M.Sc. Electronics & Communication Systems

Syllabus

AFFILIATED COLLEGES

Program Code: 36B

2023 – 2024 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A++" Grade by NAAC, Ranked 21st among Indian Universities by MHRD-NIRF)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The **M.Sc. Electronics and Communication System** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Pursue a diverse range of careers as Electronic Designers, Consultants and Entrepreneurs.
PEO2	Continue their education leading to research in interdisciplinary areas to emerge as Competent Technologist, Experts, Educators and Scientist.
PEO3	Innovate in ever changing global economic and technological environment maintaining professional discipline and high ethical standard.
PEO4	To enable graduates to acquire technical and managerial leadership positions in their chosen fields.
PEO5	Develop practical skills by providing hands-on experience to succeed in industry / technical profession through meticulous education.

Program Specific Outcomes (PSOs)	
After the successful completion of **M. Sc. Electronics and Communication System** program, the students are expected to	
PSO1	Identify user needs to provide suitable design solutions for implementing Analog & Digital Circuits for a given specification and function.
PSO2	Identify and utilize the strengths of current technologies in Raspberry Pi with Python Programming and Internet of Things with Arduino in implementing ICT enabled services for societal needs.
PSO3	Apply the core aspects of Electronics and Communication principles such as Microwave and Fiber Optics Communication, Signal Processing, Networking Technology for designing Electronic products.
PSO4	Make use of acquired technical knowledge for successful career and qualifying in competitive examinations at the National and Global levels.
PSO5	Apply the contextual knowledge of Electronics and Communication to assess societal, environmental, health, safety, legal and cultural issues with professional ethics and function effectively as in multidisciplinary environments.

Program Outcomes (POs)	
On successful completion of the **M. Sc. Electronics and Communication System** program	
PO1	An ability to attain state-of-art knowledge in Electronics and Communication, to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.
PO2	Identify, formulate, review and analyze complex emerging electronics problems to make intellectual knowledge for conducting research in a wider theoretical and practical.
PO3	Extract information about significant problems and apply appropriate techniques, resources, and modern electronic software tools towards contributing to the development of scientific/technological knowledge in Electronics.
PO4	Comprehend Professional and ethical responsibility in Electronics and Communication Profession.
PO5	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning with enthusiasm and commitment in the broadest context of technological change.

BHARATHIAR UNIVERSITY, COIMBATORE 641 046

M. Sc. Electronics and Communication Systems (CBCS PATTERN)
(Affiliated Colleges)

(For the students admitted from the academic year 2023 – 2024 onwards)

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
13A	PIC Microcontroller and Its Applications	4	4	-	25	75	100
13B	Linear ICs and its Applications	4	4	-	25	75	100
13C	Computer Communication and Networks	4	4	-	25	75	100
13D	Instrumentation and Control Systems	4	4	-	25	75	100
-	General Electronics Lab	-	-	5	-	-	-
-	PIC Microcontroller & Raspberry Pi with Python Programming Lab	-	-	5	-	-	-
-	Elective I: *	4	4	-	25	75	100
Total		**20**	**20**	**10**	**125**	**375**	**500**
SECOND SEMESTER							
23A	Raspberry Pi with Python Programming	4	4	-	25	75	100
23B	Power Electronics	4	4	-	25	75	100
23C	VHDL Programming	4	4	-	25	75	100
23D	Introduction to Industry 4.0	4	4	-	25	75	100
23P	General Electronics Lab	4	-	5	25	75	100
23Q	PIC Microcontroller & Raspberry Pi with Python Programming Lab	4	-	5	25	75	100
-	Elective II: *	4	4	-	25	75	100
Total		**28**	**20**	**10**	**175**	**525**	**700**
THIRD SEMESTER							
33A	Internet of Things with Arduino	4	4	-	25	75	100
33B	Virtual Instrumentation	4	4	-	25	75	100
33C	Digital Signal Processing	4	4	-	25	75	100
33D	MATLAB programming	4	4		25	75	100
33P	DSP and MATLAB Programming Lab	4	-	5	25	75	100

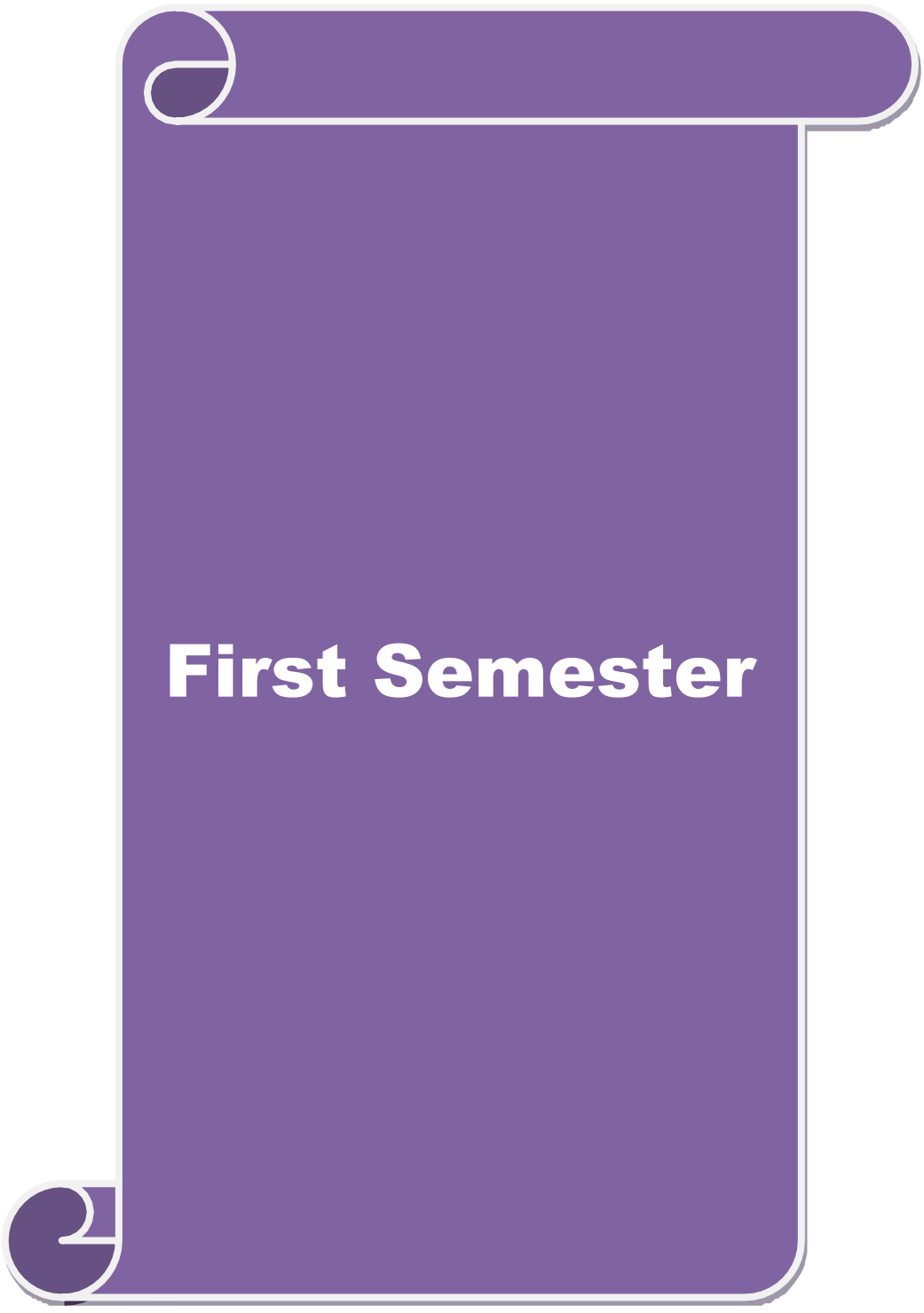
33Q	Virtual Instrumentation and VHDL Programming Lab	4	-	5	25	75	100
-	Elective III: *	4	4	-	25	75	100
Total		**28**	**20**	**10**	**175**	**525**	**700**
FOURTH SEMESTER							
47V	Project Work & Viva Voce #	10	10	-	100	150	250
-	Elective Practical: *	4	-	5	25	75	100
Total		**14**	**10**	**5**	**125**	**225**	**350**
Grand Total		**90**	**70**	**35**	**600**	**1650**	**2250**
ONLINE COURSES							
	SWAYAM- MOOC-Online Course**	**2**	-	-	-	-	50
		Non-scholastic with Credits					

