Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) V Semester (Electronics & Tele Communication Engineering)

w.e.f. July 2023

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical						
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work		L	T	P	
1	EC51	PEC	Professional Elective Course-I	70	20	10	-	-	100	3	1	-	4
2	EC52	PCC	Digital Communication	70	20	10	30	20	150	3	-	2	4
3	EC53	PCC	Linear Control Theory	70	20	10	30	20	150	3	-	2	4
4	EC54	PCC	Microprocessor, Microcontroller & Embedded System	70	20	10	30	20	150	3	-	2	4
5	EC55	PCC	Mobile Communication and Networks	70	20	10	-	-	100	3	1	-	4
	BT51	HSMC	Professional Ethics (Audit Subject)	-	-	-	-	-	-	2	-	-	-
Total				**350**	**100**	**50**	**90**	**60**	**650**	**17**	2	**6**	**20**
6	EC56	DLC	Self-Learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	-	-	-	-	8
7	EC57	MC	NSS/NCC/Swatchhata Abhiyan/Rural Outreach	Qualifier									
Additional Course for Honours or Minor Specialization				Permitted to opt for maximum 8 credits against additional MOOC courses in subject code EC57 for the award of Honours (Minor Specialization).									

Note: 01. Departmental BOS will decide list of three/four optional subjects those are available in MOOC as well for PEC.

02. MOOC/NPTEL subjects shall be taken with permission of HOD/Coordinator.

Professional Elective Course-I		
S.No.	**Subject Code**	**Subject Name**
1	EC51A	VLSI Technology
2	EC51B	Industrial Electronics
3	EC51C	Biomedical Instrumentation

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

PEC: Professional Elective Course, PCC: Professional Core Course, HSMC: Humanities and Social Sciences including Management Course, DLC: Distance Learning Course, MC: Mandatory Course,

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	
EC51A	VLSI Technology	70	20	10	-	-	100	3	1	-	4

MODULE-I

Semiconductor Processing: Crystal Structures, Defects in Crystals, Si, Poly Si, Si Crystal Growth, Czochralski process, wafer-preparation, slicing, Marking, polishing, evaluation.

Clean room and Wafer Cleaning: Definition, Need of Clean Room, RCA cleaning of Si.

Oxidation: Dry and Wet Oxidation, Kinetics of Oxidation, Oxidation Rate Constants, Dopant Redistribution, Oxide Charges, Device Isolation, LOCOS, Oxidation System.

Lithography: Overview of Lithography, Radiation Sources, Masks, Photoresist, Advanced Lithography: E-beam Lithography, X-ray Lithography, Ion Beam Lithography.

Diffusion: Pre-Deposition and Drive-in Diffusion Modeling, Dose, 2-Step Diffusions, Successive Diffusion, Lateral Diffusion, Series Resistance, Junction Depth, Irvin's Curves, Diffusion System.

Ion Implantation: Problems in Thermal Diffusion, Advantages of Ion Implantation, Applications in ICs, Ion Implantation System, Junction Depth, Ion Implantation Damage, Post Implantation Annealing, Ion Channeling, Multi Energy Implantation.

MODULE-II

Thin Film Deposition: Physical Vapor Deposition: Thermal evaporation, Resistive Evaporation, Electron beam evaporation, Laser ablation, Sputtering, Chemical Vapor Deposition: Advantages and disadvantages of Chemical Vapor deposition (CVD) techniques over PVD techniques, reaction types, Boundaries and Flow, Different kinds of CVD techniques: APCVD, LPCVD, Plasma Enhanced CVD etc.

Etching: Anisotropy, Selectivity, Wet Etching, Plasma Etching, Reactive Ion Etching.

Metallization/Interconnects: Overview of Interconnects, Contacts, Metal gate/Poly Gate, Metallization, Problems in Aluminum Metal contacts, Al spike, Electromigration, Metal Silicides, Multi-Level Metallization, Planarization, Inter Metal Dielectric.

CMOS Process Technology: Fabrication process flow- basic steps, the CMOS n-Well and p-well, Twin Tub process.

MODULE-III

MOS Transistor Theory: Introduction to the metal oxide semiconductor (MOS) structure, NMOS and PMOS enhancement transistor, Threshold voltage, MOS device design equation, Basic DC equation, DC transfer characteristics, MOS models.

