropriate mobile communication systems
2. Understand Wireless Communication System
3. Understand mobile radio propagation model
4. Distinguish various multiple-access techniques for mobile communications
5. Explain different types of Equalizers and Diversity techniques
6. Understand upcoming Higher Generation Cellular Standards.

	Subject: Wireless and Mobile Communication	L
Unit-I	Cellular System design fundamentals: Cellular Networks and Standards, Cell structure, frequency reuse, cell splitting and sectoring, Channel assignment, concept of handoff, handoff strategies, Interference (both Adjacent Channel and Co-Channel) and system capacity, power control mechanisms, Frequency management and channel assignment.	06
Unit-II	Wireless Communication System :GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE	06
Unit-III	Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings, Small Scale Fading and Multipath Propagation, Types of Small Scale Fading: Time Delay Spread, Flat, Frequency selective, Doppler Spread, Fast and Slow fading.	06

Unit-IV	Multiple Access techniques: Introduction to CDMA technology, TDMA, FDMA ,CDMA ,SDMA, OFDM techniques Comparison, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff.	06
Unit-V	Receiver Structure: selection and MRC receivers, RAKE receiver, Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.	06
Unit-VI	Higher Generation Cellular Standards: evolution of LTE technology to beyond 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, 5G Architecture and working principle.	06
	Total	**36**

Text Books:

1. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002.
2. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
3.Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London,1997
4. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
5. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.

References:

1. D. Tse and P. Viswanath, Fundamentals of Wireless Communication, Cambridge Univ. Press, 2005.
2. A. Goldsmith, Wireless Communications, Cambridge Univ. Press, 2005.
3. A. Kumar, D. Manjunath, and J. Kuri, Wireless Networking, Morgan Kaufmann, 2008.
4. Jonathan Rodriguez, - Fundamentals of 5G mobile networks, John Wiley & Sons, Ltd, 2015.

1UMEF7 RESEARCH METHODOLOGY AND IPR Max. Marks: 50

Course Objective:

1. To understand the research ethics.
2. Learn how to properly formulate the research problem.
3. Learn how to write research proposal.
4. Understand the Patent Rights and new development in IPR.

Course Outcomes:

After successful completion of the course, the student will be able to

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Unit	Subject: Research Methodology and IPR	L
I	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	4
II	Effective literature studies approaches, analysis Plagiarism, and Research ethics.	4
III	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	4
IV	**Nature of Intellectual Property:** Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. **International Scenario:** International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	4

V	**Patent Rights:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	4
VI	**New Developments in IPR:** Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	4
	Total:	**24**

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step-by-Step Guide for beginners".
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

1UMEF8 AUDIT COURSE - 1 (i) CONSTITUTION OF INDIA

Course Objective:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.
4. Understand the role, importance and functioning of Local Administration and Election Commission.

Course Outcomes:

After successful completion of this course, students will be able to

1. Interpret and discuss the salient features of Indian Constitution.
2. Implement the Constitutional Rights & Duties.
3. Identify the Organs of Governance.
4. Demonstrate the functions of local administrations for development of society and to evaluate the welfare measures for SC/ST/OBC and women.

Unit	Subject: Constitution of India	L
I	**History of Making of the Indian Constitution:** History, Drafting Committee (Composition & Working). **Philosophy of the Indian Constitution:** Preamble, Salient Features.	6
II	**Contours of Constitutional Rights & Duties:** • Fundamental Rights • Right to Equality • Right to Freedom • Right against Exploitation • Right to Freedom of Religion • Cultural and Educational Rights • Right to Constitutional Remedies • Directive Principles of State Policy • Fundamental Duties.	6
III	**Organs of Governance:** • Parliament • Composition • Qualifications and Disqualifications • Powers and Functions • Executive • President • Governor • Council of Ministers • Judiciary, Appointment and Transfer of Judges, Qualifications • Powers and Functions	6

IV	**Local Administration:** • District's Administration head: Role and Importance • Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. • Pachayati raj: Introduction, PRI: Zila Pachayat. • Elected officials and their roles, CEO Zila Pachayat: Position and role. • Block level: Organizational Hierarchy (Different departments). • Village level: Role of Elected and Appointed officials. • Importance of grass root democracy. **Election Commission:** • Election Commission: Role and Functioning. • Chief Election Commissioner and Election Commissioners. • State Election Commission: Role and Functioning. • Institute and Bodies for the welfare of SC/ST/OBC and women.	6
	Total:	**24**

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

1UMEF8 AUDIT COURSE - 1 (ii) VALUE EDUCATION

Course Objectives:

1. Understand value of education and self- development
2. Cultivate good values in students
3. Develop character and personality

Course Outcomes:

Students will be able to

1. Understand role of values in self-development
2. Learn the importance of cultivation of values
3. Develop the overall personality
4. Develop character and Competence

	Subject **VALUE EDUCATION**	L
Unit –I	**Values and self-development-**Value and value education, positive and normative dichotomy of values, Social values and individual attitudes, Work ethics, Value judgements	6
Unit-II	**Importance of cultivation of values**-Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature ,Discipline, Role of parents, Teacher's society, Peer groups religion, Government ,Mass media in cultivation of values.	6
Unit-III	**Personality and Behavior Development**-Soul and Scientific attitude, Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Doing best for saving nature.	6
Unit-IV	**Character and Competence-**Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence, Humility, All religions and same message, Mind your Mind, Self-control, Honesty.	6
	Total	**24**

Text Books:

1.Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

References:

1.Wadsworth Morgan, C.T, King, R. A. Weisz, J. R. & Schopler, Introduction to Psychology, 7th ed. Seventh reprint. Tata McGraw-Hill India.
2. Dhankar, Neerja, Value Education. New Delhi: APH Publishing Corporation.
3.
Singh, Yogesh Kumar & Rachika Nat. Value Education. New Delhi: APH Publishing Corporation.