*** ELECTIVE SUBJECTS**

Colleges can choose any one of the Group subjects as Electives

Course Code	Sem.	Title of the Course
GROUP - A		
1EA	I	Web Technology
2EA	II	Relational Data Base Management System
3EA	III	LINUX and Shell Programming
4EP	IV	RDBMS and LINUX Lab
GROUP - B		
1EB	I	Satellite and Network Communication
2EB	II	Wireless Sensor Networks
3EB	III	Digital Communication Techniques
4EQ	IV	Digital Communication Lab
GROUP - C		
1EC	I	VLSI Design
2EC	II	Low Power VLSI Design
3EC	III	VLSI Design Using Verilog
4ER	IV	VLSI System Design Lab

**SWAYAM – MOOC – online course shall be of duration at least 4 weeks with at least 2 credits. The course shall be mandatory and shall be completed within third semester (i.e., before the beginning of fourth semester).


First Semester

Course code		PIC MICROCONTROLLER AND ITS APPLICATIONS	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Digital Fundamental and Basics of Microcontroller	Syllabus Version		2023-24	

Course Objectives:

To understand the Concept of PIC microcontroller Architecture and its Applications

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Learn the Architecture and Instruction set of PIC Microcontroller	K1
2	Acquire the knowledge of Timer and Interrupt Sources	K2
3	Gain the knowledge of different Interface and I/O ports	K2
4	Gain the knowledge about the Special Features of PIC Microcontroller	K3
5	Analyze the techniques of Interfacing between Processor &Peripheral devices related to Industrial Applications	K4 &K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	CPU ARCHITECTURE AND INSTRUCTION SET	11 hours

Overview -Harvard Architecture and Pipelining - Program Memory Considerations - Register File structure and Addressing Modes - CPU Registers - Instruction set.

Unit:2	EXTERNAL INTERRUPTS AND TIMERS	12 hours

Overview -RB0/INT External Interrupt Input - Timer0 - Compare Mode - Capture Mode - Timer1/CCP Programmable Period Scaler - Timer1 External Event Counter - Timer1 and Sleep Mode - Pulse-Width-Modulated Outputs - PORTB-Change Interrupts.

Unit:3	I/O PORTS AND SERIAL PORT INTERFACE	12 hours

Overview –Synchronous Serial Port Module – Serial Peripheral Interface - I^2C Bus Interface – ADC-USART

Unit:4	SPECIAL FEATURES	11 hours

Overview - Configuration Word - -Oscillator Configurations - Reset Alternatives –Low-power Operations -Serial Programming –Parallel Slave Port.

Unit:5	INDUSTRIAL APPLICATIONS	12 hours

Introduction – Measurement Applications: Sensing Robot Arm Position - Optical Rotary Shaft Encoders - LVDT - Angular Speed Measurement (RPM Meter) - Digital Thermometer - RTD and Thermocouple Linearization. Automation and Control Applications: Power Controlling Devices - Thyristorised Control - Stepper Motor Drive.

Unit:6	Contemporary Issues	2 hours

Synchronous Serial Port Module

	Total Lecture Hours	60 hours

Text Book(s)	
1	John B.Peatman," Design with PIC Microcontrollers", Pearson Education, Low price Edition, 2009
2	Ajay V Deshmukh, " Microcontrollers: Theory and Applications" Tata McGraw-Hill Educations,2005.
Reference Books	
1	PIC 16F87X Data book, MicrochipTechnlogy Inc, 2001.
2	Tim Wilmshurst " Designing Embedded Systems with PIC Microcontrollers: Principles and Applications " Newnes, 2006
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/104/117104072/
2	https://www.watelectronics.com/pic-microcontroller-architecture-and-applications/
Course Designed By: Dr. D.Sathes Kumar, Department of ECS, Government Arts College, OOTY. Dr. K.Shanmugasundaram, Department of Electronics, SRMV College of Arts and Science, CBE	

Mapping with Programme Outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	L	M	M	M
CO2	S	M	S	M	S
CO3	S	H	L	M	M
CO4	S	L	S	M	M
CO5	S	S	S	L	M

*S-Strong; M-Medium; L-Low

Course code		LINEAR ICs AND ITS APPLICATIONS	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic Understanding of Electronic Circuits	Syllabus Version		2023-24	

Course Objectives:

The main objectives of this course are to:

1. To introduce practical applications of linear integrated circuits
2. To introduce the concept of analog multiplier and Phase Locked Loop with applications
3. To study the application of ADC and DAC in real time systems

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the significance and role of the Op-Amp.in the present contemporary world.	K2
2	Select appropriate ICs and circuits for analog system design.	K3
3	Design new analog linear circuit using operational amplifier.	K6
4	Analyze and develop electronic systems using linear ICs.	K4
5	Ability to deploy the data converters in real time scenario.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	OPERATIONAL AMPLIFIER BASICS	11 hours

Ideal Op-Amps.-Practical Op-Amps. - Internal structure – Op-Amp. Parameters - DC performance - AC performance - Interpretation of data sheets – General Op-Amp. – IC 741 Bipolar Op-Amp. – Noise – Open-loop Op-Amp Configuration – Closed-Loop Op-Amp. Configuration – Differential Amplifier – Basic Bridge Amplifier.

Unit:2	APPLICATIONS OF OP-AMP.	11 hours

Comparators – Schmitt Triggers – Linear half-wave rectifiers – Precision rectifiers – Peak Detectors – Sample and Hold Circuits – AC to DC converters – Voltage to Current converter – Current to Voltage converter - Dead-Zone circuits – Clippers – Clampers –Instrumentation amplifier – Integrators-Differentiators – Frequency Doubler – Voltage Divider – Square Rooter – Phase Angel Detector – Pulse Width Modulation.

Unit:3	FILTERS AND WAVEFORM GENERATORS	12 hours

Design of I,II order Low-pass filter - Design of I,II order High-pass filter – Band Pass Filters – Band Reject Filters – Butterworth – Chebyshev –State Variable Filters - Biquad filter - Wein bridge oscillator - Phase shift oscillator – Multivibrators - Triangular wave generators, sawtooth wave generators.

Unit:4	PLL AND TIMER	12 hours

Operating principles - Functional blocks of PLL - stability analysis - Lock and Capture ranges-Applications of PLL - PLL as FM detector - FSK demodulator - AM detector, Frequency translator - Phase shifter - Tracking filter - Signal synchronizer, Frequency Synthesizer. 555 Timer: Functional block diagram - terminals, modes of operation and applications.

Unit:5	**D/A AND A/D CONVERTERS**	**12 hours**
DAC Principles – Weighted-resistor DAC - R-2R Ladder DAC - Current output DAC, MDAC, DAC Specifications - Flash type ADC – Counter type ADC - Continuous type ADC - Successive approximation ADC - Single slope ADC, Dual slope type ADC - ADC Specifications.		
Unit:6	**Contemporary Issues**	**2 hours**
PLL Applications		
	Total Lecture Hours	**60 hours**

Text Book(s)	
1	Salivahanan S, Kanchana Bhaaskaran V S, "Linear Integrated Circuits", McGraw Hill Education (India) Private Limited, 2015
2	Robert F. Coughlin, Frederick F. Driscoll "Operational amplifiers and Linear Integrated Circuits", Prentice Hall, 2001.
3	Ramakant A.Gayakwad "Op-Amps and Linear Integrated Circuits", Pearson, 2017
Reference Books	
1	Lal Kishore, "Linear Integrated Circuits", Pearson, 2012
2	Roy Choudhry "Linear integrated circuits", New Age International, 1998
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.htm
2	https://nptel.ac.in/courses/108/106/108106068/

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Mapping with Programme Outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	S	S	S	M	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		COMPUTER COMMUNICATION AND NETWORKS	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic Computer Knowledge	Syllabus Version		2023-24	

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the computer networks for today's needs
2. Develop their skills in data communication and networking

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand and explain the concept of Data Communication and networks, layered architecture and their applications	K2
2	Analyze and Set up protocol designing issues for Communication networks.	K3
3	Evaluate data communication link considering elementary concepts of data link layer protocols for error detection and correction.	K5
4	Apply various network layer techniques for designing subnets and supernets and analyze packet flow on basis of routing protocols.	K3
5	Understand and design application layer protocols	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	DATA COMMUNICATION	11 hours

Introduction – Basic terms and concepts – Line configurations – Topology – Transmission media –MODEM: Standard and types – Analog and Digital transmission: Encoding and modulating –Channel capacity - Base band and Broad band - Transmission impairments – Multiplexing – Error Detection and control :CRC.