MOS Inverter (Static Characteristics): Resistive-load inverter, inverter with n-type MOSFET load, CMOS inverter -DC characteristics, BICMOS inverters.

CMOS Inverters (Switching Characteristics and Interconnects effects): Delay-time definitions, calculation of delay times, logical efforts, inverter design with delay constraints, Performance estimation of interconnect parasitic: Resistance and capacitance estimation, Switching characteristics, CMOS gate transistor sizing, power dissipation of CMOS inverters, Latch-up, latch-up triggering and prevention.

MODULE-IV

Short Channel Effects: Sub-threshold conduction, velocity saturation, device degradation, channel length modulation, body bias effect, DIBL, threshold adjustment, mobility degradation, hot carrier effects, MOSFET scaling goals, gate coupling, velocity overshoot, high field effects in scaled MOSFETs, substrate current and other effects in scaled MOSFETS. Moore law, Technology nodes and ITRS, Physical & Technological Challenges to scaling, Overview of nonconventional MOSFET-(FDSOI, SOI, Multi-gate MOSFET)

MODULE-V

Modeling: SPICE transistor modeling, compact MOSFET modeling approaches, history of BSIM models, BSIM family of Compact device models, BSIM6 model, BSIM-CMG model, BSIM-IMG model, physics of nanoscale MOSFET, and Design issues of nanoscale MOSFET: challenges of nanoscale MOSFET, key issues in modeling of MOSFET.

Text Books/ Reference Material:

Text Book: 1. VLSI Technology, S. M. Sze, 2nd Edition, McGraw Hill, 2003.
2. Silicon Process Technology, S K Gandhi,2nd Edition, Wiley India,2009
3. N. H. E. Weste and C. Harris, "Principles of CMOS VLSI Design: A System Perspective,3rd Edition,Pearson Education 2007.
4. CMOS Digital Integrated Circuits, Sung-Mo Kang, YusufLeblebici, 3rd edition, Tata McGrawHill, 2003

References: 1. J. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd Edition, Prentice Hall 2004.
2. Silicon VLSI Technology, Plummer, Deal and Griffin ,1st Edition, Pearson Education,2009
3. Fundamental of Semiconductor Fabrication, Sze and May, 2nd Edition, Wiley India

Course Outcomes:

Upon Successful completion of course students will be able to:

CO1	Outline the basics of semiconductor crystal properties and identify the fundamentals of IC fabrication
CO2	Illustrate the different methods involved in VLSI fabrication process, appreciate the advanced methods involved in IC fabrication and build the knowledge of process integration-NMOS, CMOS.
CO3	To analyze electrostatic variables and current-voltage characteristics of MOS devices under a variety of conditions and Understand the characteristics of CMOS inverter and analyze the static and dynamic characteristics of CMOS circuits
CO4	Understand the different short channel effects
CO5	To evaluate qualitative understanding of the physics of emerging MOS devices and conversion of this understanding into modeling.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	
EC51B	Industrial Electronics	70	20	10	-	-	100	3	1	-	4

MODULE- I Power Supplies

Power supply, rectifiers (half wave, full wave), performance parameters of power supplies, filters (capacitor, inductor, inductor-capacitor, pi filter), bleeder resistor, voltage multipliers. Regulated power supplies (series and shunt voltage regulators, fixed and adjustable voltage regulators, current regulator), switched regulator (SMPS), comparison of linear and switched power supply, switch mode converter (flyback, buck, boom, buk- boost, cuk converters)

MODULE-II Thyristors

Silicon controlled rectifies (SCR), constructional features, principle of operation, SCR terminology, turn-on methods, turn-off methods, triggering methods of SCR circuits, types of commutation, comparison of thyristors and transistors, thermal characteristics of SCR, causes of damage to SCR, SCR overvoltage protection circuit, series and parallel operation of SCRs, Line commutated converters (half wave rectifier with inductive and resistive load, single phase and three phase full wave rectifiers)

MODULE-III: Other members of SCR family

Triacs, Diacs, Quadracs, recovery characteristics, fast recovery diodes, power diodes, power transistor, powerMOSFET, Insulated gate bipolar transistor (TGBT), loss of power in semiconductor devices, comparisonbetween power power transistor and power IGBT

MODULE-IV Applications of OP-AMP

Basics of OP-AMP, relaxation oscillator, window comparator, Op-comp as rectangular to triangular pulse Converter and vice versa, Wien bridge oscillator, function generator, frequency response of OP-AMP Simplified circuit diagram of OP-AMP, power supplies using OP-AMP, filters (low-pass, high pass) using OP- AMP.