AUDIT COURSE I (iii) PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objective:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination.
3. To awaken wisdom in students

Course Outcomes:

At the end of this course, students will be able to

1. Develop their personality and achieve the highest goal in life
2. Lead the nation and mankind to peace and prosperity by studying Geeta
3. Develop versatile personality through the Study of Neetishatakam.

	Personality Development through Life Enlightenment Skills	L
Unit-I	**Unit 1 :** Neetishatakam -Holistic development of personality • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont's) • Verses- 71,73,75,78 (do's)	06
Unit-II	Approach to day to day work and duties. • Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, • Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, • Chapter 18-Verses 45, 46, 48.	06
Unit-II	Statements of basic knowledge. • Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18	06
Unit-IV	Personality of Role model. • Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39 • Chapter18 – Verses 37,38,63	06
	Total	24

References:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

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SEMESTER - II

2UMEF1 REAL TIME EMBEDDED SYSTEM Max. Marks: 80

Course Objective:

1. To study the concept of Embedded System
2. To understand core of the Embedded System
3. To recognize the importance task scheduling in real time embedded systems.
4. To get acquainted with architecture & design of an Embedded System.

Course Outcomes:

After successfully completing the course, the students will be able to

1. Understand & apply the concept of embedded system, architecture & Interfacing of memories.
2. Write efficient code in C Language & apply the Programming concepts.
3. Interface the different peripheral to microcontroller.
4. Recognize the importance task scheduling in real time embedded systems.
5. Understand the protocol & delay scheduling.
6. Get acquainted with architecture & design of an Embedded System.

	Subject: Real Time Embedded System	L
Unit-I	**Embedded System hardware :** Embedded systems overview, Hardware components like microcontroller, GPP, ASSP, AISP, SOC, Details of 32 bit ARM7 core based SoC architecture, Organization, analog, digital & high speed I/O for embedded systems, interfacing SRAM, DRAM, flash memories with microcontroller, memory management	06
Unit-II	**Embedded System Software :** Techniques of writing efficient C code for microcontroller C data types for ARM, Signed & unsigned data types, limitation of char & char & data types, storage class – static & extern, volatile keyword, operation on bits, functions, ARM / Thumb procedural call standard, pointers & arrays, conditional statements – if else, switch, structure, conditional loops – for & while, preprocessing, compiling, cross compiling, compiler driver, startup code and board support packages, calling assembly routines in C, interrupt handling in C, interrupt latency.	08
Unit-III	**ARM Philips NXP LPC2148 Microcontroller:** Programming & Interfacing: Programming on – chip components like ADC, UART, Timers, External Interrupts and interfacing external peripherals like keyboard, LCD, Stepper motor.	04
Unit-IV	**Uniprocessor Real Time Operating Systems– I:** Real time systems, goals and services, tasks and its states, task assignment & scheduling, Task Control Blocks, Context & Context Switching, ISRs, Security Issues, inter- task communication, semaphore.	06
Unit-V	**Uniprocessor Real Time Operating Systems – II**: Task Scheduling models, scheduling algorithms – rate monotonic and earliest deadline first, priority inheritance protocol, priority ceiling protocol, real time operating system features, and features of micro COS – II RTOS.	06
Unit-VI	**Embedded System Architecture & Design :** Architecture styles, implementation aspects, estimation modeling, embedded system architecture, validation and debugging of embedded systems, hardware – software co design in an embedded system	06
	Total	**36**

Text Books:

1. "Embedded Systems", Rajkamal, 2nd Edi., Tata Mc-Graw Hill.
2. "Embedded Real-time System Programming", Iyer & Gupta, Tata Mc-Graw Hill.

References:

1. "ARM System on Chip Architecture", Furber, 2nd Edi Pearson India.
2. "Introduction to Embedded System", K. V. Shibu, MGH.
3. "Philips NXP LPC 2148" user manual
4. "Scheduling in Real Time Systems", Cottet, Delacroix & Mammeri, John Wiley & Son.
5. "Real Time Systems", Rajib Mall, Pearson, India.

2UMEF5 Real Time Embedded System: Lab-I Based on the syllabus of Real Time Embedded system.

2UMEF2 DIGITAL IMAGE PROCESSING & APPLICATIONS Maximum Marks: 80

Course Objective:

1. To introduce and discuss the fundamental concepts and applications of Digital Image Processing.
2. To discuss various basic operations in Digital Image Processing.
3. To know various transform domains

Course Outcomes:

After successfully completing the course, the students will be able to

1. Explore fundamental concept in Image Processing.
2. Perform various image enhancement operation in spatial and frequency domain.
3. Apply the concept of image transform and its implementation.
4. Examine Image Enhancement in Frequency Domain.
5. Apply various methods for segmenting image and Investigate morphological operations to improve the quality of image.
6. Apply various method of image compression and its application in real world.

