M. E. Electronics (Spl in Digital Communication) (FULL TIME)
Curriculum & Syllabus
Batch 2015– 2016 and onwards

S. No.	Category	No. of Credits			
		SEM I	SEM II	SEM III	SEM IV
1.	Course Compulsory	15	15	-	-
2.	Generic Elective	4	4	-	-
3.	Programme Elective	5	5	-	-
4.	Skill development	2	2	-	-
5.	Seminar/ Workshop	2	2	-	-
6.	Dissertation Phase	-	-	12	12
Actual Credits per Semester		**28**	**28**	**12**	**12**
Total actual Programme Credits					**80**
7.	Virtual Credited Comprehensive Viva	4	4	4	4
Total Credits per Semester		**32**	**32**	**16**	**16**
Total Programme Credits					**96**

M. E. Electronics (Spl in Digital Communication) (FULL TIME)
Curriculum & Syllabus
Batch 2015– 2016 and onwards

SEM I				
S.NO	**Sub Code**	**Sub Name**	**Number of Credit L-T-P**	**Sub Type**
1.	DCR1C1	Modern Communication System	3-1-1	PC1
2.	DCR1C2	Embedded System using ARM Microcontroller	3-1-1	PC2
3.	DCR1C3	Advance Computer Networking	3-1-1	PC3
4.	DCR1Gx	Generic Elective I	3-1-0	GE1
5.	DCR1Ex	Elective I	3-1-1	PE1
6.	ASR1S1	Soft Skills -1	2-0-0	
7.	DCR1W1	Seminar/ Workshop/Research Tool	0-2-0	
8.	DCR1V1	Comprehensive Viva I	0-0-4	
Total Credit for SEM I			**28 actual + 4 Virtual credits**	
		List of Generic Elective I	**L-T-P**	
1.	DCR1G1	Advance System Design	3-1-0	
2.	DCR1G2	Wireless Sensor Network	3-1-0	
3.	DCR1G3	Advance Digital Signal Processing	3-1-0	
4.	DCR1G4	Information Theory and Coding	3-1-0	
		List of Elective I	**L-T-P**	
1.	DCR1E1	Satellite Communication	3-1-1	
2.	DCR1E2	Object Oriented Programming	3-1-1	
3.	DCR1E3	Embedded RTOS	3-1-1	
4.	DCR1E4	Software Engineering	3-1-1	
SEM II				
1.	DCR2C1	Modelling and Simulation	3-1-1	PC4
2.	DCR2C2	Mobile Communication Networks	3-1-1	PC5
3.	DCR2C3	System Design Using Verilog	3-1-1	PC6
4.	DCR2Gx	Generic Elective II	3-1-0	GE2
5.	DCR2Ex	Elective II	3-1-1	PE2
6.	ASR2S2	Soft Skills -2	2-0-0	
7.	DCR2W2	Seminar/ Workshop/ Research Tool	0-2-0	
8.	DCR2V2	Comprehensive Viva II	0-0-4	
Total Credit for SEM II			**28 actual + 4 Virtual credits**	
		List of Generic Elective II	**L-T-P**	
1.	DCR2G1	Broadband Access Technology	3-1-0	
2.	DCR2G2	Nanodevices & Nanosensors	3-1-0	
3.	DCR2G3	Advance Antenna System	3-1-0	
4.	DCR2G4	Industrial Communication	3-1-0	
		List of Elective II	**L-T-P**	
1.	DCR2E1	Analog and Digital CMOS Circuit Design	3-1-1	
2.	DCR2E2	Network Security	3-1-1	
3.	DCR2E3	Mobile Computing	3-1-1	
4.	DCR2E4	Software testing and Quality assurance	3-1-1	

M. E. Electronics (Spl in Digital Communication) (FULL TIME)
Curriculum & Syllabus
Batch 2015– 2016 and onwards

SEM III			**L-T-P**	
1	DCR3D1	Dissertation Phase I	0-0-12	
2	DCR3V3	Comprehensive Viva III	0-0-4	
Total Credit for SEM III			**12 actual + 4 Virtual credits**	
SEM IV			**L-T-P**	
1	DCR4D2	Dissertation Phase II	0-0-12	
2	DCR4V4	Comprehensive Viva IV	0-0-4	
Total Credit for SEM IV			**12 actual + 4 Virtual credits**	
Total Credit			**80 actual + 16 Virtual credits=96**	

Sem I

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1C1 **Modern Communication System**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
Duration of Theory Paper: **3 Hours**	**3**	**1**	**2**	**3**	**1**	**1**	**5**

Course Objectives: To give exposure of all the processes like modulation, Demodulation, Channel Coding, Decoding etc. of physical layer involved in modern telecommunication systems. To analyze and evaluate performance of a digital communication system.

Prerequisite(s): Basic knowledge of digital communication

COURSE CONTENTS

UNIT -I

Review of basic concepts of communication systems, Source encoding, Speech encoding techniques (Source encoders, SBC, LPC, Hybrid coders), their applications, Base-band modulation techniques their comparison and spectrum associated with their waveforms.

UNIT -II

Channel coding-Linear Block Codes, Convolution Codes, Turbo Codes their encoding and decoding, introduction to high level channel codes, interleaving and concatenated codes.

Digital modulation and demodulation - PSK, DPSK, QPSK, M-aryPSK, QAM, MSK and GMSK their generation, detection & performance analysis and comparison in presence of noise.

UNIT –III

Multi-carrier modulation and OFDM, Orthogonality, Block diagram of OFDM, Applications of OFDM, Issues in OFDM systems. Spread spectrum systems: Types, PN sequences, Characteristics of PN sequences, generation and detection of DSSS and FHSS, Spreading gain, Applications to communication systems, Multi-user detection.

UNIT –IV

Wireless channels and propagation path loss models – ISI, Types of fading, models for multi-path reception, propagation models for wireless networks, Fading mitigation techniques, Equalization principle and types (LTE, ZFE, MMSE and DFE).

UNIT –V

Diversity techniques (frequency, time, and space), Multi-antenna systems, Smart antennas, Beamforming and MIMO system, spatial multiplexing, Tradeoffs among Diversity, Beam-forming gain & spatial multiplexing, Introduction to Cognitive Radio and Cooperative communication.

BOOKS RECOMMENDED

[1]. Bernard Sklar, "*Digital Communication*", Pearson Education, 2nd Edition, 2004.

[2]. J.G.Proakis, *Digital Communication*, McGraw Hill, 4th Edition, 2001.

[3]. Lathi B. P., *Modern Analog and Digital Communication Systems*, 3rd Edition, Oxford Univ. Press, 2010.

[4]. Haykins Simon, *Digital Communication*, 3rd Edition, Wiley Publication, 2005.

[5]. I.S. Misra, Wireless Communications and Networks, 2nd Edition, TMH, 2009.

[6]. A. F. Molisch, Wireless Communications, 2nd Edition, Willey, 2014.

[7]. T. S. Rappaport, Wireless Communications Principles & Practice, 2nd Edition, PHI, 2005.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1C2 **Embedded System using ARM Microcontroller**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Objectives: The objective of this course is to teach students design and interfacing of ARM microcontroller-based embedded systems. High -level languages are used to interface the ARM microcontrollers to various applications. There are extensive hands-on labs/projects.
Prerequisite: Knowledge of Microprocessor and C++ Programming.

COURSE CONTENTS

UNIT-I

Introduction: Definition of Embedded System, Embedded Systems Vs General Computing Systems, Major Application Areas, Purpose of Embedded Systems,Characteristics and Quality Attributes of Embedded Systems, Core of the Embedded System: General Purpose and Domain Specific Processors, Embedded system architecture: RISC and CISC, RISC:Introduction of ARM Processors, Evolution of ARM, ARM design philosophy, ARM Processor fundamentals: Data flow model, Registers, Program Status Register, Pipeline, Interrupts and Vector Table, ARM Processor Families and Nomenclature.

UNIT -II

ARM Basic Instruction Set: Introduction to 32 bit programming, Instruction Set Architecture of ARM, Addressing modes, Data Processing Instructions, Branch Instructions, Load and Store Instructions, Conditional Instructions, PSR Instructions, Stack Instructions.