MODULE-V Programmable Logic Controller (PLC)

Functions, applications, advantages and disadvantages of PLC over conventional relay controllers, Comparisonof PLC with process control computer system, factors to be considered in selecting PL.C, functional blockdiagram of PLC, microprocessor in PLC, memory, input and output modules (interface cards), sequence of operations in a PLC, status of PLC, event driven device, ladder logic language, simple process controlapplications of PLC, Programming examples.

Reference Books:

1. Bishwanath Paul: Industrial Electronics and control, PHI Learning
2. Rashid: Power Electronics- Circuits, devices and applications, Pearson Education,
3. Singh and Khanchandani: Power Electronics, TMH
4. Bhimbra Power Electronics, Khanna Publishers.
5. Moorthi: Power Electronics, Oxford University Press.
6. Webb: Programmable Logic Controllers-Principles and Applications, PHI Learning.
7. Petruzulla: Programmable Logic Controllers, TMH

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Describe performance parameters of various electronic circuits (Power supplies, Regulators, Filters,SMPS)
CO2	Understand principle, construction and operation of SCR
CO3	Compare performance and working of other members of SCR family(Diac, Triac, IGBT, Power MOSFET)
CO4	Apply Op-Amp for designing electronic circuits (Oscillators, Comparator, wave shaping, power supply, filters)
CO5	Analyze functioning of PLC and its comparison with process control computer system.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
EC51C	Biomedical Instrumentation	Theory			Practical						
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	4
		70	20	10	-	-	100	3	1	-	

MODULE-I PHYSIOLOGY AND TRANSDUCERS

Cell and its structure-Resting and Action Potential - Nervous system: Functional organisation of the nervous system-Structure of nervous system, neurons - synapse-transmitters and neuralcommunication - Cardiovascular system-respiratory system - Basic components of a biomedical system - Transducers - selection criteria - Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

MODULE II ELECTRO-PHYSIOLOGICAL MEASUREMENTS

Electrodes -Limb electrodes-floating electrodes- pregelled disposable electrodes Micro, needle and surface electrodes - Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers - Isolation amplifier. ECG EEG-EMG-ERG-Lead systems and recording methods - Typical waveforms. Electrical safety in medical environment: shock hazards - leakage current-Instruments for checking safety parameters ofbiomedical equipments

MODULE III-NON-ELECTRICAL PARAMETER MEASUREMENTS

Measurement of blood pressure -Cardiac output- Heart rate Heart sound Pulmonary function measurements - spirometer - Photo Plethysmography, Body Plethysmography - Blood Gas analysers: pH of blood-measurement of blood pCO2, pO2, finger-tip oxymeter-ESR, GSRmeasurements.

MODULE IV-MEDICAL IMAGING

Radio graphic and fluoroscopic techniques-Computer tomography - MRI-Ultrasonography- Endoscopy-Thermography - Different types of biotelemetry systems and patient monitoring-

Introduction to Biometric systems

MOSULE V-ASSISTING AND THERAPEUTIC EQUIPMENTS

Pacemakers-Defibrillators - Ventilators-Nerve and muscle stimulators -Diathermy-Heart- Lung machine-Audio meters - Dialysers-Lithotripsy

TEXT BOOKS :

1. R.S.Khandpur, Hand Book of Bio-Medical instrumentation, Tata McGraw Hill Publishing Co Ltd.,2003

2. Leslie Cromwell, Fred J. Weibell, Erich A Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II edition, Pearson Education, 2002/PHI

REFERENCE BOOKS :

1. M.Arumugam, 'Bio-Medical Instrumentation", Anuradha Agencies, 2003.

2. L.A. Geddes and LE Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975.

3. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.