	Digital Image Processing & Applications	L
Unit-1	**Image processing fundamental:** Basic image processing Steps, Digital image representation, Image acquisition ,sampling and quantization, basic relationship between pixels, distance measures ,point operations, Human visual system, Image types, zooming operation	06

Unit II	**Image enhancement in spatial domain:** Basic gray level transformations, Histogram processing, Arithmetic and logic operations, spatial domain filtering, bit-plane slicing, median filter, color image processing fundamentals and color models.	06
Unit III	**Image Transforms**: 2D DFT, Walsh transform, Hadamard transform, Slant transform, Discrete transform, KL transform, Radon transform and Multi resolution wavelet transform.	06
Unit IV	**Image enhancement in the frequency domain:** Filtering in frequency domain, Homomorphic filter, Image Restoration and Denoising ,Image degradation models, Types of image blur, image restoration model, linear image restoration, nonlinear image restoration techniques, blind de convolution and classification technique ,image de noising, noise in image	06
Unit V	**Image segmentation:** Detection of discontinuities, edgebased segmentation, edge detection, edge linking, Hough transform, Thresholding, region based segmentation, watershed transformation, shape representation and classification, Morphological techniques, Object & pattern recognition & interpretation method.	06
Unit VI	**Image Compression:** Lossy block truncation & vector quantization ,lossless Huffman coding, run length coding & block coding , transform coding. Image processing standards	06
	Total	**36**

Text Books:

1."Digital Image Processing", R.C Gonzales & Woods –Addison Wesley IIIrd Ed
2."Digital Image Processing", S Jayaraman, S Esakkirajan,T Veerakumar- Tata Mc Graw Hill

References:

1. "Fundamental Digital Image Processing "by A.K.Jain –Prentics Hall Inc.
2. "Digital Image Processing", W.K Pratt IIIrd ed John Wiley
3. "Digital Image Processing and Analysis", B Chanda and D. Mujumdar-PHI new Delhi

2UMEF6 Digital Image Processing & Applications Lab.-II Based on the syllabus of Digital Image Processing & Applications.

2UMEF3 P.S.E. Elective III-(i) PARALLEL PROCESSING Maximum Marks: 80

Course Objective:

It focuse on

1. Analyze the parallelism and identify the conditions of parallelism.
2. Gain in-depth knowledge of advanced processor architecture
3. Learn parallel programming Techniques

Course Outcomes:

The students will be able to:

1. Analyze the parallelism and identify the conditions of parallelism
2. Apply pipelining concept for the performance evaluation
3. Learn the advanced processor architectures for suitable applications
4. Understand Principles of multithreading
5. Explain Parallel Programming Techniques
6. Understand Operating systems for multiprocessors systems

	Subject: Parallel Processing	L
Unit-I	**Overview of Parallel Processing** : Definition, Theory of Parallelism, conditions of parallelism, Software Parallelism, Hardware Parallelism, Performance analysis, Scalability	06
Unit-II	**Principles and implementation of Pipelining**: Linear pipeline Processor synchronous and asynchronous model, nonlinear pipeline processor reservation and latency analysis , Instruction pipeline design, Arithmatic pipeline design	06
Unit III	**VLIW processors:** Superscalar Architecture- Pentium, Intel Itanium Processor, Ultra SPARC ,MIPS on FPGA, Vector and Array Processor, Basic vector architecture, issues in vector processing, vector performance modeling, vectorizers and optimizers, FFT Multiprocessor Architecture	06

Unit IV	**Multithreaded Architecture:** Scalable and Multithreaded Architecture , Latency hiding techniques, shared virtual memory, prefetching techniques, distributed coherent cache ,scalable coherence interface, relaxed memory consistency, Principles of multithreading, , multithreading issues and solutions	06
Unit-V	**Parallel Programming Techniques:** Message passing program development, Synchronous and asynchronous message passing, Shared Memory Programming, Data Parallel Programming, Parallel Software Issues	06
Unit-VI	**Operating systems for multiprocessors systems:** Customizing applications on parallel processing platforms	06
	Total	**36**

Text Books:

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing", MGH International Edition
2. Kai Hwang, "Advanced Computer Architecture", TMH

References:

1. V. Rajaraman, L. Sivaram Murthy, "Parallel Computers", PHI.
2. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition
3. Kai Hwang, Zhiwei Xu, "Scalable Parallel Computing", MGH
4. David Harris and Sarah Harris, "Digital Design and Computer Architecture", Morgan Kaufmann.

2UMEF3 P.S.E. III (ii) **ARTIFICIAL INTELLIGENCE SYSTEM** Maximum Marks: 80

Course Objective:

1. To introduce the concept of Artificial Intelligence, search techniques and knowledge representation issues.
2. To conceptualize reasoning for artificial intelligence.
3. To provide understanding of the fuzzy logic for artificial intelligence.
4. To conceptualize game playing.
5. To provide understanding natural language processing.
6. To conceptualize knowledge Representation Issues

Course Outcomes:

After successfully completing the course, the students will be able to

1. To implement concept of Artificial Intelligence, search techniques and knowledge representation issues.
2. To apply reasoning for artificial intelligence.
3. To implement concept of fuzzy logic for artificial intelligence.
4. To implement the concept of game playing.
5. To implement the concept of natural language processing.
6. Analyze and evaluate the concept of knowledge Representation Issues.