UNIT -III

ARM Thumb Instruction Set: Overview, Branch instructions, Data processing instructions, Status register access instructions, Single register load and store instructions, Multiple register load and store instructions, Semaphore instructions, Coprocessor instructions, Stack Instructions, Interrupt Instructions.

UNIT -IV

ARM Programming- Assembly Language Programming: Directives-AREA, ENTRY, END etc., Assembly code using instruction scheduling, Register Allocation, Conditional Execution and Loops.C programming for ARM: Simple C program using function, pointers, structures, etc, Exception Handling,Interrupts, Interrupt Handling Schemes

UNIT -V

Interfacing and applications programs for LCD display, PWM ,ADC, DAC application, measurement and control of physical parameter as temperature , stepper motor control, DC motor control etc.

Books Recommended:

[1]. "ARM System Developer's Guide Designing and Optimizing System Software" by Andrew N. Sloss, Elsevier publication, 2004.
[2]. Arm System-On-Chip Architecture, 2/E , by Par Furber, Pearson Education Limited, 2000.
[3]. "EMBEDDED SYSTEM DESIGN", By Par Santanu Chatttopadhyay, PHI Learning Private Ltd., 2013.
[4]. "Embedded Microcomputer Systems, Real Time Interfacing, by Jonathan W. Valvano – Brookes /Cole, 1999, Thomas Learning.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1C3 **Advance Computer Networking**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: **3 Hours**							

Course Objectives: Appreciate working network layer protocols, selection of appropriate routing algorithm, understanding of QOS parameters, understanding of transport and application layer protocols, use of cryptography in computer networking.
Prerequisite(s): Fundamentals of computer networking, concepts of programming and operating systems.

COURSE CONTENTS

UNIT-1
Network Models, OSI Model, TCP/IP Protocol Suite, Addressing, Data Rate Limits, Performance Parameters, Transmission Media, Switching, Data Link Layer, Error Detection and Correction techniques.

UNIT-2
Data Link Control- LLC, HDLC , Multiple Access, Random Access, Wired LANS- Standard Ethernet, Fast Ethernet , Gigabit Ethernet , Wireless LANS, Bluetooth, Connecting Devices.

UNIT-3
Network Layer- Logical Addressing, IPV4 Addresses, IPV6 Addresses, Transition From IPV4 to IPV6, Address Mapping, ARP protocol, ICMP, Unicast Routing Protocols, Multicast Routing Protocols, Routing in Autonomous System

UNIT-4
Transport Layer- Process-To-Process Delivery, User Datagram Protocol (UDP), TCP, SCTP, Congestion Control, Quality of Service, Techniques to Improve QoS

UNIT-5
Application Layer- Domain Name System, Electronic Mail, File Transfer Protocol, HTTP, WWW, Remote Login (TELNET, SSH), Simple Network Management Protocol (SNMP), Internet Security- Network Layer Security, Transport Layer Security and Application Layer Security, Firewalls

BOOKS RECOMMENDED

[1] B. Forouzan, “TCP/IP Protocol Suite”, McGraw Hill,3/e,2006
[2] Douglas E. Comer, David L. Stevens, “Internetworking with TCP/IP Vol. II design, Implementation of Intranets:, PHI, 3nd Edition 2000
[3] A. S. Tanenbaum, “Computer Networks”, 4th Edition Pearson Education, 2003.
[4] W. Stalling, “Network Security and Cryptography”, 4th Edition Pearson Education, 2006.
[5] B. Forouzan, “Data Communication and Networking” 4th Ed Tata McGraw Hills

List of Generic Elective I

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1G1 **Advance System Design**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**0**	**3**	**1**	**0**	**4**
Duration of Theory Paper: **3 Hours**							

Course Objective: To provide an in-depth knowledge regarding designing of advance digital system. To emphasize on system design for timing and performance trade off.
Prerequisite: Knowledge of basic digital electronics, state diagrams and graph theory.

COURSE CONTENTS

Unit 1:

Introduction to digital IC design – full Custom and semicustom design flow and comparison , Combinational Logic Design, Synchronous State Machine Design and Analysis, Asynchronous State Machine Design and Analysis, Synthesis and Optimization of Digital Circuit (AREA, POWER AND DELAY). LOW and High Level Synthesis process, optimization of hardware. combinational logic synthesis – Technology independent and technology dependent optimization –Logic synthesis

Unit 2:

High level synthesis- Scheduling and allocation-ASAP and ALAP scheduling-Register allocation-Functional unit allocation-Interconnect path allocation-Hardware description languages-synthesis-register transfer design-Event driven simulation. Low power issues in high level synthesis and logic synthesis.

Unit 3:

Resource Sharing and Binding,Sharing and Binding for Resource-Dominated Circuits,Resource Sharing in Non-Hierarchical Sequencing Graphs, Resource Sharing in Hierarchical Sequencing Graphs, Register Sharing, Multi-Port Memory Binding, Bus Sharing and Binding, Sharing and Binding for General Circuits, Unconstrained Minimum-Area Binding.

Unit 4:

Subsystem design principles-pipelining-Data paths in processor architecture – Standard cell design considerations of adder and multiplier- Timing -Slack delay model – Effect of skew and jitter on timing, Sources of skew and jitter- Clocking disciplines -Wire model- Technology scaling effect on interconnect and -Noise in interconnects.

Unit 5:

FPGAsIntroduction to FPGA, FPGA Programming technologies, Static SRAM, Anti Fuse, EPROM, EEPROM, Xilinx FPGA (XC2000, XC3000, XC4000 and XC5000), Logic block Architecture.Field Programmable Logic Sequencer, application of FPLS Devices.Programmable Array Logic Series 20, Combinational PAL Devices, Sequential PAL Devices, Arithmetic PAL Devices.

BOOKS RECOMMENDED:

[1]. John M Yarbrough, “Digital Logic Applications and Design”, Thomson learning
[2]. Synthesis and optimization of Digital Circuits , Giovanni De Micheli , Tata McGraw Hill Edition
[3]. Jan M Rabaey, Digital Integrated Circuits - A Design Perspective, Prentice Hall, Second Edition, 2005.
[4]. Naveed A. Sherwani, Algorithms for VLSI Physical Design Automation,Springer,Third edition,1999.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1G2 **Wireless Sensor Networks**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**0**	**3**	**1**	**0**	**4**
Duration of Theory Paper: **3 Hours**							

Course Objectives: To list various applications of wireless sensor networks, describe the concepts, protocols, and differences underlying the design, implementation, and use of wireless sensor networks, and propose, implement, and evaluate new ideas for solving wireless sensor network design issues.
Prerequisite(s): Computer Networks

COURSE CONTENTS

UNIT I
Introduction and Overview of Wireless Sensor Networks
Introduction, Brief Historical Survey of Sensor Networks, and Background of Sensor Network Technology, AhHoc Networks, Applications of Wireless Sensor Networks: Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Nanoscopic Sensor Applications, Another Taxonomy of WSN Technology, Basic Sensor Network Architectural Elements, Home Control, Medical Applications, Basic Wirel ess Sensor Technology : Introduction, Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends, Wireless Network Standards: IEEE 802.15.4, ZigBee, IEE 1451

UNIT II
Medium Access Control Protocols for Wireless Sensor Networks
Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs: Schedule - Based Protocols, Random Access - Based Protocols, Coordination, Schedule Synchronization, Adaptive Listening, Access Control and Data Exchange (B -MAC,Box - MAC, Bit -MAC,H-MAC, I-MAC, O-MAC, S-MAC. Ri-MAC, T-MAC, Q-MAC (Querry MAC), Q-MAC (QoS MAC), X-MAC)

UNIT III
Routing Protocols for Wireless Sensor Networks
Introduction, Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless Sensor Networks Network Scale and Time -Varying Characteristics,Resource Constraints, Sensor Applications Data Models, Routing Strategies in Wireless Sensor Networks: WSN Routing Techniques, Flooding and Its Variants, Sensor Protocols for Information via Negotiation, Low - Energy Adaptive Clustering Hierarchy,Power-Efficient Gathering in Sensor Information Systems, Directed Diffusion,Geographical Routing,