4. and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation", Universities press (India) Ltd, Orient Longman ltd, 2000.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Identify and describe operation of biomedical instrumentation and Transducers
CO2	Analyze design parameter of ECG, EEG.
CO3	Study of non electric parameter measurement.
CO4	Understand various Medical Imaging Techniques
CO5	Study of assisting & therapeutic equipments

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
EC52	Digital Communication	End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	4
		70	20	10	30	20	150	3	-	2	

MODULE I

Digital transmission of an analog signal, Sampling theorem, quantization, companding, PAM, PWM, PPM, PCM, DPCM, delta modulation, adaptive delta modulation, delta-sigma modulation, bandwidth requirements of PCM, TDM, noise in PCM, PPM, PWM, DM.

MODULE II

Signaling formats, baseband data transmission in the presence of white Gaussian noise, and pulse shaping. intersymbol interference, Nyquist theorem for pulse shaping raised cosine filters, digital signaling through band-limited channels, synchronization techniques.

MODULE III

Digital modulation formats ASK BFSK, PSK, FSK, MFSK, DPSK.QPSK transmitters, receivers, signals spectrum, bandwidth, constellation diagrams, and M-array data communication systems.

MODULE IV

Binary synchronous data transmission, matched filters, errors probability for matched filter receivers, correlated implementation for the matched filters, Coherent and non-coherent detection of ASK, PSK, BPSK, FSK.

MODULE V

Optimum receivers and signal space concepts, orthonormal representation of signals, binary signal detection, and hypothesis testing, Probability of error calculation, ASK, PSK, FSK. BPSK, MPSK, QAM, Error correction coding.

Text Books:

1. Communication Systems, 4/e, Simon Haykin, John Wiley and Sons.
2. Communication System, A B Carlson, McGraw Hill.

Reference Books:

1. Communication Systems, Ziemmer, Tarner, John Wiley and Sons.
2. Analog and digital communication systems, B P Lathis Oxford University Press.
3. Schaum's outline in analog and digital communication, Hsu, Tata McGraw Hill,
4. Communication systems, Taub, Schitllingm Tata McGraw Hill.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understand different modulation in digital communication
CO2	Discuss and describe signaling, Nyquist theorem, sampling and noise.
CO3	Generate digital modulation signals for ASK, PSK, FSK and perform their detection.
CO4	Analyze and evaluate different types of filter and coherent or noncoherent detection of different shift keying.
CO5	Analyze probability and error calculation in digital communication.

List of Experiments:

1. To demonstrate Time Division Multiplexing and demultiplexing processes using pulse amplitude modulation signals.
2. To analyze a PcM system. and interpret the modulator and demodulator waveforms for a sampling frequency of 4KHz .
3. To analyze a DPCM system and interpret the modulator and demodulator waveforms for a sampling frequency of 8 KHz.
4. To analyze a Delta modulation system and interpret the modulator and demodulator waveforms.
5. To analyze a FsK modulation system and interpret the modulator and demodulator waveforms.
6. To analyze a PSK modulation system and interpret the modulated and demodulated waveforms.
7. To identify the various encoding schemes for a given data stream.
8. To simulate Binary Amplitude shift keying technique using MATLAB software
9. To simulate Binary Frequency shift keying technique using MATLAB software
10. To simulate Binary phase shift keying technique using MATLAB software
11. To simulate Quadrature phase shift keying technique using MATLAB software
12. To simulate Differential phase shift keying technique using MATLAB software

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
EC53	Linear Control Theory	Theory			Practical			L	T	P	4
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work					
		70	20	10	30	20	150	3	-	2	

Module I

Basic Control System Introduction and Classification of control System, open and closed loop systems Linear Control System, Mathematical models of physical systems, Transfer function, Block Diagram Representation, Signal flow Graph, MIMO, Mason's gain formula,Linearization.

Module II

Error Analysis -Effects of Feedback on gain and time constant, pole location, bandwidth,Sensitivity, Disturbance signal, Control over System Standard Test Signals, Time Response of1st Order System, Design of Higher order system, Steady-State Errors and Error coefficients,Constants, Effects of Additions of Poles and Zeros to Open Loop and Closed Loop System.Design Specification of Dynamic first and higher order system, Performance Indices.