Unit:2	STANDARD ARCHITECTURE AND PROTOCOLS	11 hours

Layered Architecture – OSI model –functions of layers – Data link control protocols – ARQ-Stop and wait, Sliding window, Go back N and Selective repeat– Asynchronous protocol: X Modem, Y Modem, Kermit – Synchronous protocol: BSC, SDLC, HDLC- TCP/IP model, SMTP, HTTP and FTP.

Unit:3	NETWORK STANDARDS	12 hours

LAN: Standard, Protocol, IEEE 802 Standards – ETHERNET, LLC, MAC, CSMA/CD, Token Ring – Token bus – FDDI – ALOHA, Wireless LAN Technology, Hub, Bridge, Router, gateway, X.25.Protocols: SLIP, PPP, LCP – Optical network – SONET, WAN - MAN- Basic Concept and standards.

Unit:4	ISDN	12 hours

Introduction: Services – IDN – Channels – User interfaces – ISDN layers –Broad band ISDN – Frame relay – ATM: concept and architecture – ISDN Protocol: Physical layer protocol, D-channel Data link layer and layer 3 protocols, Network signaling systems, SS7 protocol.

Unit:5	**UPPER OSI LAYERS**	**12 hours**
Session layer protocols, Presentation layer – Encryption / Decryption, Data security, Encryption/Decryption, Authentication, Data compression, Application Layer Protocols – MHS, File Transfer, Virtual Terminal, CMIP.		
Unit:6	**Contemporary Issues**	**2 hours**
Presentation layer – Encryption / Decryption		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	Behrous A Forouzan, "Data Communication and Networking", Tata McGraw Hill, 2013

Reference Books

1	Gary C. Kesslar and Peter Southwick, "ISDN – Concepts, Facilities and Services", McGraw Hill, 1998
2	William Stallings, "Data and computer communication", Pearson Education, 2014
3	Andrew S.Tanenbaum, "Computer Networks", Pearson Education, 2018

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/105/106105183/
2	https://www.tutorialspoint.com/data_communication_computer_network/index.htm

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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	S	S	M	M	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		INSTRUMENTATION AND CONTROL SYSTEMS	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic Knowledge in Electronic Circuits	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Give basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
2. Provide the concept of stability of control system and methods of stability analysis

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand various input/output models of dynamic system	K2
2	Analyze the stability and effect of feedback control on sensitivity	K3
3	Understand frequency domain descriptions and dynamic analysis	K2
4	Apply the basic methods of classical control system design such as root locus and phase lead-lag compensation based on Bode plots	K3
5	Understand the principles of control theory and the various components and application of Control System	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	CHARACTERISTICS OF A MEASURING INSTRUMENT	11 hours

Basic block diagram of Measuring instrument- static characteristics- accuracy- precision resolution- sensitivity- linearity -span and range. Dynamic characteristics: Zero order, first order and second order instruments- characteristics- Step, ramp and impulse response.

Unit:2	SIGNAL CONDITIONING	12 hours

Capacitive transducer- Piezo Electric-Hall effect- LVDT- Digital transducers- Fibre optic sensors-Smart transducers- IEEE Standards1451- Introduction to LAB VIEW.

Unit:3	BASICS OF CONTROL SYSTEMS	12 hours

Open loop and closed loop control systems- feedback characteristics- Mechanical, Electrical, Pneumatic and Hydraulic systems-Transfer function- Block diagram reduction techniques- Signal flow graph- Mason's gain formula.

Unit:4	STABILITY ANALYSIS IN TIME DOMAIN	12 hours

Standard inputs-time responses- specifications - concept of stability-Routh Hurwitz criteria- Root locus-construction and analysis- Lead, Lag and Lag Lead compensator using Root locus technique.

Unit:5	FREQUENCY DOMAIN ANALYSIS	11 hours

Bode plot-Polar plot and Nyquest plot- construction, interpretation and stability analysis-closed loop frequency response- Lead, Lag compensator using Bode plot

Unit:6	Contemporary Issues	2 hours

Block diagram reduction techniques, Signal flow graph

	Total Lecture Hours	60 hours

Text Book(s)	
1	Doeblin E O and Manik D N, " Measurement Systems",6th Edition,TMH Ltd,2011
2	Albert D Helfric and Cooper W D,"Modern Electronic Instrumentation and Measurement Techniques",PHI learning Edition,2017
3	Nagrath I J and Gopal M,"Control Systems Engineering",6th Edition,New age International Publishers,2017
4	Benjamin C Kuo and Farid Golnaragi,"Automatic Control Systems",10th Edition, McGraw hill,2017
Reference Books	
1	Renganathan S, "Transducer Engineering",Allied Publishers, 2013
2	Katsuhiko O'Gara," Modern Control Engineering",PHI learning Pvt. Ltd,5th Edition,2015
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/108/106/108106098/
2	https://www.tutorialspoint.com/control_systems/index.htm

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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	M	M	S	S
CO3	S	S	M	M	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Second Semester

Course code		RASPBERRY PI WITH PYTHON PROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic knowledge in Electronics and Computer programming	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Learn the basic concepts of Python and use of various data structures and functions.
2. Understand the various components of ARM Cortex – A Series.
3. Provide the necessary knowledge of the Raspberry Pi to design and develop practical applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the core programming constructs of Python.	K2
2	Express proficiency in the handling of functions in Python.	K2
3	Understand the ARM processor design philosophy, architecture and its families.	K2
4	Articulate the functions and features of ARM Cortex A-Series Processors.	K3
5	Analyze and design the Raspberry Pi using Python for peripheral interfacing .	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION TO PYTHON	11 hours

Getting started with Python - Comments - Python Identifiers – Keywords - Variables – Standard data types – Operators – Statement and Expression – String operations – Boolean Expressions – Control statements – Iteration statement – Input from keyboard

Unit:2	FUNCTIONS IN PYTHON	11 hours

Built-in Functions - Composition of Functions - User Defined Functions - Parameters and Arguments - Function Calls - The return Statement - Python Recursive Function - The Anonymous Functions - Writing Python Scripts

Unit:3	INTRODUCTION TO ARM PROCESSOR	12 hours

The RISC Design Philosophy - The ARM Design Philosophy -Embedded System Hardware - Embedded System Software - Registers -Current Program Status Register - Pipeline - Exceptions, Interrupts, and the Vector Table - Core Extensions - Architecture Revisions - ARM Processor Families

Unit:4	ARM CORTEX – A SERIES	12 hours

ARM Cortex processors categories, ARMv8-A Architecture and Processors, Exception levels - Execution states, Changing Exception levels: ARMv7 processor modes - ARMv7 privilege levels, Caches: A basic cache arrangement - Cache terminology, Memory management: The memory management unit - Virtual and physical memory, big.LITTLE Technology: Structure of a big.LITTLE system, Software execution models in big.LITTLE

Unit:5	**RASPBERY PI**	**12 hours**
Introduction to Raspberry Pi - Installation of NOOBS on SD Card - Installation of Raspbian on SD Card - Terminal Commands - Installation of Libraries on Raspberry Pi - Getting the Static IP Address of Raspberry Pi - Run a Program on Raspberry Pi - Installing the Remote Desktop Server - Pi Camera - Face Recognition Using Raspberry Pi - Installation of I2C Driver on Raspberry Pi - Serial Peripheral Interface with Raspberry Pi - Programming a Raspberry Pi - Play with LED and Raspberry Pi - Reading the Digital Input - Reading an Edge - Triggered Input		
Unit:6	**Contemporary Issues**	**2 hours**
Installation of NOOBS on SD Card and Installation of Raspbian on SD Card		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	Balagurusamy E, “Introduction to Computing and Problem Solving Using Python”, McGraw Hill Education (India) Private Limited, 2016
2	Andrew N. Sloss, Dominic Symes, Chris Wright, “ARM System Developer’s Guide Designing and Optimizing System Software”, Morgan Kaufmann Publishers is an imprint of Elsevier, 2004
3	ARM® Cortex®-A Series, Programmer’s Guide for ARMv8-A, Version 1.0, ARM, 2015
4	Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, "Internet of Things with Raspberry Pi and Arduino", CRC Press, 2019

Reference Books

1	Rashi Gupta, “MakingUse ofPython”, Wiley Publishing, Inc., First Edition, 2002
2	Wolfram Donat, “Learn Raspberry Pi Programming with Python”, Apress, 2018

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.tutorialspoint.com/python/index.htm
2	https://pythonprogramming.net/introduction-raspberry-pi-tutorials/
3	https://learn.sparkfun.com/tutorials/python-programming-tutorial-getting-started-with-the-raspberry-pi/all

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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	S	M	S	S	S
CO5	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		POWER ELECTRONICS	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Knowledge in Semiconductor Devices	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Impart knowledge on the switching behavior of power semiconductor devices.
2. Provide students a clear understanding of power controlled rectifiers, choppers and inverters.
3. Equip the students to develop power electronics systems for domestic and industrial applications.

Expected Course Outcomes:

On the successful completion of this course, student will be able to:

1	Remember the construction and characteristics of power electronics devices.	K1
2	Understand the single-phase and three-phase controlled AC-to-DC converters.	K2
3	Understand the different DC-to-DC converters.	K2
4	Understand and acquire knowledge on the inverters.	K2
5	Apply knowledge of power electronic circuits in various applications.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	POWER SEMICONDUCTOR DEVICES	13 hours

Introduction to power electronics - History of power electronics - Classification of power semiconductor devices - Structure and I-V characteristics of Power Diode,Power MOSFET, IGBT, SCR, TRIAC, and GTO - Triggering methods of Thyristor - Switching characteristics of Thyristor - Gate characteristics -Protection of Thyristor - Commutation of Thyristor

Unit:2	PHASE CONTROLLED RECTIFIERS (AC-TO-DC CONVERTERS)	12 hours

Principle of phase control - Single-phase half-wave circuit with RL load and freewheeling diode, Single-phase half-wave circuit with RLE load - Full-wave controlled Converters - Single-phase full-wave converters: Single-phase full-wave mid-point converter, Single-phase full-wave bridge converter – Three-phase Thyristor converters: Three-phase full converters, Three-phase semiconverters - Effect of source impedance on performance of converters - Dual Converters

Unit:3	CHOPPERS (DC-TO-DC CONVERTERS)	12 hours

Basic Chopper classification - Basic Chopper operation: Principle of step-down Chopper (Buck Converter), Principle of step-up Chopper (Boost Converter), Principle of step-down/step-up Chopper (Buck/Boost Converter) - Control strategies - Thyristor Chopper circuits:Voltage commutated Chopper, Current commutated Chopper, Load Commutated Chopper - Jones Chopper - Morgan Chopper - AC Chopper - Multiphase Chopper

Unit:4	INVERTERS (DC-TO-AC CONVERTERS)	10 hours

Classification of inverters - Performance parameters of inverters - Single-phase half-bridge voltage source inverters - Single-phase full-bridge inverters - Three-phase inverters -- Pulse-Width Modulated inverters - Voltage control of inverters - Series inverter - Parallel inverter – Current source inverter

Unit:5	**APPLICATIONS OF POWER ELECTRONICS**	**11 hours**
Electronic timer - Alarm circuit - Ambient-light control power switch - Buck-Boost regulator - Battery charger - Sine wave inverter - Uninterrupted power supply (UPS) - Switched-mode Power Supply (SMPS) - HVDC transmission - Circuit breaker - DC motor drive - Stepper motor drive - Servo motor drive - Microcontroller-based universal motor speed control - Fuzzy logic control of induction motor		
Unit:6	**Contemporary Issues**	**2 hours**
Microcontroller-based motor speed control & Fuzzy logic control of induction motor		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	Soumitra Kumar Mandal, “Power Electronics”, McGraw Hill Education (India), 2014
2	P.S. Bimbhra, “Power Electronics”, Khanna Publishers (India), 2012.
3	M D Singh and K B Khanchandani, “Power electronics”, TMH, 2nd Edition 2007.
4	Alok Jain, "Power Electronics and its Applications", Penram International Publishing, 2004

Reference Books

1	Muhammad H. Rashid, “Power Electronics - Circuits, Devices and Applications”, Prentice Hall of India, 3rd Edition 2003.
2	Ned Mohan, Undeland and Robbins, “Power Electronics - Converters, Applications and Design”, John Willey & sons, 3rd Edition 2003.
3	P.C. Sen, “Modern Power Electronics”, Wheeler Publishing Co (India), First Edition 1998.
4	VedamSubramanyam, “Power Electronics - Devices, Converters and Applications”, New Age International Publishers (India), 2nd Edition 2006.
5	Jai P.Agrawal, “Power Electronics Systems”, Pearson Education, Second Edition, 2002.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/108/105/108105066/
2	https://nptel.ac.in/courses/108/102/108102145/
3	https://nptel.ac.in/courses/108/107/108107128/

Course Designed By:
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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	L
CO2	S	M	M	M	L
CO3	S	M	M	M	L
CO4	S	M	M	M	L
CO5	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		VHDL PROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic knowledge in Hardware Description Programming Language with Simulation Software's	Syllabus Version		2023 -24	

Course Objectives:

The main Objectives of this course are to:

1. To analyze logic processes and implement logical operations using combinational logic circuits.
2. To understand concepts of modeling techniques and features of VHDL.
3. Learn hardware description language (HDL) for the specification, simulation, synthesis and implementation of digital logic systems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Discriminate between combinatorial and sequential circuits	K2
2	Define and describe digital design flows for system design and recognize in different approaches.	K3
3	Understanding the Synthesis and Simulation Process of Code	K4
4	Building Simulation Module as per System Specification	K4
5	Understand Programming using FPGA/CPLD concept	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	INTRODUCTION AND BASIC CONCEPTS OF VHDL	11 hours

History of VHDL – Capabilities of VHDL – Hardware Abstraction – Basic Terminology – Entity Declaration – Architecture Body Declaration – Basic Language Elements – Identifiers – Data Objects – Data Types – Operators.

UNIT: 2	MODELING TECHNIQUES - BEHAVIORAL MODELING	12 hours

Entity Declaration – Architecture Declaration – Process Statements – Variable Assignment Statements – Signal Assignment Statement – Wait Statement – If Statement – Case Statement – Null Statement – Loop Statement – Exit Statement – Next Statement – Assertion Statement – Report Statement – Multiple Process – Postponed Process.

UNIT: 3	DATA FLOW AND STRUCTURAL MODELING	12 hours

DATA FLOW MODELING: Concurrent Signal Assignment Statement – Delta Delay Revisited – Multiple Drivers – Conditional Signal Assignment Statement – Selected Signal Assignment Statement – Block Statement – Concurrent Assertion Statement – Value of a Signal.

STRUCTURAL MODELING: Component Declaration – Component Instantiation – Resolving Signal Value – Examples – Half Adder – Full Adder – 4 To 1 Multiplexer – Decoder And Encoders.

UNIT: 4	**ADVANCED FEATURES IN VHDL**	**12 hours**

Generics – Configuration Specification – Configuration Declaration – Default Rules and Conversion Functions – Direct Instantiation – Incremental Binding – Subprograms – Subprogram and Operator Overloading – Signatures – Default Value of Parameters – Package Declaration – Package Body – Design File and Libraries – Order of Analysis – Implicit and Explicit Visibilities – Attributes in VHDL.

UNIT: 5	**DESIGN OF FPGA'S AND CPLD**	**11 hours**

State Machine Chart – Programmable Logic Array – Programmable Logic Array Devices – Altera Max 7000 CPLD's – Xilinx xc 4000 Structures – Xilinx Interconnection – Xilinx Logic – Xilinx 3000 series FPGA's – Altera Complex Programmable Logic Devices – Altera flex 10 k series CPLD's.

UNIT: 6	**Contemporary Issues**	**2 hours**

Design concepts of FPGA'S and CPLD

	Total Lecture Hours	**60 hours**

Text Book(s)

1	J. Bhasker, "A VHDL Primer", Prentice Hall PTR, Third Edition, 1999.
2	Charles H. Roth, Jr., Lizy K. John, "Digital Systems Design Using VHDL", Cengage Learning, 2016.

Reference Book(s)

1	Gaganpreet Kaur, "VHDL: Basics to Programming", Pearson Education India, 2011.
2	Navabi, "VHDL: Modular Design and Synthesis of Cores and Systems", Tata McGraw-Hill Publishing Company Limited, 2008.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayam.gov.in/nd1_noc19_cs73/preview
2	https://nptel.ac.in/courses/106/102/106102181/
3	https://nptel.ac.in/content/storage2/courses/117108040/downloads/VHDL.pdf

Course Designed By:
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COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	S	M	S
CO3	S	S	M	S	S
CO4	M	S	S	S	S
CO5	S	S	S	M	S

*S-Strong; M-Medium; L-Low

Course code		INTRODUCTION TO INDUSTRY 4.0	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic Mathematics, Programming & Automation knowledge is Essential	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. To know the automated learning techniques.
2. To study the techniques of knowledge representation.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the representation of knowledge	K2
2	Understand machine learning, AI and RPA techniques in developing real world applications.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INDUSTRY 4.0	12 hours

Need – Reason for Adopting Industry 4.0 - Definition – Goals and Design Principles - Technologies of Industry 4.0 – Big Data – Artificial Intelligence (AI) – Industrial Internet of Things - Cyber Security – Cloud – Augmented Reality.

Unit:2	MACHINE LEARNING	12 hours

Machine Learning - Introduction – Definition – Types of Machine Learning –Supervised, Unsupervised, Reinforcement Learning – Algorithms for Machine Learning – Problems solved by Machine Learning - Tools for Machine Learning - Applications areas of Machine Learning.

Unit:3	ARTIFICIAL INTELLIGENCE	12 hours

Artificial Intelligence (AI) – What & Why? - History of AI - Foundations of AI -The AI - environment - Societal Influences of AI - Application Domains and Tools - Associated Technologies of AI - Future Prospects of AI - Challenges of AI

Unit:4	ROBOTIC PROCESS AUTOMATION (RPA)	12 hours

Robotic Process Automation (RPA): Introduction to RPA – Need for automation – Programming constructs in RPA – Robots and Softbots – RPA architecture and process methodologies - Industries best suited for RPA - Risks & Challenges with RPA.

Unit:5	APPLICATIONS AND TOOLS OF INDUSTRY 4.0	10 hours

Applications of IoT – Manufacturing – Healthcare – Education – Aerospace and Defense – Agriculture – Transportation and Logistics – Impact of Industry 4.0 on Society: Impact on Business, Government, People. Tools for Artificial Intelligence, Big Data and Data Analytics, Virtual Reality, Augmented Reality, IoT, Robotics.

Unit:6	Contemporary Issues	2 hours

Applications of Industrial Automation Systems using Machine Learning & Artificial Intelligence

	Total Lecture Hours	**60 hours**
Text Book(s)		
1	P. Kaliraj, T. Devi, Higher Education for Industry 4.0 and Transformation to Education 5.0, 2020	
Reference Books		
1	Stuart J. Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", Third Edition, Pearson Publishers, 2015	
2	S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Second Edition, Wiley-India, 2007	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/106/105/106105195/	
2	https://nptel.ac.in/courses/106/106/106106139/	
3	https://nptel.ac.in/courses/106/105/106105077/	
4	https://nptel.ac.in/courses/112/101/112101098/	
Course Designed By: Dr. D.Sathes Kumar, Department of ECS, Government Arts College, OOTY. Dr. K.Shanmugasundaram, Department of Electronics, SRMV College of Arts and Science, CBE		

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		GENERAL ELECTRONICS LAB	L	T	P	C
Core/Elective/Supportive		Core	-	-	5	4
Pre-requisite		Basic Concepts in Electronics	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. To inculcate experimental skills to test basic of Linear ICs and Power Electronics
2. To learn circuits using OPAMP, PLL and Timer ICs

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Design Oscillators and Filters using op-amp.	K6
2	Analyze circuits using PLL, OPAMP and timer ICs	K4
3	Analyze power amplifier circuits	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

	List of Experiments (Any 20 Experiments)	150 Hours

1. Op-Amp Characteristics.
2. V to I & I to V Convertors.
3. Half Wave Rectifier and Full Wave Rectifier Using Op-Amps.
4. Integrator and Differentiator Using Op-Amps.
5. Design of Low Pass and High Pass Filters.
6. Design of Band Pass, Band Reject & Notch Filters.
7. Instrumentation Amplifier
8. Triangular & Saw Tooth Wave Generators using Op-Amps.
9. Square Wave Generator & Schmitt Trigger Using Op-Amps.
10. Hartley & Colpitts Oscillator using Op-Amps.
11. Phase Shift and Wein Bridge Oscillator using Op-Amps.
12. Astable and Monostable Multi-Vibrators using 555.
13. Voltage Controlled Oscillator using 566.
14. Any Two Applications using Ic565
15. Function Generator using 8038.
16. Dual Power Supply using 78xx and 79xx
17. Adjustable Positive and Negative Voltage Regulator using LM 317 & LM337
18. Low and High Voltage Regulator using LM 723
19. AC Power Control using Thyristors.

20. Switching Circuits For TRIAC.
21. Thyristor Chopper.
22. Single Phase Invertor (20W)
23. Power Amplifier Using LM 380.
24. Different Trigerring Circuits for Thyristor.
25. Study a Firing Circuit Suitable for Single Phase Half Controlled Convertor.
26. Single Phase Half Controlled Bridge Convertor with Two Thyristors & Two Diodes.
27. Single Phase Fully Controlled Bridge Convertor using Four Thyristors.
28. Pspice Simulation of DC to DC Step Down Chopper.

	Total Practical Hours	**150 hours**

Course Designed By:
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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	S
CO2	S	S	S	S	S
CO3	S	M	M	S	S

*S-Strong; M-Medium; L-Low

Course code		PIC MICROCONTROLLER & RASPBERRY PI WITH PYTHON PROGRAMMING LAB	L	T	P	C
Core/Elective/Supportive		Core	-	-	5	4
Pre-requisite		Basic Concepts in Electronics	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Provide the knowledge of PIC microcontroller and Raspberry Pi based system design
2. Interfaces different motors and create Automation system
3. Design the system that interact with environment and communicate over the internet

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Design PIC microcontroller and Rapberry Pi based system	K6
2	Interface microcontroller-based system to real world	K4
3	Acquire the knowledge, techniques and skill to integrate hardware and software	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

	List of Experiments (Any 10 Experiments)	75 hours

PIC Microcontroller

1. Addition and Subtraction of Two 8-bit Numbers
2. Multiplication and Division of Two 8-bit numbers
3. Largest Number in an Array
4. Ascending Order of an Array
5. 4-bit Binary Counter
6. Flashing of LED
7. Seven Segment Display Interface
8. LCD Interface
9. DC Motor Direction Controller
10. Stepper Motor Interface
11. Servo Motor Control using PWM
12. Data Transfer using USART
13. SPI Communication

	List of Experiments (Any 10 Experiments)	75 hours

Raspberry Pi with Python Programming

1. Addition and Subtraction of Two 8-bit Numbers
2. Multiplication and Division of Two 8-bit numbers
3. Largest Number in an Array
4. Ascending Order of an Array
5. 4-bit Binary Counter
6. Flashing of LED
7. Seven Segment Display Interface
8. PIR sensor interface
9. Interfacing DC Motor
10. Stepper Motor Interface
11. Pulse Width Modulation
12. Interfacing of Relay
13. Remote-controlling of Electronic Device through Web Interface

	Total Practical Hours	**150 hours**

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COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	S
CO2	S	S	S	S	S
CO3	S	M	S	M	M

*S-Strong; M-Medium; L-Low

Third Semester

Course code		INTERNET OF THINGS WITH ARDUINO	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic knowledge in Electronics and Computer programming	Syllabus Version	2023 -24		

Course Objectives:

The main objectives of this course are to:

1. Learn the basic principles of various smart sensors and apply it in IoT applications
2. Train the students to build IoT systems using sensors, single board computers and open source IoT platforms.
3. Make the students to apply IoT data for real time applications in various domain in secured manner.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts on sensing devices, actuation, processing and communications	K2
2	Implement the Sensors based system using Arduino	K3
3	Understand the key technologies, protocols and standards in Internet of Things.	K2
4	Apply the wireless technologies for IoT using ESP8266	K3
5	Illustrate the applications of IoT in real time scenario	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	SENSORS AND ACTUATORS	11 hours

Sensors Classification - Working Principle of Sensors - Criteria to Choose a Sensor - Generation of Sensors - Resistance sensor – Voltage sensor – Current sensor - PIR Proximity sensor - Barometric pressure sensor – Gyroscope - DC motor - Servo motor- Stepper motor

Unit:2	ARDUINO	12 hours

Introduction to Ardunio – Arduino family of boards with Pin description – Installation of Arduino IDE – Basic Commands for Arduino – LCD Commands – Serial Communication Commands – Interface LED with Arduino – Interface LCD with Arduino - Interface PIR sensor with Arduino – Interface LDR with Arduino – Interface with Bluetooth module.

Unit:3	INTRODUCTION TO IoT	11 hours

Characteristics of IoT – Design Principles of IoT – IoT Architecture and Protocols – IoT Levels - IoT vs M2M - Design Methodology - Challenges in IoT Design – IoT system management - IoT Cloud platforms: Temboo; SensorCloud; ThingWorx; ThingSpeak; Blynk; Cayenne from myDevices

Unit:4	DATA OVER IoT	12 hours

ESP8266 module: Hardware requirements - Installing the Arduino IDE for the ESP8266 - Connecting your module to your Wi-Fi network - Controlling an LED - Reading data from a GPIO pin - Reading data from a digital sensor - Configuring the ESP8266 module and controlling an LED - Controlling the LED from a cloud dashboard - Controlling the lamp from anywhere in the world – Monitoring temperature and Humidity using DHT11

Unit:5	**SMART USE OF IoT**	**12 hours**
Smart Home - Wearables – Connected Cars – Industrial IoT Applications – Smart Cities – IoT in Agriculture – IoT Applications in Retail – Energy Engagement – IoT in Healthcare.		
Unit:6	**Contemporary Issues**	**2 hours**
Interfacing with ARDUINO		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, and Mahendra Swain, "Internet of things with Raspberry pi and Arduino", CRC Press Taylor & Francis Group 2020.
2	Volker Ziemann, A Hands-On Course in Sensors Using the Arduino and Raspberry Pi, CRC Press, Taylor & Francis Group, 2018
3	Marco Schwartz, Internet of Things with ESP8266, Packt Publishing, 2016
4	Mohammad Ali Jabraeil Jamali, Bahareh Bahrami, Arash Heidari, Parisa Allahverdizadeh, Farhad Norouzi, Towards the Internet of Things Architectures, Security, and Applications, Springer Nature Switzerland AG, 2020

Reference Books

1	Ashwin Pajankar, Arduino Made Simple, BPB Publications, First Edition, 2018
2	Pethuru Raj, Anupama C. Raman, The Internet of Things Enabling Technologies, Platforms, and Use Cases, CRC Press, Taylor & Francis Group, 2017

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.arduino.cc/en/IoT/HomePage
2	https://swayam.gov.in/nd2_arp19_ap52/preview
3	https://opensource.com/article/17/12/how-build-custom-iot-hardware-arduino

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COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	S	M	S	S	S
CO5	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		VIRTUAL INSTRUMENTATION	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic knowledge in Instrumentation	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Know the basic concepts of virtual Instrumentation
2. Learn the concepts of Data Acquisition, signal Processing and Manipulation

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of virtual Instruments and enhance programming skills in LABVIEW	K2
2	Understand the fundamentals of Virtual Instrumentation and data Acquisition.	K2
3	Apply the theoretical concepts to realize practical systems	K3
4	Analyze and evaluate the performance of Virtual Instrumentation Systems.	K5
5	Create a VI system to solve real time problems using data acquisition.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	11 hours

General functional description of a digital instrument - Block diagram of a Virtual Instrument - Physical quantities and Analog interfaces - Hardware and Software - User interfaces - Advantages of Virtual instruments over conventional instruments - Architecture of a Virtual instrument and its relation to the operating system.

Unit:2	SOFTWARE OVERVIEW	11 hours

Lab VIEW - Graphical user interfaces - Controls and Indicators - 'G' programming - Labels and Text - Shape, Size and Color - Owned and free labels - Data type, Format, Precision and representation - Data types - Data flow programming - Editing - Debugging and Running a Virtual instrument - Graphical programming palettes and tools - Front panel objects - Functions and Libraries.

Unit:3	PROGRAMMING STRUCTURE	12 hours

FOR loops, WHILE loops, CASE structure, formula nodes, Sequence structures - Arrays and Clusters - Array operations - Bundle - Bundle/Unbundle by name, graphs and charts - String and file I/O - High level and Low level file I/O's - Attribute modes Local and Global variables. **OPERATING SYSTEM AND HARDWARE OVERVIEW:** PC architecture, current trends, Operating system requirements, Drivers – Interface Buses – PCI Bus – Interface cards – specification – Analog and Digital interfaces – Power, Speed and timing considerations.

Unit:4	HARDWARE ASPECTS	12 hours

Installing hardware, Installing drivers - Configuring the hardware - Addressing the hardware in LabVIEW - Digital and Analog I/O function - Data Acquisition - Buffered I/O - Real time Data Acquisition.

Unit:5	**LABVIEW APPLICATIONS**	**12 hours**
IMAQ - Motion Control: General Applications - Feedback devices, Motor Drives – Instrument Connectivity - GPIB, Serial Communication - General, GPIB Hardware & Software specifications - PX1 / PC1: Controller and Chassis Configuration and Installation.		
Unit:6	**Contemporary Issues**	**2 hours**
PC architecture, current trends and Operating system requirements		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	Garry M Johnson, "Labview Graphical Programming", Tata McGraw Hill, New Delhi,2006.
2	Robert H.Bishop,"Learning with Lab-View" Prentice Hall, 2014
3	Labview : Basics I & II Manual, National Instruments, 2005.

Reference Books

1	Lisa K Wells, "Labview for Everyone", Prentice Hall of India, New Delhi, 2009.
2	Barry Paron, "Sensor, Transducers and Labview", Prentice Hall, New Delhi, 2000

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.ni.com/getting-started/labview-basics/
2	https://www.electronics-notes.com/articles/test-methods/labview/vis-virtual-instruments.php

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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	S	M	S	S	S
CO5	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		DIGITAL SIGNAL PROCESSING	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic knowledge in Signals and System	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. To introduce signals, systems, time and frequency domain concepts, and DSP techniques
2. To acquire the knowledge of design, implementation, analysis and comparison of digital filters for processing of discrete time signals.
3. To program DSP Processor for various applications

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understanding the fundamentals of discrete time signals and systems	K2
2	Know the computational algorithms and properties of the DFT in DSP system design	K1
3	Evaluate design problems related to frequency selective processing and design FIR/IIR filters	K5
4	Create a knowledge about Programmable digital signal processor	K6
5	Familiar with programming environment used to develop TMS320C54XX processor applications.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	BASICS OF SIGNALS AND SYSTEMS	10 hours

Introduction to Signals - System and Signal processing - Classification of Signals - representation of signals - Standard discrete time signals - Classification of Discrete time signals -Operation on signals - Classification of Discrete time systems - Interconnection of systems - Convolution and correlation - Sampling and quantization.

Unit:2	COMPUTATION OF DISCRETE FOURIER TRANSFORMS	13 hours

Introduction - Direct evaluation of DFT - Fast Fourier transform (FFT) - Decimation-in-time algorithm(DIT) - Radix-2 DIT-FFT algorithm steps - Decimation-in-frequency algorithm(DIF) - Radix-2 DIF-FFT algorithm steps - Differences and similarities of DIT and DIF algorithm - IDFT using FFT algorithm.

Unit:3	SYSTEM STRUCTURES AND FILTERS DESIGN	13 hours

Introduction: Block diagram and signal flow graph representation, **IIR system**: Direct, Canonic, Cascade and Parallel form, **FIR system**: Direct, Canonic, Cascade and Lattice structure. **IIR Filters:** Impulse invariant technique, Bilinear transformations. **FIR Filters:** Windowing method using Kaiser Window, Frequency sampling method.

Unit:4	DIGITAL SIGNAL PROCESSOR	10 hours

Multiplier and multiplier accumulator(MAC) -Bus structure & memory access scheme – Multiple access memory- Multiported memory - VLIW architecture – Pipelining - Special addressing modes in P-DSP's -On Chip Peripherals

Unit:5	**TMS320C5X PROCESSOR PROGRAMMING AND APPLICATIONS**	**12 hours**
TMS 320C5x Architecture: CALU - ARAU - PLU – Program control - Status registers- Assembly language syntax – Instruction set - Addressing modes - Applications		
Unit:6	**Contemporary Issues**	**2 hours**
TMS 320C5416 Architecture - Instruction set – Applications		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	P. Ramesh babu, **"**Digital Signal Processing**"**, SciTech Publication, 2011
2	B.Venkataramani and M.Bhaskar, "Digital Signal Processors-Architecture, Programming and Applications**''**, Tata McGraw Hill,2004
3	TMS 320C5X - Users guide, Texas instruments,1998

Reference Books

1	Salivaghan,Vallavaraj, "Digital Signal Processing", Tata McGraw Hill,2003
2	John G.Proakis, Dimitris G. Manolakis, D.Sharma**, "**Digital Signal Processing Principles, Algorithms, and Applications**"** – Pearson Education, 2014.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.my-mooc.com/en/mooc/dsp/
2	https://swayam.gov.in/nd1_noc19_ee50/preview
3	https://nptel.ac.in/courses/117/102/117102060/
4	https://www.ti.com/lit/ug/spru056d/spru056d.pdf

Course Designed By:
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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	M
CO2	M	M	S	M	S
CO3	S	S	M	S	S
CO4	M	S	M	S	S
CO5	S	M	S	M	M

*S-Strong; M-Medium; L-Low

Course code		MATLAB PROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		High-level programming language, Signals and Systems, Advanced Mathematics	Syllabus Version	2023 -24		

Course Objectives:

The main objectives of this course are to:

1. Introduce MATLAB computing environment.
2. Provide students a basic understanding of MATLAB, including vector and matrix operations, input-output statements, graphics and control structures.
3. Enable students to use MATLAB for signal processing and image processing applications.

Expected Course Outcomes:

On the successful completion of this course, student will be able to:

1	Become familiar with fundamental operations in MATLAB.	K2
2	Understand MATLAB programming techniques including input-output statements, MATLAB graphics and control structures.	K2
3	Program scripts using the MATLAB development environment to solve scientific and mathematical problems.	K3
4	Acquire a reasonable level of competence in MATLAB programming for signal processing.	K3
5	Apply MATLAB to solve image processing problems.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION TO MATLAB	11 hours

MATLAB environment – Help feature – Types of files – Platform – Search path – MATLAB commands –Character set – Data types – Constants and Variables – Operators – Hierarchy of operators – Built-in functions – Assignment statement

Unit:2	VECTORS AND MATRICES	11 hours

Scalars and vectors – Entering data in matrices – Line continuation – Matrix subscripts/indices – Multi-dimensional matrices and arrays – Matrix manipulations – Generation of special matrices –Matrix and array operations – Functions with array inputs – Structure arrays – Cell arrays

Unit:3	INPUT-OUTPUT STATEMENTS, MATLAB GRAPHICS AND CONTROL STRUCTURES	12 hours

Input-Output statements: Data input – Interactive inputs – Reading/Storing file data – Output commands – Low level input-output functions – MATLAB graphics: Two-dimensional plots – Multiple plots – Style options – legend command - Sub plots – Specialized two-dimensional plots – Three-dimensional plots - Control structures: Loops – Branches control structures

Unit:4	MATLAB PROGRAMMING FOR SIGNAL PROCESSING	12 hours

Representation of basic signals - Discrete convolution - Discrete correlation - Sampling theorem - Fast Fourier transform - Butterworth analog filters (low-pass filter) - Butterworth digital IIR filters (low-pass filter) - IIR filter design using impulse invariant method - IIR filter design using bilinear transformation method - FIR filter design using rectangular window technique

Unit:5	MATLAB PROGRAMMING FOR IMAGE PROCESSING	12 hours
Images in MATLAB: Reading, writing and querying images - Basic display of images - Accessing pixel values - Converting image types - Arithmetic operations on images: Image addition and subtraction , Image multiplication and division - Logical operations on image – Thresholding - Point-based operations on images: Logarithmic transform, Exponential transform, Power-law (gamma) transform - Pixel distributions: Histograms, Adaptive thresholding, Contrast stretching, Histogram equalization - Filtering for noise removal: Mean filtering, Median filtering, Gaussian filtering - Image restoration by inverse filtering		
Unit:6	**Contemporary Issues**	**2 hours**
Filtering for noise removal		
	Total Lecture Hours	**60 hours**

Text Books

1	Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, "MATLAB and its application in Engineering", Pearson Education India, 2009.
2	S. Salivahanan, A. Vallavaraj, "Digital Signal Processing", Tata McGraw-Hill Education, 2001.
3	Chris Solomon, Toby Breckon, "Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab", Wiley-Blackwell, 2011.

Reference Books

1	Stephen J. Chapman, "MATLAB Programming for Engineers", Cengage Learning, 2007..
2	https://www.mathworks.com/help/pdf_doc/matlab/getstart.pdf
3	Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB, Second Edition, Tata McGraw Hill Education Private Limited, 2010.
4	Attaway, Stormy, "MATLAB: A Practical Introduction to Programming and Problem Solving", Elsevier Science, 2017.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://ocw.mit.edu/courses/mathematics/18-s997-introduction-to-matlab-programming-fall-2011/
2	https://www.coursera.org/learn/matlab
3	https://nptel.ac.in/courses/103/106/103106118/

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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	L
CO2	S	M	S	M	L
CO3	S	M	S	M	L
CO4	S	S	S	M	S
CO5	S	S	S	M	S

*S-Strong; M-Medium; L-Low

Course code		DSP AND MATLAB PROGRAMMING LAB	L	T	P	C
Core/Elective/Supportive		Core Practical	0	0	5	4
Pre-requisite		Elementary knowledge of computer programming and understanding of basic mathematics	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Provide an exposure to the specific application areas like digital signal processing and digital image processing.
2. Impart practical working knowledge on a very powerful technical programming language MATLAB used by scientific, engineering and non-engineering community.

Expected Course Outcomes:

On the successful completion of this course, student will be able to:

1	Understand the basic concepts of digital signal processing and to enable their usage in the higher learning.	K2
2	Use MATLAB development environment for the verification of mathematical functions.	K3
3	Implement MATLAB algorithms for the fundamental image processing applications.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

	List of Experiments (Any 6 Experiments)	**40 hours**

Using Digital Signal Processor

1) Arithmetic operations
2) Generation of basic continuous-time signals
3) Generation of basic discrete-time signals
4) Study the signal operations performed on independent variable (time)
5) Solving difference equations
6) Study the linearity property of systems
7) Study the time invariance property of systems
8) Discrete Convolution of signals
9) Discrete Correlation of signals
10) Study the frequency response of discrete-time system with a Z-transform
11) Compute direct DFT (4-point)
12) Compute DFT using DIT FFT Algorithm (4-point)

13) Design of Butterworth digital IIR Filter (Low-pass and High-pass filters)

14) Design of digital FIR filter using windowing technique (Rectangular window)

	List of Experiments (Any 6 Experiments)	35 hours

MATLAB PROGRAMMING

1) Study of basic Matrix operations
2) Solution of Linear equations
3) Determination of Eigenvalues and Eigenvectors of a square Matrix
4) Determination of Roots of a Polynomial
5) Plotting of 2D and 3D cures
6) Differentiation and Integration of a function
7) Solution of Differential equation by Euler method
8) Determination of time response of RLC circuit
9) Laplace and Inverse Laplace transform of a function
10) Image Arithmetic Operations
11) Image Sampling: Zooming and Shrinking operations
12) Basic Gray Level Transformations: Power Law and Log transforms
13) Image Contrast Enhancement by Histogram equalization technique
14) Spatial Image Filtering: Low-pass and High-pass filtering

	Total Practical Hours	75 hours

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Mapping with Programme Outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	M	M	M	S
CO2	S	M	M	M	L
CO3	S	M	M	M	L

*S-Strong; M-Medium; L-Low

Course code		VIRTUAL INSTRUMENTATION AND VHDL PROGRAMMING LAB	L	T	P	C
Core/Elective/Supportive		Core	0	0	5	4
Pre-requisite		Elementary knowledge of Instrumentation and VHDL simulation Software's	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Introduce the concept of virtual instrumentation and to develop basic VI programs
2. Learn knowledge about digital circuit design by VHDL programming

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Analyze and design different type of programs based on data acquisition	K4
2	Familiarize with the VI software and learn programming in VI	K2
3	Design and simulate list of combinational and sequential digital circuits using simulation software's - VHDL language	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

	List of Experiments (Any 6 Experiments)	40 hours

Virtual Instrumentation

1. Creating a simple VI to place a Digital Control
2. Navigation and Editing
3. VI to make a Degree C to Degree F Converter
4. Converting VI in to Sub VI
5. Write a programme to count Modulus 32 and display the values in decimal, octal and binary.
6. Built a VI using while loop that displays random numbers in to three wave form charts. (Strip, scope & Sweep)
7. Data Acquisition using Lab VIEW
8. Development of Temperature Measurement using Lab VIEW
9. Development of Virtual Instrument for Function Generator using Lab VIEW
10. Development of Virtual Instrument for Audio Signal Spectrum Analyser using Lab VIEW

	List of Experiments (Any 6 Experiments)	35 hours

VHDL PROGRAMMING LAB

1. Simple Logic Gates
2. Half Adder and Full Adder

3. Half Subtractor and Full Subtractor
4. Encoder and Decoder
5. Multiplexer and Demultiplexer
6. Solving Boolean Equations
7. Flip - Flops
8. Digital Counters
9. Shift Registers and Ring Counter
10. 4 bit and 8 bit Multiplier
11. Arithmetic and Logic Unit
12. Implementation of Simple Programs in CPLD or FPGA kit

	Total Practical Hours	**75 hours**

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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	S
CO2	S	M	M	M	L
CO3	S	M	M	M	L

*S-Strong; M-Medium; L-Low

Elective Course

Course code		WEB TECHNOLOGY	L	T	P	C
Core/Elective/Supportive		Semester I : Elective - Group-A	4	0	0	4
Pre-requisite		Basic knowledge in Computer programming	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. To enable the students to learn the basics of internetworking.
2. To learn the concept of web pages.
3. To know about the internet security systems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Apply the concept of networking method in various applications.	K3
2	Demonstrate the internetworking standard, its architecture, advantages and limitations.	K4
3	Design and development of web-pages and web-applications	K5
4	Create knowledge on web pages and protocols.	K6
5	Understand Programming web pages with JavaScript /DOM	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1		**10 hours**

Internetworking concepts – Devices: Repeaters – Bridges – Routers – Gateways – Internet topology Internal Architecture of an ISP – IP Address – Basics of TCP – Features of TCP – UDP.

Unit:2		**12 hours**

DNS - Email - FTP - HTTP - TELNET - Electronic commerce and Web technology - Aspects - Types – E-procurement models – Solutions – Supply chain management – Customer Relationship Management – Features Required for enabling e-commerce – Tiers – Concepts of a Tier

Unit:3		**12 hours**

Web page – Static Web pages – Dynamic Web pages – DHTML – CGI – Basics of ASP technology – Active Web pages - User Sessions: Sessions and session Management – Maintaining state information - Transaction Management: Transaction Processing monitors – object Request Brokers – Component transaction – monitor – Enterprise Java Beans.

Unit:4		**12 hours**

Security issues: Basic concepts – cryptography – Digital signature – Digital certificates – Security Socket Layer (SSL) – Credit card Processing Models – Secure Electronic Transaction –

3D Secure Protocol – Electronic money. Electronic Data Interchange: Overview of EDI – Data Exchange Standards – EDI Architecture – EDI and the Internet		
Unit:5		**12 hours**
Extensible Markup Language (XML) – Basics of XML – XML Parsers – Need for a standard– Limitations of Mobile Devices – WAP Architecture – WAP stack – Object Technology.		
Unit:6	**Contemporary Issues**	**2 hours**
Knowledge of framework and platforms- security-performance		
	Total Lecture Hours	**60 hours**

Text Book(s)	
1	Achyat.S.Godbole and Atul Kahate, "Web Technologies", Tata McGraw Hill Pub. Co, Delhi, 2006
Reference Books	
1	Ellote Rusty Harold, "Java Network Programming", O'Reilly Publications, 1997.
2	Jason Hunter, William Crawford, "Java Servlet Programming", O'Reilly Publications, 1998.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd2_ugc19_lb05/preview
2	https://nptel.ac.in/courses/106/105/106105084/
3	https://www.scss.tcd.ie/owen.conlan/CS7062/1_Web_Technologies_Handout.pdf

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Mapping with Programme Outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	M	S	M	M
CO2	M	S	M	S	S
CO3	S	M	M	S	M
CO4	M	S	S	S	M
CO5	S	M	M	S	M

*S-Strong; M-Medium; L-Low

Course code		RELATIONAL DATA BASE MANAGEMENT SYSTEM	L	T	P	C
Core/Elective/Supportive		Semester II : Elective - Group-A	4	0	0	4
Pre-requisite		Basic knowledge in Computer programming	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. To Define basic foundational terms of Database.
2. To Compare relational model with the Structured Query Language (SQL) and also known the constraints and controversies associated with relational database model.
3. To identify the major types of relational management systems and to understand the applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate the basics of query evaluation and apply query optimization techniques.	K2
2	Utilize the knowledge of basics of SQL and construct queries using SQL	K1
3	Apply relational database theory, and be able to write relational algebra expressions for queries	K3
4	Work successfully on a team by design and development of a database application system as part of a team	K4
5	Use commercial relational database system (Oracle) by writing Queries using SQL and to compare the basic database storage structures and access techniques: file and page organizations, indexing methods including B -tree, and hashing.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	12 hours

Purpose of Database systems- View of Data-Data Models-Database Languages-Transaction Management-Storage Management Database Administrator- Database Users-System Structure. ENTITY Relationship Model: Basic concepts-keys-Entity Relationship Diagram, Weak Entity sets, E-R Features. Data Modeling and Normalization: Data Modeling – Dependency – Database Design – Normal forms – Dependency Diagrams - Denormalization– Another Example of Normalization.

Unit:2	ORACLE TABLES	11 hours

DDL: Naming Rules and conventions – Data Types – