Syllabus & Scheme of PG Program

Master of Engineering

(Digital Communication)

Electronics & Communication Engineering

2022-23

IPS ACADEMY

INSTITUTE OF ENGINEERING & SCIENCE, INDORE

(A UGC Autonomous Institute affiliated to RGPV)

IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Scheme Based on AICTE Flexible Curriculum

Department of Electronics & Communication Engineering

M. E. (DC) Semester I (First year)

S.No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work Lab Work & Sessional		L	T	P	
1.	PSMC-MEDC101	PSMC	Differential Calculus & Random Processes	70	20	10	-	-	100	3	-	-	3
2.	PSCC-MEDC101	PSCC	Advanced Digital Communication (ADC)	70	20	10	-	-	100	3	1	-	4
3.	PSCC-MEDC102	PSCC	Digital Signal Processing (DSP) & Its Application	70	20	10	-	-	100	3	1	-	4
4.	PSEC-MEDC101	PSEC	Program Specific Elective Course-1	70	20	10	-	-	100	3	-	-	3
5.	LC-MEDC101	LC	ADC & Embedded System Design Lab	-	-	-	60	40	100	-	-	4	2
6.	LC-MEDC102	LC	DSP Application Lab	-	-	-	60	40	100	-	-	4	2
7.	MLC-MEDC101	MLC	Basics of Wireless Communication	70	20	10	-	-	100	2	-	-	2
8.	AUD-MEDC101	AUD	Disaster Management	-	-	-	-	-		2	-	-	0
			Total	350	100	50	120	80	700	16	2	8	20

Program Specific Elective Courses-1 (PSDC-MEEC101)
(A) Embedded System Design
(B) Optical Network Design
(C) SDR & Cognitive Radio

1 Hr Lecture	1 Hr Tutorial	2 Hr Practical
1 Credit	1 Credit	1 Credit

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
PSCC-MEDC101	Advanced Digital Communication	3: 1: 0 (40 Hrs.)	4

Recommended Prerequisite: Analog Communication, Digital Communication

Course Objective: The objective is to understand different digital modulation techniques, optimum receivers, signal design band limited channels and concept of equalizers and fading channels.

THEORY:

Module I (8 Hrs.)
Introduction to digital modulation technique and their spectral characteristics, optimum receivers for signals corrupted by AWGN and their performance for memory less channel, optimum receivers for CPM, regenerative repeaters and link budget analysis.

Module II (8 Hrs.)
Estimation of signal parameters, carrier phase and symbol timings. Signal design band limited channels and their characterization, probability of error in detection PAM with zero ISI, modulation codes for spectrum spacing.

Module III (8 Hrs.)
Optimum receivers for channels with ISI and AWGN, linear equalization and decision feedback equalization, adaptive linear and adaptive decision feedback equalizer.

Module IV (8 Hrs.)
Multi channel and multi carrier systems, spread spectrum signals for digital communication, direct sequence spread spectrum signals and frequency hopped spread spectrum signals and their performances, OFDM.

Module V (8 Hrs.)
Characterization of fading multipath channels, frequency non-selective slowly fading channels, diversity techniques for fading multi path channels, coded waveform for fading channels and their application.

Assessment: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Understand different modulation techniques and optimum receivers for AWGN channel.
2. Understand about estimation of signal parameters and signal design for band limited channel.
3. Understand different type of equalizers to improve performance under fading channels.
4. Understand the performance of spread spectrum techniques and multicarrier systems.
5. Understand the multipath fading channels and diversity techniques.

Text/ Reference Books:

1. John G. Proakis, “Digital Communications”, McGraw Hill, 5th Edition, 2008.
2. Glover and Grantt, “Digital Communication”, PHI, 3rd Edition, 2009.
3. Simon Haykin, “Digital communications”, 2nd edition, John Wiley, 2014
4. Bernard Sklar, “Digital Communications Fundamentals and Applications”, Pearson Education, 2nd Edition, 2007

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
PSCC-MEDC102	Digital Signal Processing (DSP) & Its Application	3:1:0 (40 Hrs.)	4

Recommended Prerequisite: Fundamental of mathematics, DSP.

Course Objective: The purpose of this course is to make the students learn about theoretical basis of DSP, with the method of description of discrete and digital signal and systems in the domain and transform domain. Also learn the different transform and processing like Hilberts and Haar Transform speech processing and image processing.

THEORY:

Module I (8 Hrs.)
Review of Discrete time signals: sequences, representation. Discrete time systems: linear, time in variant, LTI systems, properties, and constant coefficients difference equations. Frequency Domain representation of discrete time signals and systems , review of Z Transform – Properties, ROC, Stability, Causality, Criterion. Inverse Z Transform, Recursive and Non Recursive systems, Realization of discrete time system.