UNIT IV
Transport Control Protocols and Middle wares for Wireless Sensor Networks
Traditional Transport Control Protocols: TCP (RFC 793), UDP (RFC 768), MobileIP, Introduction, WSN Middleware Principles, Middleware Architecture: Existing Middleware: MiLAN (Middleware Linking Applications and Networks), IrisNet (Internet-Scale Resource-Intensive Sensor Networks Services)

UNIT V
Operating Systems for Wireless Sensor Networks
Introduction, Examples of Operating Systems: TinyOS,Mate, MagnetOS

Books Recommended:

[1]. Wireless Sensor Network by KazemSohraby, Daniel Minoli, TaiebZnati Pub: Wiley.
[2]. Wireless Sensor Networks Signal Processing and Communications by Ananthram Swami,Qing Zhao, Yao -Win Hong, Lang Tong Pub: John Wiley & Sons.
[3]. Ad Hoc Wireless Networks: Architectures And Protocols By Murthy Pub: Pearson Education
[4]. Wireless sensor networks Edited by C. S. Raghavendra Pub: Springer
[5]. Fundamentals of Sensor Network Programming: Applications and Technology By Sridhar S.Iyengar, NandanParameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DRC1G3 Advance Digital Signal Processing	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Course Objective: To provide clear conceptual knowledge of different DSP algorithms and to introduce speech, multimedia and other signal processing applications.
Prerequisite(s): A basic course in Digital signal processing.

COURSE CONTENTS

Unit 1
Overview of DSP,FIR filters, IIR filters, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, Linear prediction & optimum linear filters stationary random process, forward- backward filters linear prediction, solution of normal equation.

Unit2
Multi rate DSP, Sampling rate conversion, poly phase filters, multistage decimator & interpolator, QMF, digital filter banks,DFT in spectral estimation., Adaptive filters & spectral estimation.

Unit 3
Minimum mean square criterion, , LMS algorithm, Recursive least square algorithm,Application of DSP& Multi rate DSP Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications

Unit 4
Image representation :Gray scale and color images , image sampling a nd quantization. Image enhancement: Filter in spatial and frequency domains , histogram based processing and homomorphic filtering. Edge Detection edge linking, boundary descriptors. Image Segmantation :Thresholding, region based segmentation Image Compression: lossy and lossless compression techniques.

Unit 5
Entropy coding, lossy and lossless predictive coding, uniform and non uniformquantizers, transform based compression, JPEG, Image reconstruction from projections: Principles, mathematical basis of tomography. Projections, The Fourier Slice Theorem, Reconstruction Algorithms for Parallel Projections, Three dimensional projections. Computer visualization of 3D data :Rendering techniques: Surface based and volume based techniques. Direct Volume rendering: Ray casting, opacity function. Maximum Intensity Projection

BOOKS RECOMMENDED:

[1]. Gonzalez and Woods :Digital Image Processing, Pearson Education 3rd Edition
[2]. A.K.Jain : Fundamentals of Digital image processing , PHI
[3]. J.G. Proakis and D.G .Manolakis Digital signal processing: Principles, algorithm and applications, Macmillan publishing
[4]. IfeachorE.C., Jervis B.W. Digital signal processing, a Practical approach, 2nd ed. Pearson edu. 2003.
[5]. Salivahanan, Vallavaraj&Gnanpriya Digital signal processing:: Tata Mcgraw Hill
[6]. References:
[7]. S.W.Smith Digital signal processing: A practical guide for engineers and scientists, Elsevier
[8]. S.K.Mitra , Digital signal processing:: Tata Mcgraw Hill

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1G4 **Information Theory and Coding**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**0**	**3**	**1**	**0**	**4**
Duration of Theory Paper: **3 Hours**							

Objectives: To understand encoding and decoding of digital data streams.To introduce methods for the generation of these codes and their decoding techniques. To have a detailed knowledge of compression and decompression techniques.

Pre-requisites: To have the basic knowledge of digital and analog communication systems, and channels.

COURSE CONTENTS

Unit I

Information theory

Concept of amount of information - units, Entropy -marginal, conditional and joint entropies -relation among entropies Mutual information, information rate, channel capacity, redundancy and efficiency of channels.

Unit II

channels

Symmetric channels, Binary Symmetric Channel, Binary Erasure Channel, Cascaded channels, repetition of symbols, Binary unsymmetric channel, Shannon theorem. Continuous channels – Capacity of band limited Gaussian channels, Shannon-Hartley theorem, Trade off between band width and signal to noise ratio, Capacity of a channel with infinite band width, Optimum modulation system.

Unit III

Source coding

Encoding techniques, Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy, Noiseless coding theorem. Construction of basic source codes – Shannon-Fano algorithm, Huffman coding, Arithmetic coding, ZIP coding.

Unit IV

Error detection and correction

Parity check coding, Linear block codes, Error detecting and correcting capabilities, Generator and Parity check matrices, Standard array and Syndrome decoding, Hamming codes, Encoding and decoding of systematic and unsystematic codes. Cyclic codes – Generator polynomial, Generator and Parity check matrices, Encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, BCH codes, RS codes, Burst error correction.

Unit V

Convolutional codes

Encoding- State, Tree and Trellis diagrams, Maximum likelihood decoding of convolutional codes - Viterby algorithm, Sequential decoding -Stack algorithm. Interleaving techniques – Block and convolutional interleaving, Error Control and Signal Space Coding

Books Recommended:

[1]. Simon Haykin, *Communication Systems*, John Wiley & Sons. Pvt. Ltd, 2009

[2]. Taub& Schilling, *Principles of Communication Systems*, Tata McGraw-Hill, 2007

[3]. Das, Mullick&Chatterjee, *Principles of Digital Communication* ,Wiley Eastern Ltd,2002

[4]. Shu Lin & Daniel J. Costello, *Error Control Coding Fundamentals and Applications*, Jr., Prentice Hall, Inc,2004.

[5]. Bernard Sklar, *Digital Communications Fundamentals and Applications*, Person Education Asia, 2001.

[6]. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007

List of Elective I

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1E1 Satellite Communication	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 6 Hours/week							

Course Objectives: The course provides fundamentals, link design, overview of practical consideration and applications of satellite communication.

Prerequisite(s): Fundamentals of communication systems.

COURSE CONTENTS

Unit I

SATELLITE ORBITS: Kepler's Laws, orbital mechanics and parameters, – Look Angle Determination, orbital perturbations-longitudinal and inclination changes, geo stationary and non-geo-stationary orbits, Orbital Effects in Communications system performance- Doppler shift, range variations, solar eclipse, sun transit outage, Launching Procedures - launch vehicles.

Unit II

SATELLITE SUB-SYSTEMS AND LINK DESIGN: Satellite sub systems, Attitude and Orbit control system, Telemetry, Tracking and command. Communication sub-systems- Description of the communication system and various types of transponders, satellite antennas.

Satellite link design-Basic transmission theory, system noise temperature and G/T ratio, design of downlinks, satellite system using small earth stations, uplink design, system design examples, Ku band uplink and downlink design and rain effects on Ku band.

Unit III

MODULATION AND MULTIPLEXING TECHNIQUES FOR SATELLITE LINKS: Frequency modulation, Analog FM transmission by satellite, digital transmission, digital modulation and demodulation digital transmission of analog signals, time division multiplexing- TDM terminology, TDM systems and channel synchronization in TDM.

Unit IV

MULTIPLE ACCESS TECHNIQUES USED IN SATELLITE COMMUNICATION: FDMA-intermodulation, calculation of C/N with intermodulation, TDMA-Bits, symbol and channels, frame structure, TDMA in a fixed station network- synchronization and transmitter power in TDMA networks, CDMA, spread spectrum transmission and reception, CDMA in a fixed earth station and LEO satellite network.

Unit V

SATELLITE APPLICATIONS: VSAT Systems-overview, network architecture, access control protocols, modulation and multiple access selection, VSAT earth station and calculation of link margin, Low earth orbit and Non Geo –stationary satellite systems-Orbit consideration, coverage and frequency consideration, delay and throughput considerations, system considerations, DBS system, Satellite navigation and the Global Positioning System .