	Artificial Intelligence System	L
Unit-I	What is AI (Artificial Intelligence)? : The AI Problems, The Underlying Assumption, What are AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final WordProblems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means- Ends Analysis.	06
Unit-II	Knowledge Representation Issues: Representations And Mappings, Approaches To Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.	06
Unit III	Symbolic Reasoning Under Uncertainty: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bays' Theorem, Certainty Factors And Rule-Base Systems, Bayesian Networks, DempsterShafer Theory.	06
Unit-IV	Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler Structures: Conceptual Dependency, Scripts, CYC	06

Unit-V	Game Playing: Overview, And Example Domain: Overview, MiniMax, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction	06
Unit-VI	Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking Connectionist Models:Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI.	06
	Total	**36**

References:

1.Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
2.Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2009.

2UMEF3 PSE Elective III (iii) HIGH SPEED DIGITAL SYSTEM DESIGN Maximum Marks: 80

Course Objective:

1. Evaluate impact of trace discontinuities and interconnects on the signal integrity.
2. To study different issues in Interconnect
3. To study Noise minimization techniques
4. To study different High-Speed Measurement Techniques.

Course Outcomes:

1. Apply the concept of Interconnect Design in Ideal Transmission Line
2. Analysis the different issues in Interconnect
3. Apply Digital Timing Analysis
4. Design different Methodologies for Noise Minimization
5. Apply different High-Speed Measurement Techniques
6. Use of Vector Network Analyzer for different measurement

	High Speed Digital System Design	L
Unit- I	The Importance of Interconnect Design, Ideal Transmission Line Fundamentals, Crosstalk, Crosstalk Estimation.	06
Unit-II	Non ideal Interconnect Issues, Concentric-Ring Skin-Effect Model, Connectors, Packages, and Vias	06
Unit-III	Nonideal Return Paths, Simultaneous Switching Noise, Power Delivery	06
Unit-IV	Buffer Modeling, Digital Timing Analysis, Clock Repeaters, Zero-Delay Clock Repeaters, Clock Jitter	06
Unit-V	Design Methodologies, Radiated Emissions Compliance and System Noise Minimization	06
Unit-VI	High-Speed Measurement Techniques, Digital Oscilloscope, Time Domain Reflectometry, Vector Network Analyzer	06
	Total	**36**

Text Books:

1. "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices" Stephen H. Hall Garrett W. Hall, James A. McCall, John Wiley & Sons, Inc.
2. "High-Speed Digital Design: A Handbook of Black Magic" Howard Johnson, Prentice Hall publication

References:

1. "High Speed Signal Propagation: Advanced Black Magic" Howard W. Johnson, Prentice Hall
2. "Signal Integrity Issues and Printed Circuit Board Design" Douglas Brooks, Prentice Hall
3. "Signal Integrity, Simplified" Eric Bogatin, Prentice Hall
4. "Noise Reduction Techniques in Electronic Systems" Henry Ott -John Wiley & Sons.

2UMEF4 PSE Elective-IV-(i) INTERNET OF THINGS AND APPLICATIONS Maximum Marks: 80

Course Objective:

1. To introduce the need and the concept of IOT.
2. To conceptualize the concept of M2M.
3. To provide understanding of IOT architecture.
4. To introduce IOT applications in various fields.
5. To conceptualize the security and privacy issues in IOT.
6. To conceptualize security and privacy Issues.

Course Outcome:

After successfully completing the course, the students will be able to

1. Apply the concept of IOT in various systems.
2. Apply the concept of M2M in various systems.
3. Analyze IOT architecture.
4. Implement IOT applications in various fields.
5. Analyze and evaluate security and privacy issues in IOT.
6. Analyze and evaluate security and privacy Issues.

	Subject: Internet of Things and Applications	L
Unit-I	IoT& Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	06
Unit-II	M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	06
Unit III	IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Introduction, Reference Model and architecture, IoT reference Model, IoT Reference View, Other Relevant architectural views.	06
Unit-IV	IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.	06
Unit-V	Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues	06
Unit-VI	Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security	06
	Total	**36**

References:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1stEdition, Apress Publications, 2013.
3. Cuno Pfister, "Getting Started with the Internet of Things", OReilly Media, 2011.

2UMEF4 PSE Elective- IV(ii) PATTERN RECOGNITION AND MACHINE LEARNING Maximum Marks: 80

Course Objective:

1. To understand the concept of pattern recognition.
2. To design classifier using neural network and SVM.
3. To develop independent machine learning algorithm.
4. To design the unsupervised learning algorithm.

Course Outcomes:

After successful completion of this course, students will be able to

1. Analysis the parametric and linear models for classification.
2. Design neural network for classification.
3. Design SVM for classification.
4. Develop independent machine learning techniques.
5. Develop unsupervised learning techniques.
6. Evaluate & resolve the problems in pattern recognition.