Module II(8 Hrs.)
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.

ModuleIII (8 Hrs.)
Time frequency concepts of signal, Stationary Vs Non-Stationary Signals, Fourier Transform, Short Time Fourier Transform, Continues Wavelet Transform, Scale, Time & frequency resolution, The Discrete Wavelet Transform (DWT).

Module IV(8 Hrs.)
Signal normalization, filter, feature extraction, image representation: Gray scale and color images, image sampling and quantization. Image enhancement: Filter in spatial and frequency domains, histogram based processing and homomorphism filtering. Edge Detection edge linking, boundary descriptors. Image Segmentation: Thresholding, region based segmentation Image Compression: lossy and lossless compression techniques, JPEG, Image reconstruction from projections.

Module V (8 Hrs.)

Discrete time Random signals: Discrete time random process, Averages, Spectrum Representation of finite energy signals, response of linear systems to random signals. Power spectrum estimation: Basic principles of spectrum estimation, estimate of auto con variance, power spectrum, cross con variance and cross spectrum. Advance signal processing technique and transforms: multi rate signal processing- down sampling/up sampling, introduction to discrete Hilberts Transform, Haar Transform etc.

Course Outcomes:

1. Students earned credits will develop ability to
2. Students will be able to solve difference equation and Z transforms equation.
3. Students will able to design IIR and FIR filter.
4. Students will perform speech and multi rate processing.
5. Students will perform image processing.
6. Students will be able to know about discrete time random process, Hilberts and Haar Transform.

Text/Reference Books:

1. Oppenheim, Schafer, “Digital Signal Processing”, PHI Learning, 1975.
2. Proakis, “Digital Signal Processing”, Pearson Education, 2009.
3. Sanjay Sharma, “Digital Signal Processing” 5th Edition, S. K. Kataria& Sons. 2009.
4. Ingle, Proakis, “Digital Signal Processing- A MATLAB based Approach”, Thompson Cengage Learning, 2012.
5. S. Salivahanan, “Digital signal processing”: Tata McGraw-Hill Education. 2011.
6. Kenneth R Castleman “Digital Image Processing”, Pearson Education.
7. Rafael C Gonzalez, “Digital Image Processing” 4th Edition by, Pearson India.
8. RobiPolikar, The Engineer’s guide to wavelet Analysishttps://users.rowan.edu/polikar/WTtutorial.html

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
PSEC-MEDC101(A)	Embedded System Design	3:0:0 (40 Hrs.)	3

Recommended Prerequisites : Fundamentals of embedded system, Processors

Course Objectives :
1. To study Embedded System Overview.
2. To study some advanced Architectural Issues : CISC, RISC, DSP and Harvard/ Princeton on Architectures.
3. To learn different of microcontrollers used in embedded system

THEORY:

Module I (8 Hrs.)
Embedded System Overview: Embedded System definition. Processor Technology: General purpose, Single Purpose, Application Specific, Super scalar, Pipelined, Very Long Instruction Word (VLIW) Processor, Microprocessors, Micro controllers and DSP Processors. Embedded Processors in VLSI circuit.

Module II (8 Hrs.)
Architectural Issues: CISC, RISC, DSP and Harvard/Princeton Architectures. Memory: ROM, EPROM, EEPROM, FLASH, RAM, SRAM, DRAM, SDRAM, NVRAM, EDORAM, DDRRAM, Memory Hierarchy and Cache. Interfacing: Interfacing using Glue Logic, Interrupt, DMA, I/O Bus structure, I/O devices, Serial Communication Protocols, Parallel Communication Protocols, Wireless Protocols.

Module III (8 Hrs.)
Introduction to 8-bit Microcontrollers e.g. 8051, 68HC11, 80196, Timers/Counters, USART. Detailed study of 8051 microcontroller, with its programming in assembly language and Interrupts, Serial Programming etc.

Module IV (8 Hrs.)
Interfacing of Microcontroller such as SPI, PWM, WDT, Input Capture , Output Compare Modes, Interfacing LED, Switches, ADC, DAC, LCD , RTC. Idea about the C programming of Microcontroller. I2C, CAN bus architecture.

Module V (8 Hrs.)
Introduction to 16/32-bit microcontrollers. Introduction to ARM Architecture and Organization, Difference between ARM7, ARM9 & ARM11 TDMI, ARM programming model, ARM Instruction set.

Course Outcomes:

Students earning credits will develop ability to:

1. To understand overview of embedded system and DSP processor
2. To design & understand CIRC, RISC and various architectures
3. To understand different types of Microcontrollers & different ports.
4. To understand interfacing of microcontroller with various input output devices.
5. To design and understand various ARM processor.