BOOKS RECOMMENDED:

[1]. T. Pratt, C. Bostain, J. Allnutt, 'Satellite Communications', Second Edition, John Wiley & Sons, 2003.
[2]. M.Richharia, 'Satellite Communication Systems-Design Principles", Macmillan 2003
[3]. Bruce R. Elbert, 'The Satellite Communication Applications' Hand Book, Artech HouseBostan London, 1997.
[4]. Tri T. Ha, 'Digital Satellite Communication', II edition, 1990.
[5]. Emanuel Fthenakis, 'Manual of Satellite Communications', McGraw Hill Book Co.,1984.

[6]. Brian Ackroyd, 'World Satellite Communication and earth station Design', BSP professional Books, 1990.
[7]. G..B.Bleazard, 'Introducing Satellite communications NCC Publication, 1985.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1E2 Object Oriented Programming	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Course Objectives: The aim of the course is to give a thorough grounding in object-oriented techniques for Java, as well as to examine the major uses of Java – internet programming, design pattern, user interfaces and Networking.
Prerequisite(s): Knowledge Object Oriented Programming concept using object oriented languages such as C++, Objective C.

COURSE CONTENTS

UNIT -I
Introduction to Object Oriented Programming and Java :
Object Oriented Concepts, Abstraction, Encapsulation, Information Hiding. Java features: Java syntax, data types, data type conversions, control statements, operators and their precedence. Introduction to Class: Instance members and member functions. Concept of object initialization, constructors,constructor overloading. Access modifiers: Class attributes and methods

UNIT -II
Inheritance and Polymorphism
Class relationships: Inheritance and its types, Merits and Demerits, Polymorphism: Dynamic method dispatch, Runtime polymorphism, Abstract classes, Interfaces and packages.

UNIT -III
Exception Handling, Multithreading and Introduction to Java APIs:
Exceptions: Need for exceptions, Checked V/s Unchecked exceptions, creating exceptions.
Multithreading: Introduction, Priorities and scheduling, Thread Synchronization and its life cycle. String Handling, Wrapper classes: Arrays and Vectors

UNIT -IV
Java I/O, Applets and Event Handling:
Basic concept of streams I/O stream & reader-writer classes. File handling. Applet and its Life Cycle, Basic GUI elements, Event Delegation Model and event handling

UNIT -V
Introduction to elementary procedures, Real & Complex vector and Matrix & Determinants and operations like: Initialization, Duplication, Elimination, Interchanging, Rotation, Norms, Scaling, Multiplication & calculation of rank etc,.Evaluation of various polynomials like Chebyshev polynomial, Fourier polynomial etc.,Analysis of real matrix problems like: Overdetermined systems, underdetermined system, homogenous, pseudo inversion. Sparse
Real matrices, Similarity Transformation, Eigen value problems., Numerical differentiation, Differential equations,Introduction to special functions like: Exponential, Gamma, Error, Infinite time series, Fast Fourier transforms etc

BOOKS RECOMMENDED:
[1]Hang T. Lau, *A Numerical Library in Java for Scientist & Engineers*, Library of Congress Cataloging-in-Publication Data byChapman & Hall/ CRC Press Company.
[2] Cay S.Horstmann, *Core JAVA Vol-1*, Pearson Education.
[3] Herbert Schildt, *The complete Reference*, Tata McGraw Hill.
[4] Kathy Sierra, *Bert Bates, Head First Java,* 2nd Edition, Oreilly

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1E3 **Embedded RTOS**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**0**	**3**	**1**	**0**	**4**
Duration of Theory Paper: 3 Hours							

Objective: provide an understanding of general embedded system concept, Embedded Software development, RTOS essentials, advantages and trade-offs. It will provide practical experience necessary to use an RTOS in an embedded system development

Prerequisites : Opertaing system, Microcontrollers and C Programming

COURSE CONTENTS

UNIT – I:

Introduction

Introduction to UNIX/LINUX, Overview of Commands, File I/O (open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

UNIT - II:

Real Time Operating Systems

Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, Tasks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use

UNIT - III:

Objects, Services and I/O

Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem

UNIT - IV:

Exceptions, Interrupts and Timers

Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

Embedded Firmware:

Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT - V:

Case Studies of RTOS

RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, Tiny OS, and Basic Concepts of Android OS.

Books Recommended:

[1]. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011
[2]. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH.
[3]. Advanced UNIX Programming, Richard Stevens
[4]. Embedded Linux: Hardware, Software and Interfacing – Dr. Craig Hollabaug

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1E4 Software Engineering	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Course Objectives: The main purpose of this course is to impart knowledge on the basic principles of software development life cycle.

Prerequisite: Knowledge of Basic Data Types - Lists, Stacks, Queues, Hash Tables ,Trees - Binary Trees, Tree Traversal, Memory Management - Storage Allocation, Garbage Collection, Algorithms - Divide and Conquer, Backtracking, Iterative Techniques, Searching and Sorting,Complexity - O-Notation

COURSE CONTENTS

UNIT I
INTRODUCTION
Software Engineering-Software Process- Generic process model-Prescriptive process model-specialized, unified process-Agile development-Agile Process- Extreme Programming- Other agile Process models-Software engineering Knowledge-core Principles-Principles that guide each framework Activity.

UNIT II
REQUIREMENTS
Requirements Engineering-Establishing the Groundwork-Eliciting Requirements- Developing use cases-Building the requirements model-Negotiating, validating Requirements-Requirements Analysis-Requirements Modeling Strategies.

UNIT III
DESIGN MODELING WITH UML
ModelingConcepts and Diagrams - Use Case Diagrams - Class Diagrams - Interaction Diagrams - State chart Diagrams – Activity Diagrams - Package Diagrams - Component Diagrams – Deployment Diagrams - Diagram Organization- Diagram Extensions. Design Process- Design concepts: Abstraction, Architecture, patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring, Object Oriented Design Concepts, Design Classes- Design Model: Data, Architectural, Interface, Component, Deployment Level Design Elements .

UNIT IV
SOFTWARE IMPLEMENTATION
Structured coding Techniques-Coding Styles-Standards and Guidelines- Documentation Guidelines-Modern Programming Language Features: Type checking-User defined data types-Data Abstraction-Exception Handling- Concurrency Mechanism.

UNIT V-
ESTING AND MAINTENANCE
TESTING: Software Quality- Software Quality Dilemma- Achieving Software Quality- Testing: Strategic Approach to software Testing- Strategic Issues- Testing: Strategies for Conventional Software, Object oriented software, Web Apps-Validating Testing- System Testing- Art of Debugging.
MAINTENANCE: Software Maintenance-Software Supportability- Reengineering- Business Process Reengineering- Software Reengineering- Reverse Engineering- Restructuring- Forward Engineering-Economics of Reengineering

Books Recommended:

[1]. Roger S, *"Software Engineering – A Practitioner's Approach"*, seventh edition, Pressman, 2010.
[2]. Pearson Edu, *"Software Engineering by Ian sommerville"*, 9th edition, 2010.
[3]. Hans Van Vliet, *"Software Engineering: Principles and Practices"*–, 2008.
[4]. Richard Fairley, *"Software Engineering Concepts"*, 2008.

Soft –Skill I

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- A			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
ASR1S1: **Soft Skill-1**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	2	**-**	**-**	**2**	**-**	**-**	**2**
Duration of Theory Paper: 3 Hours							

Objective: To learn about basic Life and Organizational skills.
Pre-requisites: Nil.

COURSE CONTENTS

Unit I

Social Skills and Negotiation Skills

Life Skills: Generic, Problem Specific and Area Specific Skills, Self-Awareness : Definition, Types of Self- Self Concept, Body Image, Self Esteem Techniques used for Self Awareness: Johari Window, SWOT Analysis Empathy- Sympathy, Empathy & Altruism, Effective Communication - Definition, Functions, Models, Barriers.