Unit	Subject (TH): Pattern Recognition and Machine Learning	L
I	**Introduction to Pattern Recognition**: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis.	6
II	**Linear models:** Linear Models for Regression, linear regression, logistic regression Linear Models for Classification.	6
III	**Neural Network**: perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving backpropagation, additional networks and training methods, Adaboost, Deep Learning	6
IV	**Linear discriminant functions -** decision surfaces, two-category, multi-category, minimum-squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine.	6
V	**Algorithm independent machine learning** – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers.	6
VI	**Unsupervised learning and clustering –** k-means clustering, fuzzy k-means clustering, hierarchical clustering.	6
	Total:	**36**

References:

1. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.
3. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

2UMEF4 PSE Elective-IV(iii) MODERN ELECTRONICS AND DESIGN SYSTEM Max. Marks: 80

Course Objective:

1. Understand how to design programmable gain amplifier.
2. Learn the design of power regulator, Communication and control system.
3. Understand the Electronic Systems for Aircrafts.
4. Learn the design of Portable Electronic System
5. Develop the layout and grounding of Electronics systems.

Course Outcomes:

After successful completion of this course, students will be able to

1. Design various amplifiers like programmable gain amplifier auto zero amplifier etc.
2. Implement buck boost power regulator.
3. Construct the Electronics navigation systems.
4. Illustrate Electronic Systems for Aircrafts.
5. Explain the portal electronic systems.
6. Design the Layout and grounding for analog and digital systems.

Unit	Subject: Modern Electronics and Design System	L
I	**Amplifiers Design:** Digital isolation techniques, High speed clamping amplifiers, Programmable gain amplifiers, Auto-zero amplifiers, Lock-in amplifiers.	6
II	**Power Regulator Design:** Switch Mode Regulator topologies like buck, boost, buck-boost their control techniques and selection of passive, active and magnetic components for these regulators.	6
III	**Communication and Control System Design:** Electronic navigation systems, Underwater sound systems, Phase lock loop design, Direct digital synthesis.	6
IV	**Electronic Systems for Aircrafts** Radio systems and Autopilot systems in aircraft, Digital engine control and motion control systems for automobiles.	6
V	**Portable Electronic System Design**: Types and characteristics of modern batteries, Portable devices like Mobile TV, VoIP phones, Glucose meter, Pulse Oximetry, Cardio Pulmonary Resuscitation systems, Ultrasound systems, Barcode readers, Payment terminals. Smart battery management systems	6

VI	**Electronic System Design for Production:** Layout and grounding for analog and digital systems, Safety, Testability, Reliability and Thermal management in electronic systems, Quality, reliability, testing and environmental aspects in printed circuit board design, Design of enclosures for electronic products, EMC of electronic products	6
	Total:	36

Text Books:

1. "Linear Circuit Design Handbook", Analog Devices Corporation (Editor: Zumbahlen), Elsevier 2008
2. "Demystifying Switching Power Supplies" Mach, Elsevier, 2005
3. "Circuit Design – Knowit All", Ashby, Baker, Elsevier, 2008
4. "Standard Handbook of Electronics Engineering" Chritiansen & Alexander, 5th ed McGraw Hill, 2008

References:

1. "Digital Frequency Synthesis Demystified", Goldberg, LLH Publishers
2. "Aircraft Digital Electronic and Computer Systems", Tooley, Elsevier 2007
3. "Aircraft Electricity and Electronics", Bent
4. "Battery Operated Devices and Systems", Pistoia, Elsevier, 2008
5. "Understanding Automotive Electronics", 6th ed Ribbens, Elsevier, 2003
6. "Grounding and Shielding Circuits and Interference", 5th ed Morrison, Wiley, 2007
7. "Printed Circuit Boards" Khandpur, McGraw Hill, 2008

2UMEF7 TECHNICAL PAPER WRITING Max. Marks: 50

Course Objective:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

Course Outcomes:

After successfully completing the course, the students will be able to

1. Ensure proper planning and preparation.
2. Learn about what to write in each section.
3. Review of literature
4. Understand the skills needed when writing a Title.
5. Understand that how to improve your writing skills and level of readability.
6. Ensure the good quality of paper at very first-time submission.

Unit	**Subject: Technical Paper Writing**	L
Unit-I	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	04
Unit-II	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, and Introduction**.**	04
Unit-III	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	04
Unit-IV	Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when Writing a Review of the Literature	04
Unit-V	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	04
Unit-VI	Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	04
	Total	**24**

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

2UMEF8 Audit Course II (i) ENGLISH FOR RESEARCH PAPER WRITING

Course Objective:

1. Understand that how to improve your writing skills and level of readability.
2. Learn about what to write in each section.
3. Understand the skills needed when writing a Title.
4. Ensure the good quality of paper at very first-time submission.

Course Outcomes:

After successful completion of this course, students will be able to

1. Demonstrate writing meaningful sentences and coherent paragraphs.
2. Show conciseness, clarity and avoid redundancy in writing.
3. Evaluate and summarize literature and apply methodology and write results and conclusion.
4. Describe how to develop title, write abstract and introduction and apply correct style of referencing and use punctuation appropriately.