Module III

Domain Stability Analysis- Concept of Stability of Linear Systems, Effects of Location of Poles on Stability, Necessary Conditions for Stability, Routh-Hurwitz Stability Criteria, Relative Stability Analysis, Root Locus technique, Experimental determination of transferfunction. Frequency Domain Stability Analysis-Performance Specification in Frequency Domain, Co- relation between frequency Domain and Time Domain, Bode Plot, Minimum-Phase and Non- Minimum Phase System, Polar Plots, Inverse Polar Plot, Nyquist Stability Criterion, Assessment of Relative Stability (Phase Margin, Gain Margin and Stability), Constant-M and N Circle, Nichols Chart.

Module IV

Approaches to System Design, Types of Compensation, Design of Phase-Lag, Phase Lead and Phase Lead-Lag Compensators in Time and Frequency Domain, Proportional, Derivative, Integral and PID Compensation. Modeling of discrete -time systems -sampling -mathematical derivations for sampling sample and hold -Z-transforms-properties -solution of difference equations using Z transforms -examples of sampled data systems -mapping between s plane and z plane

Module V

State variables Analysis and Design- Concept of State Variables and State Model, State Space Representation of Systems, Solution of State Equation, Transfer Function Decomposition, Discrete time system.

Text Books:

1. Ziemer R.E., Tranter W.H. & Fannin D.R., "Signals and Systems", Pearson Education Asia

2 Ogata K., "Modern Control Engineering", Prentice Hall India

3. Nagarath I.J. & Gopal M., "Control System Engineering", Wiley Eastern Ltd.

4. Kuo B.C., "Digital Control Systems", Oxford University Press.

5. Computer-Based Industrial Control. Author, Krishna Kant. Publisher, Prentice Hall India.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Describe mathematical model of the electrical and mechanical systems and simplifycomplex systems using different graphical techniques in closed and open loop systems.
CO2	Apply time domain analysis and steady state response in control systems
CO3	Analyze Time Domain and frequency domain stability Techniques in control systems
CO4	Design control systems with the desired phase and gain performance.
CO5	Demonstrate the concept of state, state variable and state model and apply this knowledge in steady state analysis automation systems.

List of Experiments:

1. IMPLEMENTATION OF TIME RESPONSE OF A SYSTEM IN MATLAB.
2. STUDY OF ROOT LOCUS PLOT USING MATLAB.
3. PLOTTING BODE PLOTS THROUGH MATLAB.
4. EFFECT OF VARIATION OF K_P , K_D AND K_I OF PID CONTROLLER ON SYSTEM PARAMETERS.
5. STEP RESPONSE OF A SECOND ORDER SYSTEM.
6. FREQUENCY RESPONSE OF A SECOND ORDER SYSTEM.
7. STEP RESPONSE AND FREQUENCY RESPONSE OF A PLANT.
8. TRANSFER FUNCTION MODEL FOR STATE SPACE USING MATLAB.
9. TO STUDY AC SERVO MOTOR AND PLOT ITS TORQUE SPEED CHARACTERISTICS.
10. TO STUDY AC SERVO MOTOR AND PLOT ITS TORQUE SPEED CHARACTERISTICS.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
EC54	Microprocessor, Microcontroller & Embedded System	End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	4
		70	20	10	30	20	150	3	-	2	

Module-I

Von Neumann model-CPU, Memory, I/O, System Bus, Memory address register, Memory data register, program Counter, Accumulator, Instruction register, Micro operations, Register Transfer Language, Instruction Cycle, Instruction formats. **Control Unit Organization**: Hardwired control Unit, Micro programmed Control Unit, Control Memory, Micro program sequencer. **Memory organization**: RAM, ROM, Cache memory and mapping, Virtual memory. Introduction to 8085 Microprocessor.

Module-II

Intel 8086 microprocessor: Introduction to 16-bit microprocessor, 8086 architecture, pin functions, Register organization, Instruction Format, Addressing modes of 8086, Minimum and Maximum mode configuration, Instruction set of 8086, Assembler Directives and Operators,Assembly language Programming.

Module-III

Interfacing: Memory interfacing, Interfacing I/O devices, Interfacing with RAM and ROM, 8279 programmable Keyboard/Display interface, 8255A programmable Peripheral interface, Interfacing keyboard and seven-segment display using 8255A, 8254 programmable Interval Timer, 8259A programmable Interrupt Controller, 8257 DMA Controller, RS-232C standard, 8251 USART, Stepper motor interfacing.