Unit II

Thinking Skills

Thinking Nature, Elements of Thought, Types of Thinking, Concept Formation, Reasoning, Creative & Critical Thinking - Definition, Nature, Stages Problem Solving Definition, Steps in Problem Solving Factors Influencing Problem Solving Decision Making Definition, Process, Need, Consequences, Models of Decision Making Goal Setting.

Unit III

Coping Skills

Coping with Emotions - Definition, Characteristics, Types, Classification: Wheel Model, Two-Dimensional Approach, Coping Strategies Coping with Stress, Definition, Stressors, Sources of Stress, The General Adaptive Syndrome Model of Stress. Conflict Management- Sources, Impacts of Conflict and Conflict Resolution.

Unit IV

Personality

Defining Personality, Personality Determinants, Personality Development, Personality Change Various types of Personality. Motivation and its Process.

Unit V

Leadership

Definition of Leadership, Classification: Types of Leaders and Styles of Leadership, Characteristics and Functions of Leadership, Values and Ethics of Leadership.

Theories Of Leadership

Leader Member Exchange Theory, Contingency Theory, Path- Goal Leadership Theory Transformational Leadership Theory, Charismatic Theory.

BOOKS RECOMMENDED:

[1] Stephen P. Robbins, Organizational Behaviour, Pearson Edu., 10th Ed., 2003.
[2] Debra McGregor, Developing Thinking; Developing Learning. A Guide to Thinking Skills in Education, Open University Press, McGraw Hill House, 2007.
[3] Kumar Mahi. Stress Coping Skills Ebook, Health & Medicine, Technology, 2009.
[4] Stephen P. Robbins, Timothy A. Judge, Seema Sanghi, Organizational Behaviour, Dorling Kindersley (India) Pvt. Ltd., Pearson Edu., 2007.
[5] Ryan Carey, The Effective Altruism Handbook, Published in 2015 by the Centre For Effective Altruism Oxford, Oxfordshire United Kingdom.
[6] Life Skills – Skills for Life: A handbook, International Federation of Red Cross and Red Crescent Societies Reference Centre for Psychosocial Support, Paramedia 1662, Denmark. 1st edition, 2013.

Sem II

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR2C1 **Modeling and Simulation**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: **3 Hours**							

Course Objectives: To give exposure of stochastic processes and to show their importance in engineering education and research To develop skills to identify a process, its inputs and outputs. Then to develop a model and quantify the results. To give an hands on experience in MATLAB to be used as a simulation tool for the stochastic processes To develop an orientation towards research in electronics and computer engineering.
Prerequisite(s): Fundamental knowledge of Probability Theory.

COURSE CONTENTS

UNIT –I
Introduction to Probability Theory -Relative Frequency and Classical Definitions, Sample Space and Events, Conditional Probabilities, Independent Events, Bayes Formula, Bernoulli Trials.

UNIT –II
Random Variables- Definition, Discrete Random Variables, Probability mass Function , Distrribution Functions: Bernoulipmf, Bionomialpmf, Geometric pmf, Poisson pmf, ContinuousRandom Variables, Cumulative Distribution Function(CDF), Probability Density Function (PDF), Exponential Distribution, Reliability and failure rate, Normal Distribution, Uniform Distribution. Mean, Variance and Moments of Random Variables, Function of a Random Variable and it's Expectation, Jointly Distributed Random Variable.

UNIT –III
Markov Chains- Classification of stochastic process, Introductionto Markov chains, Classification of States, Transition Probabilities, Limiting State Probabilities, HigherTransition Probabilities, Concept of Transient States and Absorption Probabilities, Solution of Problems Based on Markov Chains.

UNIT –IV
Markov Processes -Introduction to Continues Time Markov Chains, Birthand Death Processes, The Transition Probability Function, Limiting Probabilities, Exponential Distribution & Poison Process. Solution of Problems Based on Continuous Time Markov Chains, Introduction to Queuing Theory and M/M/1 Queuing Systems.

UNIT –V
Simulation- Simulation of Queues, Statistical Inference and FewExamples on Simulation
Estimation of Mean and Variance, Confidence Interval, Regression and Correlation analysis

BOOKS RECOMMENDED

[1]. S.M. Ross, "Introduction to Probability Models, 9th Edition, Elsevier Publication", 2007.
[2]. K.S.Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", 2nd Edition , A Wiley-Interscience Publication.
[3]. Averill M. Law,W. David Kelton, "Simulation Modeling and Analysis", 3rd Edition, Tata McGraw-Hill Publication.
[4]. A Papoulis, S.VPillai, "Probability Random Variables and Stochastic Processes", 4th Edition, TMH Publication, 2002.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR2C2 **Mobile Communication Networks**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: **3 Hours**							

Course Objectives: To provide the knowledge of cellular concept, types of wireless networks, different generations mobile communication systems,, and the aspects of mobile radio environment which is very different than conventional communication system.
Prerequisite(s): Knowledge of digital communication, OSI Model and internet protocol.

COURSEF CONTENTS

Unit 1
Evolution of Modern Mobile Wireless Communication Systems : Different types of Wireless Communication, Classification of Wireless Networks: Wireless Local Area Networks, Personal Area Networks, Fixed Wirelessli Access, Ad-hoc and Sensor Networks, Satellite Cellular Communication, First Generation, Second Generation, Third Generation wireless Networks, All-IP Networks, Requirements for services, Technical Challenges of Wireless Communications.

Unit 2
Cellular Systems Design Fundamentals: Multiple access Techniques, Cellular Structutre, Cell Cluster, Frequency Reuse, Co-channel and Adjacent channel Interference, Enhancement of system Capacity, Channel Assignment, Cellular Communication priciples, Mobility Management, Radio Resource Management, 1G AMPS system.

Unit3
2G and 2.5 G Systems: GSM system architecture, Air interface, Lgical and Physical Channels, Voice encoding, channel encoding, Cryptography, Frequency hopping, Equalization in GSM, Connection establishment and Handover, Protocols and Signaling, Services and Billing.
GPRS system architecture, Signaling, Roaming, Interfaces and Related Protocols, IP internetworking Model, GPRS applications.

Unit 4
3G Systems: WCDMA/UMTS: System Overview, Air Interfaces, Physical and Logical Channels, Speech coding, Multiplexing, Channel Encoding, Spreading, Modulation, Power control, Connection Establishment, Handover.
3GPP LTE: System Overview, Physical Layer, Logical and Physical Channels, Physical Laye Procedures.

Unit 5
IP for Mobile Networks : Overview of IP, IP Routing protocols, Basic Mobile IP, IP for GPRS and UMTS, Integration of different Technologies, Mobility management in Wireless Networks, All IP Networks, Key technologies for 4G.

BOOKS RECOMMENDED:

[1]. A. F. Molisch, "Wireless Communicatins", Second Edition, Wiley Publications, 2014.
[2]. I. S. Misra, "Wireless Communications & Networks", Second Edition, MGH, 2013.
[3]. J. Schiller, “Wireless Communications”, Second Edition, Pearson Education, 2008.
[4]. T. S. Rappaport, Wireless Communications Principles & Practice, 2nd Edition, PHI, 2002.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	Instructions Hours per Week			Credits			
DCR2C3 System Design Using Verilog	L	T	P	L	T	P	Total
	3	1	2	3	1	1	5
Duration of Theory Paper: 3 Hours							

Course Objectives: To enable the students to translate a functional system description into appropriate digital blocks coded in Verilog .Perform synthesis, place, and route of a digital design into a target FPGA
Prerequisite(s): Digital Design, Microprocessor architecture, C++ language.

COURSE CONTENTS

UNIT –I
Overview of Digital Design with Verilog HDL -Evolution of CAD, emergence of HDLs, typical HDL-based design flow, why Verilog HDL?, trends in HDLs.
Hierarchical Modeling Concepts -Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block.
Basic Concepts -Lexical conventions, data types, system tasks, compiler directives.

UNIT -II
Modules and Ports-Module definition, port declaration, connecting ports, hierarchical name referencing.
Gate-Level Modeling -Modeling using basic Verilog gate primitives, description of andlor and buflnot type gates, rise, fall and turn-off delays, min, max, and typical delays.
Dataflow Modeling -Continuous assignments, delay specification, expressions, operators,operands, operator types.