Unit	Subject (TH): English for Research Paper Writing	L
I	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	6
II	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	6
III	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.	6
IV	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.	6
	Total:	**24**

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

2UMEF8 Audit Course II (ii) SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives:

1. Get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning.
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.

Course Outcomes:

Students will be able to …..

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood.
3. Being a logical language will help to develop logic in students.
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Unit	Sanskrit for Technical Knowledge	L
Unit-1	alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences	06
Unit-2	order, Introduction of roots, Technical information about Sanskrit Literature.	06
Unit-3	Technical concepts of Engineering-Electrical, Mechanical	06
Unit-4	Technical concepts of Engineering- Architecture, Mathematics	06
	Total	24

References:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha- Vempati Kutumbshastri, Rashtriya Sanskrit
3. Sansthanam, New Delhi Publication

2UMEF8 AUDIT COURSE II (iii) PEDAGOGY STUDIES

Course Objective:

Students will be able to:

1 Review existing evidence on the review topic to inform program design and policy making undertaken by the DfID, other agencies and researchers.

2. Identify critical evidence gaps to guide the development.

Course Outcomes:

1. Able to formulate research problem statement.
2. Utilization of pedagogical practices in formal and informal classrooms used in developing country.
3. Implementation of evidence based effective pedagogical practices and Pedagogic strategies in different scenario.
4. Improve the professional development of students as well as identify the research gap and future directions.

	Pedagogy Studies	L
Unit-1	**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology. Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and searching.	06
Unit-2	**Thematic overview:** Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.	06
Unit-3	**Evidence on the effectiveness of pedagogical practices:** **Methodology for the in-depth stage:** quality assessment of included studies. How can teacher education (curriculum and practicum) and the school, curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.	06
Unit-4	**Professional development: alignment with classroom practices and** **follow-up support :** Peer support , Support from the head teacher and the community, Curriculum and assessment , Barriers to learning: limited resources and large class sizes. **Research gaps and future directions :** Research design, Contexts , Pedagogy Teacher education ,Curriculum and assessment ,Dissemination and research impact	06
	Total	**24**

References:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

SEMESTER-III

3UMEF1 PSE ELECTIVE-V (i) RANDOM PROCESS Maximum Marks: 80

Course Objective:
Students will be able to:

1. Understand the concept of Probability and Random Variables.
2. Learn the Multi-dimensional Random Variables.
3. Explain the Random Processes and Characterization.
4. Explain Power Spectral Density

Course Outcomes:
1. Apply the concept of Probability and Random Variables.
2. Analyze the different types of Standard Distributions
3. Learn the Multi-dimensional Random Variables.
4. Explain the Random Processes and Characterization.
5. Analyze the properties of correlation.
6. Explain Power Spectral Density

Unit		L
Unit-1	Probability and Random Variables:Axioms of probability, Conditional probability, Total probability, Baye's theorem, Concept of random variable, Discrete random variable, Continuous random variable, CDF& PDF, Expectations & Moments, Characteristics functions, Moment generation function.	06
Unit-2	**Standard Distributions**: Binomial, Poisson, Geometric, Negative Binomial, Uniform,Exponential, Gamma, Weibull and Normal distributions and their properties, Functions of a random variable, Central Limit Theorem (CLT), Generation of random numbers.	06
Unit-3	**Multi-dimensional Random Variables:** Joint distribution function, Joint density function, Marginal distribution function, Conditional distribution, Covariance & Covariance matrix, Expectations & Moments, Mean and Variance of weighted sum of Random Variables, Joint Gaussian Random Variables.	06
Unit-4	**Random Processes and Characterization**: Concept of random process, Characterization and Classification, Gaussian Random Processes. Poision Process, Wiener Process, Stationery Process, Introduction to White noise, Random Walks, Brownian motion.	06
Unit-5	**Correlation of Random Processes**: Correlation function, Properties of Auto Correlation function, Relationship between two Random Processes, Properties of Cross Correlation function.	06
Unit-6	**Power Spectral Density (PSD):** - Concept of Power Spectral Density, Properties of PSD, Power Spectral Estimation, Cross Spectral Density, Power Spectrum in Laplace Domain	06
	Total	**36**

References:

"Probabilistic Random Signals and Statistics", X Rong Li, CRC Press

2) "Random Signals and Systems", Bernard Picnicbono, PHI.

3) "A First Course in Probability", Shelabo Ross, Pearson Education.

3UMEF1 PSE ELECTIVE-V (ii) **CLOUD COMPUTING** Maximum Marks: 80

Course Objectives:
1. To understand cloud computing concepts;
2. To study various platforms for cloud computing
3. To explore the applications based on cloud computing

Course Outcomes:

On completion of the course, student will be able

1. To install cloud computing environments.
2. To develop any one type of cloud
3. To handle the virtualization Tools and Mechanisms
4. To understand the cloud requirement in other domain
5. Implement and interlink with cloud with IoT
6. To explore future trends of cloud computing