Text/References Books:

1. Dr. RajKamal, Embedded Systems, TMH, 2nd edition 2008.
2. K. J. Ayala , 8051 Microcontrollers, Penram International, 3nd Edition 2007M. A. Mazidi & J. G. Mazidi, 8051 Microcontroller and Embedded System, Pearson Education Asia 2nd edition 2006.
3. J. W. Valvano, Embedded Microcomputer Systems - Real Time Interfacing, Thomson Asia Pte. Ltd. 2nd edition 2012.
4. R. H. Barnett, 8051 family of Microcontrollers, PHI, 2nd edition 2012.
5. Peter Spasov, Microcontroller Technology: The 68HC11, PHI, 4th Edition 2001.
6. Dr. Rajkamal, Microcontrollers (Architecture, Programming, Interfacing and System Design), Pearson Education. 3nd Edition 2009

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
PSEC-MEDC101(B)	Optical Network Design	2:1:0 (40 Hrs.)	3

Recommended Prerequisite: Optical Fiber Communication

Course Objective: To learn the fundamentals of optical network design and architecture of the optical networks. In addition, to know the challenges of optical network design for different applications such as QoS, Fiber to Home, deployment of fiber, support for 5G/6G services etc.

THEORY:

Module I (8 Hrs.)
Wavelength division multiplexing, wavelength convertor, review of OSI architecture, Optical Sources and detectors, Optical Amplifier etc. Practical optical networks: NSFNET, EON, ARPANET etc.

Module II (8 Hrs.)
Static and dynamic traffic in optical network. Routing and Wavelength Assignment problem (RWA), Routing strategies: Fixed, Fixed alternate, Dynamic, Dijkstra Routing. Wavelength Assignment Strategies: random, first fit, least used, most used, max sum etc. Optical multicast routing: node architecture, tree generation, and virtual source-based trees

Module III (8 Hrs.)
Multicore fiber, cross connect problem in multicore fiber, different types of multicore fiber, Routing modulation and core assignment problem.

Module IV (8 Hrs.)
Elastic optical network: What is elasticity and elastic optical network architecture, frequency slots, Routing and spectrum assignment problem (RSA), spectrum assignment constraints: continuity and contiguity constraints. Effect of modulation on bandwidth assignments.

Module V (8 Hrs.)
Design of survivable optical network, Survivability: Protection and restoration, path based and link based strategies, segment based strategies. Single and double link failure model, multiple failure in optical networks.

Assessment: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Illustrate and Review Fundamentals of WDM Optical network
2. Illustrate and Analyze Routing and wavelength assignment strategies
3. Illustrate and Analyze Multicore fiber network.
4. Illustrate and Design Elastic optical network.
5. Illustrate and Analyze Survivability in WDM optical network

Text/ Reference Books:

1. CSR Murthy, G Mohan, "WDM Optical Networks: Concepts, Design, and Algorithms", 2rd editionPHI.2002.
2. Luis, Mark, "Provisioning, Recovery, and In-Operation Planning in Elastic Optical Networks", 1st editionWaily. 2017
3. Canhui (Sam) Ou, Biswanath Mukherjee, "Survivable Optical WDM Networks", 1st editionSpringer.2005
4. Biswanath Mukherjee, "Optical Communication Networks", 1st editionMCH. 1997

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
PSEC-MEDC101(C)	SDR & Cognitive Radio	3:0:0 (40 Hrs.)	3

Recommended Prerequisite: Communication Networks, Mobile Communication.

Course Objective: To make the students understand the fundamental concepts Software Defined Radios (SDR) and Cognitive Radio. This Course provides Comprehensive coverage of hardware and software architecture of software defined radio .The Course deals with the design of the wireless networks based on the cognitive radios.

THEORY:

Module I (8 Hrs.)
Introduction to Software Defined Radio: Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

Module II (8 Hrs.)
SDR Architecture: Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

Module III (8 Hrs.)
Introduction to Cognitive Radios: Marking radio self-aware, cognitive techniques– position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

Module IV (8 Hrs.)
Cognitive Radio Architecture: Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

Module V (8 Hrs.)
Next Generation Wireless Networks: The XG Network Architecture, Spectrum sensing, Spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross-layer design, channel modeling, RF front end design and applications.

Assessment: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Describe the basics of the software defined radios.
2. Learn the hardware and software architecture of software defined radio.
3. Design the wireless networks based on the cognitive radios.
4. Gives an understanding of cognitive radio architecture.
5. Explain the concepts behind the wireless networks and next generation networks.

Text/ Reference Books:

1. Joseph Mitola III, "Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", JohnWiley & Sons Ltd. 2000.
2. Thomas W. Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", ARTECH HOUSE .2009.
3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.
4. Ian F. Akyildiz, Won–Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access /cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.
5. Simon Haykin, "Cognitive Radio: Brain–Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.
6. Hasari Celebi, Huseyin Arslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications, Jan 2008.
7. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.
8. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.
9. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010, www.nptel.ac.in.
10. Jeffrey H. Reed, "Software Radio: A Modern Approach to Radio Engineering" Pearson Education Low Price Edition.
11. Kwang Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd.

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
LC- MEDC101	ADC & Embedded System Design Lab	0:0:4	2

Recommended Prerequisite: Communication, Microcontroller

Course Objective: The objective is to design and simulate different type of digital modulation techniques and study development tools for ATMEL/PIC microcontroller and to write program to interface LCD.

LAB:

List of Experiments

1. To perform and analyze experiment of sampling process, signal reconstruction and aliasing.
2. To perform and analyze experiment of Time Division Multiplexing (TDM).
3. To perform and analyze experiment of ASK Modulation and Demodulation
4. To perform and analyze experiment of FSK Modulation and Demodulation
5. To perform and analyze experiment of PSK Modulation and Demodulation
6. To perform and analyze experiment of Quadrature Phase Shift Keying (QPSK) Modulation and Demodulation
7. To perform QPSK modulation with Rayleigh fading & AWGN using MATLAB.
8. To study development tools/environment for ATMEL/PIC microcontroller programme and Architecture.
9. To write an assembly language program to add, subtract, multiply, divide 16 bit data by Atmel microcontroller.
10. To write an assembly language program to generate 10 KHz frequency using interrupts on P1.2.
11. To study and analyze the interfacing of 16 x 2 LCD.
12. To implement, analyze the interfacing of seven segment display.
13. To study and Program Transmission and Reception of data through serial port.

Assessment: Internal viva, Continuous evalution of experiments, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Design and demonstrate different type of digital modulation techniques.
2. Simulate the digital modulation schemes with the display of waveforms.

3. Study development tools for ATMEL/PIC microcontroller.
4. Study interfacing of LCD and seven segment display.

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
MLC-MEDC101	Basics of Wireless Communication	2:0:0 (40 Hrs.)	2

Recommended Prerequisite: Analog Communication, Digital Communication, Antenna & Wave Propagation, Mobile Communication

Course Objective: The objective is to study the characteristics of wireless channel, channel models, design of cellular system, transceivers and multipath mitigation techniques.

THEORY:

Module I (8 Hrs.)
Wireless Channels: Large scale path loss- Path loss models: Free Space and Two-Ray models -Link Budget design - Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth - Doppler spread & Coherence time, fading due to Multipath time delay spread - flat fading - frequency selective fading - Fading due to Doppler spread - fast fading - slow fading.

Module II (8 Hrs.)
Channel models: Narrowband, wideband and directional models, deterministic channel-modeling methods.
Channel sounding: Introduction, time domain measurements, frequency domain analysis, modified measurement methods, directionally resolved measurements.
Antennas: Introduction, antennas for mobile stations, antennas for base stations.

Module III (8 Hrs.)
Cellular Architecture: Multiple Access techniques - FDMA, TDMA, CDMA - Capacity calculations - Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity- trunking & grade of service - Coverage and capacity improvement.

Module IV (8 Hrs.)
Transceivers and signal processing: Structure of a wireless communication link: transceiver block structure, simplified models. Modulation formats, demodulator structure, Error performance in fading channels, OFDM principle - Cyclic prefix, Windowing, PAPR.

Module V (8 Hrs.)
Multipath Mitigation Techniques: Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity - Micro and Macro

diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

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Assessment: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Characterize a wireless channel and evolve the system design specifications.
2. Understand various types of channel models.
3. Design a cellular system based on resource availability and traffic demands.
4. Understand structure of wireless communication link.
5. Know the multipath mitigation techniques for the wireless channel and system under consideration.

Text/ Reference Books:

1. Rappaport T. S., “Wireless communications”, Pearson Education, Second Edition, 2010.
2. Andreas. F. Molisch, “Wireless Communications”, John Wiley – India, Second Edition, 2011.
3. Andrea Goldsmith, “Wireless Communication”, Cambridge University Press, 2011.
4. Van Nee, R. and Ramji Prasad,”OFDM for wireless multimedia communications”, Artech House, 2000.
5. David Tse, Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
6. Upena Dalal, “Wireless Communication”, Oxford University Press, First Edition, 2008.