UNIT -III
Behavioral Modeling -Structured procedures, initial and always, blocking'and nonblocking statements, delay control, event control, conditional statements, multiway branching, loops, sequential and parallel blocks.
Tasks and Functions -Differences between tasks and functions, declaration, invocation.
Useful Modeling Techniques -Procedural continuous assignments, overriding parameters, conditional compilation and execution, useful system tasks.

UNIT -IV
Timing and Delays -Distributed, lumped and pin-to-pin delays, specify blocks, parallel and full connection, timing checks, delay back-annotation.
Switch-Level Modeling- MOS and CMOS switches, bidirectional switches, modeling of power and ground, resistive switches, delay specification on switches.

UNIT -V
Logic Synthesis with Verilog HDL-Introduction to logic synthesis, impact of logic synthesis, Verilog HDL constructs and operators for logic synthesis, synthesis design flow, verification of synthesized circuits, modeling tips, design partitioning.

BOOKS RECOMMENDED
[1] Samir Palnitkar , *"Verilog HDL-A guige to Digital Design and Synthesis "* 2nd Edition, Pearson , 2006.
[2] J. Bhaskar, "*A Verilog HDL Primer*", B.S Publications,
[3] Douglas J. Smith, "*Hdl Chip Design : A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog"*.Doone Pubns ,1998.
[4] Blaine Readler , "*Verilog by Example: A Concise Introduction for FPGA Design*", Full Arc Press, 2011

List of Generic Elective II

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR2G1 **Broadband Access Networks**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**0**	**3**	**1**	**0**	**4**
Duration of Theory Paper: **3 Hours**							

Course Objectives: To provide a detailed structure and working of different networks used for accessing broadband signals.

Prerequisite(s): knowledge of analog and digital communication and basic.s of computer networks

COURSE CONTENTS

Unit 1

Introduction: Broadband access, Its definition, coverage and economin impact, Legacy broadband technologies, Fixed wireline broadband technologies (Digital subscriber line, Cable modem, Broadband over power line), Fixed wireless broadband technologies (MMDS, Free space optics , Satellite) Mobile wireless broadband technologies (GPRS, EDGE, UMTS).

Unit2

WLAN: Types, System architecture, Protocol Architecture, Medium access control CSMA/CA, Comparison of IEEE varients of WLAN (IEEE 802.11 – 802.11 ac), Frame formats, Modulation and coding, High Throughput WLANs., Wi-Fi based Wireless Mesh Networks.

Unit 3

WiMax: System Overview, Fixed Wi-Max, Mobile Wi-max, Physical Layer Overview (Modulation and coding, Physical and logical channels, Multiple antenna Techniques, Link Control), MAC Layer, Multihop relay WiMAX , Gigabit WiMAX, Wi-Max based Wireless Mesh Networks.

Unit 4

Optical Networking: Introduction and challenges- Advantages of optical network, WDM optical networks, WDM network evolution, WDM network construction, broadcast and select optical WDM network, wavelength routed optical WDM network, Challenges of optical WDMnetwork.**Optical Access Network** Introduction to access network, PON, EPON , GPON and WDMEPON: overview, principal of operation, architecture, standards; dynamic Bandwidth allocation and Quality of Service.

Unit 5

Optical switching &FiWi access networks Optical packet switching basics, slotted and unslotted networks, header and packet format, contention resolution in OPS networks, self routing, examples on OPS node architecture, optical burst switching, signaling and routing protocols for OBS networks, contention resolution in OBS networks, Radio over Fiber, Radio and Fiber, Integration of EPON and WiMax, Hybrid Wireless-Optical Broadband Access Network / Fiber wireless (FiWi) access networks.

BOOKS RECOMMENDED:

[1]. Optical Network Series: Biswanath Mukherjee, Springer, 2006.
[2]. Optical Networks: R.Ramaswami and K.Sivarajan, Â Morgan Kaufmann Publishers, 2nd ed., 2002.
[3]. A. F. Molisch, "Wireless Communicatins", Second Edition, Wiley Publications, 2014.
[4]. Schiller, “Wireless Communications”, Second Edition, Pearson Education, 2008.
[5]. 3. Optical Switching Networks: Mayer & Martin, Cambridge University Press, 2008.
[6]. Broadband Access Networks -Technologies and Deployments, Editors: Shami, Abdallah, Maier, Martin, Assi, Chadi (Eds.) , Springer, 2009.
[7]. FiWi Access Networks, Martin Maier, NavidGhazisaidi, Cambridge University Press,2011.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR2G2 Nanodevices & Nanosensors	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**0**	**3**	**1**	**0**	**4**
Duration of Theory Paper: 3 Hours							

Course Objectives: this course will focus on understanding of the basic structure principals of Nano-devices and sensors.
Prerequisite(s): Introduce the quantum mechanical concepts needed to understand the operation

COURSE CONTENTS

Unit-I

QUANTUM DEVICES Quantum Electronic devices – Electrons in mesocopic structures – Short channel, MOS Transistor – split Gate Transistor – Electron wave transistor – Electron spin transistor – Quantum Dot array – Quantum computer- Bit and Qubit. Carbon Nanotube based logic gates, optical devices. . Connection with quantum dots, quantum wires, and quantum wells

Unit-II

TUNNELING DEVICES Tunneling element – Tunnel Effect and Tunneling Elements-Tunneling Diode – Resonant Tunneling Diode – Three -Terminal Resonate Tunneling Devices-Technology of RTD-Digital circuits design based on RTDs - Basics Logic Circuits – Single Electron Transistor(SET) – Principle – Coulomb Blockade- Performance – Technology- Circuit Design- Logic and Memory Circuits – SET adder as an Example of a Distributed Circuit.

Unit-III

NANOSENSORS I Micro and nano-sensors, Fundamentals of sensors, biosensor, micro fluids, Packaging and characterization of sensors, Method of packaging at zero level, dye level and first level. Sensors for aerospace and defense: Accelerometer, Pressure Sensor, Night Vision System, Nano tweezers, nano-cutting tools, Integration of sensor with actuators and electronic circuitry,

Unit-IV

NANOSENSORS II Sensor for bio-medical applications: Cardiology, Neurology and as diagnostic tool, For other civil applications: metrology, bridges etc. Biosensors. Clinical Diagnostics, generation of biosensors, immobilization, characteristics, applications, conducting Polymer based sensor, DNA Biosensors, optical sensors. Biochips. Metal Insulator Semiconductor devices, molecular electronics, information storage, molecular switching, Schottky devices,

Unit-V

NEMS Inertial sensors – accelerometer – gyroscope - micromechanical pressure sensors – pizoresistive –capacitive - microrobotics – micro channel heat sinks – optical MEMS – visual display – precision optical platform – optical data switching – RF MEMS – MEMS variable capacitors – MEMS switches – Resonators.

BOOKS RECOMMENDED:

[1]. K. Goser, P. Glosekotter and J. Dienstuhl, “Nanoelectronics and Nanosystems-From Transistors to Molecular Quantum Devices” , Springer, 2004.
[2]. HerveRigneault, Jean-Michel Lourtioz, Claude Delalande, Ariel Levenson, “Nanophotonics”, ISTE.
[3]. W.R.Fahrner, “Nanotechnology and Nanoelectronics – Materials, Devices and Measurement Techniques” Springer, 2006 13

[4]. Nano Engineering in Science &Technology: An introduction to the world of nano design by Michael Rieth.
[5]. Tai –Ran Hsu, "MEMS & Microsystems Design and Manufacture", Tata McGraw-Hill publication, 2001.
[6]. P. Rai-Choudhury, "MEMS and MOEMS technology and applications", PHI learning private Ltd, 2009.
[7]. Mohamed Gad-el-Hak, "The MEMS Handbook", CRC Press, 2002.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR2G3 **Advance Antenna System**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**0**	**3**	**1**	**0**	**4**
Duration of Theory Paper: **3 Hours**							

Objectives: Achieve the skill to analyze and design advanced antennas and antenna systems using numerical techniques
Prerequisites: Eelectromagnetic field theory.