		L
Unit-1	**Basics of Cloud Computing:** Overview, Applications, Intranets and the Cloud. Your Organization and Cloud Computing- Benefits, Limitations, Security Concerns. Software as a Service (SaaS)- Understanding the Multitenant Nature of SaaS Solutions, Understanding SOA. Platform as a Service (PaaS)-IT Evolution Leading to the Cloud, Benefits of Paas Solutions, Disadvantages of PaaS Solutions. Infrastructure as a Service (IaaS)-Understanding IaaS, Improving Performance through Load Balancing, System and Storage Redundancy, Utilizing Cloud-Based NAS Devices, Advantages, Server Types. Identity as a Service (IDaaS).	06
Unit-2	**Data Storage and Security in Cloud:** Cloud file systems: GFS and HDFS, Big Table, HBase and Dynamo Cloud data stores: Data store and Simple DB Gautam Shrauf, Cloud Storage-Overview, Cloud Storage Providers. [Anthony T. Velte]3 Securing the Cloud-General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery- Understanding the Threats.	06
Unit-3	**Virtualization:** Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation. Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP), Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security.	06
Unit-4	**Amazon Web Services:** Services offered by Amazon Hands-on Amazon, EC2 - Configuring a server, Virtual Amazon Cloud, AWS Storage and Content Delivery Identify key AWS storage options Describe Amazon EBS Creating an Elastic Block Store Volume Adding an EBS Volume to an Instance Snap shotting an EBS Volume and Increasing Performance Create an Amazon S3 bucket and manage associated objects. AWS Load Balancing Service Introduction Elastic Load Balancer Creating and Verifying Elastic Load Balancer.	06
Unit-5	**Ubiquitous Clouds and the Internet of Things:** Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking.	06
Unit-6	**Future of Cloud Computing:** How the Cloud Will Change Operating Systems, Location-Aware Applications, Intelligent Fabrics, Paints, and More, The Future of Cloud TV, Future of Cloud-Based Smart Devices, Faster Time to Market for Software Applications, Home-Based Cloud Computing, Mobile Cloud, Autonomic Cloud Engine, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing. Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow.	06
	Total	**36**

Text Books:

1. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, 2010, The McGraw-Hill.
2. Dr. Kris Jamsa, “ Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more” , Wiley Publications, ISBN: 978-0-470-97389-9
3. 3. Gautam Shrof, “ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications, Cambridge University Press, ISBN: 9780511778476

References:

1. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication, ISBN10: 8126536039
2. Buyya, “Mastering Cloud Computing”, Tata McGraw Hill, ISBN-13: 978-1-25-902995-0,
3. Barrie Sosinsky,"Cloud Computing", Wiley India, ISBN: 978-0-470-90356-8
4. Kailash Jayaswal, “Cloud computing", Black Book, Dreamtech Press
5. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, “Cloud Computing: Concepts, Technology and Architecture”, Pearson, 1st Edition, ISBN :978 9332535923, 9332535922
6. Tim Mather, Subra K, Shahid L.,Cloud Security and Privacy, Oreilly, ISBN-13 978-81-8404- 815-5

3UMEF1 PSE ELECTIVE-V (iii) DATA COMPRESSION Maximum Marks: 80

Course Objectives:

1. To understand different data compression techniques.
2. To learn Arithmetic coding and Adaptive Arithmetic coding.
3. To understand Context based Image Compression.
4. To know various methods of Wavelets Transforms

Course Outcomes:

At the end of this course, students will be able to

1. Learn different data compression techniques
2. Understand Various Coding methods
3. Study techniques for image compression
4. Differentiate Scalar and Vector Quantization
5. Understand methods of Wavelets Transforms
6. Learn speech, video and Fractal image compression

	Data Compression	L
Unit-1	Introduction to Data Compression: Data compression, Lossless compression, Lossy Compression, Performance Measures, Coding, Modeling, Grading Compression Algorithms, Minimum Redundancy Coding: The Shannon-Fano algorithm, The Huffman Algorithm, Adaptive coding: Adaptive Huffman Coding, Updating The Huffman trace, Decoding, The overflow problem, Rescaling Bonus, Arithmetic Coding: Difficulties, Practical Matters, a complication, Decoding.	06
Unit-2	Arithmetic coding, Dictionary Techniques: Arithmetic coding: Coding a sequence, generating binary codes, Comparison of Huffman and Arithmetic Coding, Adaptive arithmetic coding, Repetition Finder, Application related to file compression and Image Compression	06
Unit-3	Image compression: Context based Compression: Prediction with Partial Match (PPM), Burrows Wheeler Transform, Associative coder. Dynamic Markov Compression Lossless Image Compression: JPEG, JPEGLS, Run-length coding, facsimile coding standards, Differential Lossless Compression Transform Coding: K L Transform, DCT, DST, Discrete Walsh-Hadamard transform	06
Unit-4	Quantization: Scalar Quantization, Quantization problem, Uniform quantization, Adaptive quantization, Nonuniform Quantization, Entropy Coded Quantization. Vector Quantization (VQ): Advantages over Scalar Quantization, The Linde-Buzo-Gray algorithm, Tree Structured Vector Quantization, Structured VQ.	06
Unit-5	Sub-band Coding, Wavelets method: Sub band Coding: Filters, Basic Sub-band coding, algorithm, design of Filter Banks, Application to speech coding, audio coding and Image compression. Wavelets: Fourier Transform, Frequency Domain, Uncertainty Principle, Fourier Image Compression, CWT and Its Inverse, Haar Transform, Filter Banks, DWT, Multi-resolution Decomposition, Various Image Decompositions, IWT	06
Unit-6	Speech Compression: MPEG, MP3.Video compression: Pixel details, Motion estimation, quantization and bit packing, MPEG-2. Fractal Image compression: History, Iterated function system (IFS), Basic IFS, Image compression with IFS and with partitioned IFS. Fractal Image decoding, Resolution independence. Introduction to Wavelet based compression Techniques.	06
	Total	**36**

References:

1. "Introduction to Data Compression", Khalid Sayood, 2nd Ed. Academic Press
2. "Data Compression: The complete Reference", David Saloman, 3 rd Ed, Springer 2004.
3. "Digital Image Processing", S Jayaraman, S. Esakkirajan, T Veerakumar, Tata Mc-Graw Hill.
4. "Digital Image Processing", R. C.Gonzalez and Woods 3rd Ed, pearson Education

3UMEF2 Open Elective (i) OPERATIONS RESEARCH Maximum Marks: 80

Course Objective:

1. To understand and apply the dynamic programming.
2. To understand and apply the non-linear programming.
3. To model and simulate real time problems.
4. To perform the sensitive analysis.

Course Outcomes:

After successful completion of this course, students will be able to

1. Apply the dynamic programming to solve problems of discreet and continuous variables.
2. Apply the concept of non-linear programming
3. Carry out sensitivity analysis
4. Model the real-world problem and simulate it.
5. Perform scheduling and sequencing of models.
6. Apply graphical solutions methods.

	Subject: Operations Research	**L**
1.	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.	6
2.	Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.	6
3.	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.	6
4.	Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	6
5.	Competitive Models, Single and Multi-Channel Problems, Sequencing Models, Dynamic Programming.	6
6.	Flow in Networks, Elementary Graph Theory, Game Theory Simulation.	6
	Total:	**36**

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008.
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009.
5. Pannerselvam, Operations Research: Prentice Hall of India 2010.
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

3UMEF2 Open Elective (ii) - COST MANAGEMENT & ENGINEERING PROJECTS Max. Marks: 80

Course Objective:

1. To understand the meaning, types of cost and cost management process.
2. To know the concept of project and various stages of project execution.
3. To understand role of an individual in any project team and importance of project site.
4. To learn Activity-Based Cost Management and Quantitative techniques for cost management.

Course Outcomes:

At the end of this course, students will be able to

1. Differentiate the types of cost and cost management process
2. Understand meaning of project and various stages of project execution
3. Describe the role of an individual in any project team
4. Understand Total Quality Management and Theory of constraints
5. Learn Activity-Based Cost Management and types of budgets
6. Solve problems based on Cost management

	Cost management & Engineering Projects	L
Unit-1	Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.	06

Unit-2	Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents	06
Unit-3	Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process	06
Unit-4	Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints	06
Unit-5	Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.	06
Unit-6	Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	06
	Total	**36**

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

3UMEF2 Open Elective (iii) E- WASTE MANAGEMENT Maximum Marks: 80

Course Objective:

1. To study various scenario of E-waste
2. Discuss key elements of E-waste management
3. To Study the key terms associated with E- waste
4. to study the different national and international act

Course Outcomes:

1. To Know about the environmental impacts of e-waste.
2. Identify various e- waste hazardous
3. Apply various way to control E- waste
4. Distinguished the role of various national and international act
5. Understand the various laws applicable for e-waste management and handling
6. Explain Emerging recycling and recovery technologies

	E- Waste Management	L
Unit- 1	**Introduction:** E- waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India.	06
Unit-2	**E-waste hazardous on Global trade** Essential factors in global waste trade economy, Waste trading as a quint essential part of electronic recycling, Free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India's stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities of India.	06

Unit-3	**E-waste control measures** Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source.	06
Unit-4	**E-waste (Management and Handling) Rules** 2011; and E-Waste (Management) Rules, 2016 - Salient Features and its likely implication. Government assistance for TSDFs.	06
Unit-5	**The international legislation:** The Basel Convention; The Bamako Convention. The Rotterdam Convention. Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union, Restrictions of Hazardous Substances (RoHS) Directive	06
Unit-6	Emerging recycling and recovery technologies, Guidelines for environmentally sound management of e-waste, environmentally sound treatment technology for e-waste, Guidelines for establishment of integrated e-waste recycling and treatment facility.	06
	Total	**36**

Text Books:

1. E-waste: implications, regulations, and management in India and current global best practices", Johri R., TERI Press, New Delhi
2. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi
3. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009

References:

1. Electronic Waste – 1st Edition (Toxicology and Public Health Issues), Fowler B. 2017Elsevier
2. Electronic Waste Management. Science, Hester R.E., and Harrison R.M. 2009
3. Fowler B, Electronic Waste – 1st Edition (Toxicology and Public Health Issues), 2017Elsevier

SEMESTER: III & IV

(Dissertation) Dissertation Phase – I and Phase - II

Teaching Scheme

Lab work : 6 and 12 hrs/week

COURSE OUTCOMES:

At the end of this course, students will be able to

- Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain
- The student should complete the following:
- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation
- The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:
- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I and II at M. Tech. (Digital Electronics):

- As per the AICTE directives, the dissertation is a year long activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. department laboratories and centers OR in industry allotted through departments T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referre and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

- Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
- Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.
- During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.
- Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

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