Module-IV

Microcontroller: Introduction to micro controller 8051, its architecture, Signal descriptions, Register set, Operational features; Program status word (PSW), memory and I/O addressing by 8051, I/O configuration, Counters and Timers, Interrupts and stack of 8051, Addressing modes and instruction set of 8051.

Module-V

Embedded system: Introduction, Classification of embedded systems, Processors, Hardware units; Power source, Clock oscillator circuit and clocking unit. Software embedded into a system, Application areas. Embedded system vs General computing system, IOT, Embedded firmware design, RTOS based embedded system design.

Reference Books:

1. Morris Mano, "Computer System Architecture" (PHI).
2. William Stalling, "Computer Organization and Architecture" (PHI).
3. Microprocessor architecture, Programming and Applications with the 8085 by Ramesh S.Gaonkar
4. B B Brey, "The Intel Microprocessors, Architecture, Programming and Interfacing"(PHI).
5. K M Bhurchandi and A K Ray,"Advanced Microprocessors and Peripherals"(Mc-Graw Hill Education).
6. Shibu K V, "Introduction to Embedded Systems" (Mc-Graw Hill Education).
7. Microprocessors and Microcontrollers : Architecture, Programming And System Design 8085, 8086, 8051, 8096, by Dr. Krishnakant, PHI Publication.

Course Outcomes:

Upon successful completion of course student will be able to:

CO1	Understand the fundamental concepts of computer system architecture.
CO2	Explain the architecture and working of 8086 microprocessor.
CO3	Illustrate how the different peripherals are interfaced with microprocessor.
CO4	Analyze the architecture and working of 8051 Microcontroller.
CO5	Design various embedded system applications.

Microprocessor, Microcontroller & Embedded System Lab

List of Experiments:

1. BYTE ADDITION, SUBTRACTION, MULTIPLICATION AND DIVISION
2. SCAN STRING FOR CHARACTER
3. IF THEN ELSE IMPLIMENTATION
4. CONVERTING BCD NUMBER TO BINARY
5. ADDITION OF SERIES OF NUMBERS
6. LARGEST AND SMALLEST NUMBER IN A LIST
7. SORTING NUMBERS IN ASCENDING ORDER
8. ARRANGING AN ARRAY OF NUMBERS IN DESCENDING ORDER & VERIFY
9. COPYING BYTES OF DATA FROM SOURCE TO DESTINATION & VERIFY
10. ROTATE STEPPER MOTOR IN FORWARD AND REVERSE DIRECTION.

Prof. & Head

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	
EC55	Mobile Communication and Networks	70	20	10	-	-	100	3	1	-	4

Module I:

Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G 3G, 4G and 5G cellular mobile standards.

Module II:

Signal propagation- Propagation mechanism, reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small-scale fading-Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and RMS delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate. Capacity of flat and frequency selective channels. Antennas: antennas for mobile terminal, monopole antennas, PIFA, base station antennas and arrays.

Module III:

Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

Module IV:

Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity Altamonte scheme. MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff.

Module V:

Performance measures- Outage, average SNR, average symbol/bit error rate. System examples GSM, GPRS, EDGE, CDMA and WCDMA, OFDM and their applications in 2G, 3G, 4G and 5G mobile communications.

References Books:

1. Erik Dahlman , 4G, LTE-Advanced Pro and The Road to 5G

2. Sassan Ahmadi, 5G NR: Architecture, Technology, Implementation, and Operation of 3GPP New Radio Standards Hardcover , 2019.

3. Vijay K. Garg, "Wireless Communication and Networking", Elsevier, Morgan Kaufmann, Reprinted 2012.

4. Vijay K. Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, Fifth Impression 2008

5. T.S.Rappaport, "Wireless Communications Principles and Practice", PHI, II Edition, 2006.

6. William Lee ,"Mobile Cellular Telecommunications: Analog and Digital Systems", McGraw Hill Education.

7. Wireless Communication, Andrea Goldsmith, **Cambridge University Press**

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understand the fundamental concepts required to study cellular systems.
CO2	Identify various signal propagation characteristics with their associated parameters.
CO3	Acquire the concept of frequency reuse and its purpose to increase the system capacity.
CO3	Learn the method of reduction of interference occurs due to co-channel cells
CO4	Understand the concept of spectrum utilization and channel assignment.
CO5	Learn the speech and data transmission in GSM and CDMA.

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