COURSE CONTENTS

UNIT I
Fundamental Concepts:
Physical concept of radiation, Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

UNIT II
Radiation from Wires and Loops:
Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

UNIT III
Aperture Antennas:
Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts.
Broadband Antennas:
Broadband concept, Log-periodic antennas, frequency independent antennas.

UNIT IV
Microstrip Antennas:
Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.
Antenna Arrays:
Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays.

UNIT V
Basic Concepts of Smart Antennas:
Concept and benefits of smart antennas, Fixed weight beamforming basics, Adaptive beamforming

Books Recommended:
[1]. C.A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley & Sons., 2005.
[2]. W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design", 2nd Ed., John Wiley & Sons., 1998.
[3]. R. S. Elliot, "Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.
[4]. R. E. Collin, "Antennas and Radio Wave Propagation", McGraw-Hill., 1985.
[5]. F. B. Gross, "Smart Antennas for Wireless Communications", McGraw-Hill., 2005.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR2G4 Industrial Communication	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**0**	**3**	**1**	**0**	**4**
Duration of Theory Paper: 3 Hours							

Objective: The focus of the course is on the protocols, algorithms and tools needed to support the development and delivery of advanced Industrial network for Control and communication
Prerequisites : Programming ability and an understanding of basic networking, OS, and architecture issues.

COURSE CONTENTS

UNIT-I
Historical Overview of Industrial Automation and Communication Networks,Hierarchical Levels in Industrial, Communication Networks,Transmission Methods,Industrial Network Components,Network Topology.
Serial Communication Standards: Standards organizations, Serial data communication interface standards, Balanced and unbalanced transmission lines, Synchronous & asynchronous communication, RS 232,422,485 interface standards and Troubleshooting.
Parallel Communication Standards : Parallel data communications interface standards - General purpose interface bus (GPIB) or IEEE - 488, The Centronics interface standard, The universal serial bus (USB), Different configuration modes - two wire & four wire point - to -point & multidrop connections.

UNIT-II
HART Communication protocol - Evolution of signal standards, features of HART protocol,Communication modes, HART networks, HART Data format or telegram structure, field device & Control system interface to HART bus, HART cabling considerations, HART commands and types, HART field controller implementation, 3 layers of HART-OSI model, DDL and compatibility, Advantages and applications of HART protocol.

UNIT-III
Field Bus: Basics, Architecture, OSI -model, FF/Foundation FB segments,interconnection type - distributed and Chicken foot, FFB types -H1 & HSE, Network design and system configuration, General considerations,advantages of FB & Foundation FB and their comparison.

UNIT-IV
Controller Area Network DeviceNet, CANopen, Interbus, Actuator Sensor Interface (AS-I), ControlNet.

UNIT-V
An Introduction to Industrial Ethernet Ethernet's Roots',Ethernet Physical Layer, Data Link Layer, The Ethernet Frame, Hubs and Switches, Higher Level Network Functions, Ethernet and Industrial Systems, Industrial Ethernet communication protocols

Books Recommended:

[1]. Steve Mackay, John Park and Edwin Wright, "Practical Data Communication for Instrumentation and Control", Newnes Elsevier,2002.
[2]. David Bailey and Edwin wright , "Practical SCADA for industry" , Newnes Elsevier
[3]. Romilly Bowden, 'HART application Guide', HART Communication Foundation,1999

List of Elective II

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR2E1	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
Analog and Digital VLSI Circuit Design	**3**	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Course Objectives: This course presents the fundamental of CMOS VLSI design with different VLSI design methodologies and combinational, sequential and semiconductor memory circuit design. It also covers the limitations of CMOS in NANO technology with introduction to the NANO Technology.
Prerequisite(s): Knowledge of semiconductor devices is required.

COURSE CONTENTS

UNIT -I
Introduction: VLSI design flow, VLSI design style, Fabrication process Flow: basic Steps, the CMOS n-well Process.Metal oxide semiconductor (MOS) structure, Types of MOSFET: Enhancement and Depletion. Structure and operation of MOS transistor.MOSFET process simulation.

UNIT -II
MOS transistor: threshold voltage of MOSFET, controlling of threshold voltage, MOSFET current – Voltage Characteristics.Transconductance, Drain conduction. Aspect ratio, process parameters, second order effects, MOS small signal and Large signal model, MOS capacitances.

UNIT -III
CMOS Inverter: Analysis of different types of inverter circuit, CMOS inverter, transfer characteristic, calculation of propagation delay, rise time, fall time, noise margin and power dissipation for CMOS Inverter. Effect of threshold voltage and supply voltage on Delay and power dissipation.

UNIT -IV
CMOS circuit Design: CMOS logic**,** pseudo NMOS logic, pass transistor logic, Transmission Gate logic and Dynamic logic circuit design. Designing of Combinational logic circuit, sequential logic circuit design and semiconductor memory circuit.

Unit –V
CMOSAnalog Circuit Design: Large signal models, small signal models, current sources, single stage amplifiers, differential amplifiers, operational amplifiers, frequency response, frequency response of amplifiers, frequency response of operational amplifiers, stability and frequency compensation, frequency compensation

BOOKS RECOMMENDED

[1]. Sung-mo Kang and Yusuf Leblebici, *CMOS Digital Integrated Circuit analysis and Design,* 3rd Edition, Tata McGraw-Hill.
[2]. [Neil H.E. Weste and Kamran Esharhian, *Principal of CMOS VLSI design*,2nd Edition, PHI,.anded), AW/Pearson, 2001.
[3]. CMOS mixed-signal circuit design by R. Jacob BakerWiley India, IEEE press, reprint 2008.
[4]. Design of analogCMOS integrated circuits by BehadRazaviMcGraw-Hill, 2003.

List of experiment:

Note : Use the BSIM3v3 (T-SPICE Level 49) model to characterize a 0.18µm CMOS process (TSMC).

1. Determine the threshold voltage $V_{TH,}$ for the NMOS and PMOS devices (for V_{BS}=0, L=0.18µm and W= 1µm), by extrapolating from the I_D-V_{GS} curve at low V_{DS}. Explain your circuit setup. How does this result compare to values reported in the model file? Also, determine the body-effect parameter.

2. Determine the subthreshold slope factor S for the NMOS and PMOS devices (at V_{DS} =1.8V, room temperature). Determine the leakage currents at V_{GS} =0 V. Repeatit at a lower temperature T=77k.

3. Determine the effects of channel length L on the threshold voltage V_{Th} between 0.18 µm to 2.0 µm. Draw V_{Th} of the NMOS and PMOS as a function of L (for V_{DS}=1.8 and 1.2V).

4. Determine the effects of drain-source voltage $V_{DS,}$ on the threshold voltageV_{Th}between and 1.8V.Draw V_{Th} as a function of V_{DS} (for L=0.18µm). What is the measured DIBL factor?

5. With the given CMOS inverter Circuit calculate and estimate the static Characteristics

   (a) Determine the VTC of CMOS Inverter
   (b) Obtain the $NM_{H,}$ NM_{L}, and V_M for the inverter

   Dynamic Characteristics

   (c) Measure the t_{pHL}, t_{pLH}, $t_{P,}$ $t_{r,}$$t_f$
   (d) Power Consumption with varying load capacitances from 100fF to 500fF. And compute the power Delay Product (PDP) foe the 0.18 Micron technologies.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR2E2 Network Security	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Course Objectives:

Prerequisite(s):

COURSE CONTENT

UNIT –I:

Introduction: Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security.Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques.

UNIT –II:

Modern Techniques: Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of operations.

Algorithms: Triple DES, International Data Encryption algorithm, Blowfish, RC5, CAST-128, RC2, Characteristics of Advanced Symmetric block cifers.

Conventional Encryption: Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation.

Public Key Cryptography: Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography.

UNIT –III:

Number Theory: Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete alogarithms.

Message authentication and Hash Functions: Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.

UNIT –IV:

Hash and Mac Algorithms: MD File, Message digest Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC.

Digital signatures and Authentication Protocols: Digital signatures, Authentication ,Protocols, Digital signature standards.

Authentication Applications: Kerberos, X.509 directory Authentication service.Electronic Mail Security: Pretty Good Privacy, S/MIME.

UNIT –V:

IP Security: Overview, Architecture, Authentication, Encapsulating Security Payload, Combining security Associations, Key Management.

Web Security: Web Security requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction.

Intruders, Viruses and Worms: Intruders, Viruses and Related threats.

Fire Walls: Fire wall Design Principles, Trusted systems.

Books Recommended:

[1]. Cryptography and Network Security: Principles and Practice - William Stallings, Pearson Education.

[2]. 1.Network Security - Private Communication in a Public World by Charlie Kaufman, Radia Perlman

and Mike Speciner, Pearson/PHI.
[3]. Principles of Information Security, Whitman, Thomson.
[4]. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
[5]. Introduction to Cryptography, Buchmann, Springer.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR1E3 **Mobile Computing**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: **3 Hours**							

Objective: The focus of the course is on development and delivery of Android based software for mobile devices

Prerequisites : Programming ability and an understanding of basic JAVA

COURSE CONTENTS

UNIT-1

An Open Platform for Mobile Development,Native Android Applications,Android SDK Features,Introducing the Open Handset Alliance,Introducing the Development Framework,Developing for Android,Developing for Mobile Devices,Android Development Tools

UNIT-2

Creating Applications and Activities,Introducing the Application Manifest,The Android Application Life Cycle ,Understanding Application Priority and Process States ,Externalizing Resources,Creating User Interfaces,Fundamental Android U I Design,Introducing Views,Introducing Layouts,Creating New Views,Creating and Using Menu s

UNIT-3

Introducing Intents,Introducing Adapters, Using Internet Resources, Introducing Dialogs,Android Techniques for Saving Data,Saving Simple Application Data,Saving and Loading Files,Databases in Android,Introducing Content Providers

UNIT-4

Maps, Geocoding, and Location-Based Services,Setting up the Emulator with Test Providers,Selecting a Location Provider,Using Proximity Alerts,Using the Geocoder,Creating Map - Based Activities,Working in the Background,Introducing Services,Using Background Worker Threads,Introducing Notifcations,Using Alarms

UNIT-5

Peer-to-Peer Communication,Introducing Android Instant Messaging,Introducing SMS,Accessing Android Hardware,Using the Media APIs, Camera, Sensor Manager, Accelerometer and Compass,Bluetooth,Android Telephony,Managing Net work and Wi-Fi Connections, Controlling Device Vibration, Advanced Android Development,Paranoid Android,Using AID L to Support IP C for Services,Implementing an AIDL Interface, Building Rich User Interfaces

Books Recommended:

[1]. Reto Meier, "Professional Android Application Development", Wiley Publication , 2009.
[2]. J.F. DiMarzio, "Android A Programmer's Guide", TATA McGraw Hill, 2008.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
DCR2E4	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
Software testing and Quality assurance	**3**	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Course Objectives: To enhance students software testing and analysis skills.

Prerequisites

COURSE OF CONTENTS

UNIT I
QUALITY MODELS
Introduction-views on quality-cost of quality-quality models-Statistics and measurements-Statistics and measurements-Analysis of given source code using SQALE and Sonar models.

UNIT II
QUALITY FRAMEWORK and TESTING:
Quality framework characteristics – verification- Measuring test adequacy overview of black box testing techniques-decision tables-combinatorial testing classification tree method- white box testing-Random and exploratory.

UNIT III
SOFTWARE ANALYSIS
Introduction to Static analysis- Static analyzer for finding dynamic programming errors-dataflow testing – procedure to apply data flow testing- examples performance analysis and verification-Security analysis and verification –Software vulnerabilities and exploitation.

UNIT IV
QUASAR METHOD
Applying the Design structure matrix to system decomposition and integration problems- achieving Agility through Architecture visibility-Recovering and verifying architecture through design structure matrices.

UNIT V
QUALITY MANAGEMENT
Project quality management- Essential Testing-Test driven development –guidance for software verification and validation plans-Master test planning.

Books Recommended:

[1]. Edited by KshirasagarNaik and PriyadarshiTripathy, *"Software testing andQuality Assurance: theory and practice"*, John wiley& sons Inc, copyright,2008.
[2]. Daniel Galin, *"Software Quality Assurance from Theory to Implementation"*,Pearson Education Ltd., 2004.
[3]. *"Quality models to engineering quality requirements"* published in journal ofobject technology, chair of Software engineering, Vol.2, No. 5 Sep. – October2003. Online at http://www.jot.sm.
[4]. Tyson R. Browning, A review and new directions, *"Applying the designstructure matrix to system decomposition and integration problems"*, IEEEtransactions on Engineering management, Vol. 48, No.3, August 2001.
[5]. Neerajsangal and frank waldman in the journal of *"Defense softwareengineering Dependency models to mana*

Soft –Skill 2

Devi Ahilya University, Indore, India Institute of Engineering & Technology				ME – I Year (Spl Digital Communication) Semester- B			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
ASR2S2: **Soft Skill-2**	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	2	**-**	**-**	**2**	**-**	**-**	**2**
Duration of Theory Paper: 3 Hours							

Objective: To learn about basic Life and Organizational skills.
Pre-requisites: Nil.

COURSE CONTENTS

Unit I
Perception & Learning
Perception: Importance of Perception, Factors influencing perception – Selective Perception, Halo effect, Projection, Stereotyping.
Learning : Defining & Importance, Theories of Learning – Behavioral, Cognitive & Social Learning, Learning Curves – Diminishing-returns, Increasing-returns & S Shaped. Reinforcement – Positive, Negative, Punishment & Extinction.

Unit II
Values, Attitude & Job Satisfaction
Values – Meaning, Importance & Types; Loyalty & Ethical Behaviour; Values across Cultures, Hofstede's Framework for assessing Cultures.
Attitude & Job Satisfaction – Meaning & Components of Attitude; Attitudes towards Job – Job Satisfaction, Job Involvement, Organizational Commitment; Job Satisfaction & Productivity, Absenteeism & Turnover; Attitudes & Consistency; Cognitive Dissonance Theory.

Unit III
Group Dynamics
Groups – Definition & Meaning , Stages & Process of Group Formation, types,
Work Group Behaviour – structure, factors affecting – Norms, Conformity, status, Groupthink, Group shift, Social Loafing, Production Blocking. Group Decision making techniques.

Unit IV
Team Building & Sustaining
Team : Meaning , Types & Process of Team- building, Characteristics of a Matrix, Organizational Matrix and Team work ,Conflict and Communication in teams , Effective Team Member and Team Relations , Successful Teams, Team Leadership, Team Performance - Evaluation and Rewarding System .

Unit V
Organizational Dynamics
Power & Politics : Bases of Power- Formal & Personal, Dependency- a key to Power, Contrasting Leadership & Power, Coalitions, Sexual Harassment, Power Tactics, Organizational Politics, Impression Management.
Organizational Culture – Organizational Structure, Work Specialization, Departmentalization, Chain of Command, Span of Control, Centralization & Decentralization. Organizational Culture & National Culture, Resistance to Change & Change Management.

BOOKS RECOMMENDED:
[1] Stephen P. Robbins, Organizational Behaviour, Pearson Edu., 10th Ed., 2003.
[2] R. D. Agarwal, Organization & Management, Tata McGraw-Hill Publishing Co.Ltd, 2007
[3] Jit S. Chandan , Organizational Behaviour, Vikas Publishing House, 3rd Ed., 2006.
[4] Stephen P. Robbins, Timothy A. Judge, Seema Sanghi, Organizational Behaviour, Dorling Kindersley (India) Pvt. Ltd., Pearson Edu., 2007.

[5] Ramneek Kapoor, Managerial Skills, Pathmaker Bangalore, Nakoda Publishers & Printers, 1st Ed.
[6] Life Skills – Skills for Life: A handbook, International Federation of Red Cross and Red Crescent Societies Reference Centre for Psychosocial Support, Paramedia 1662, Denmark. 1st edition, 2013.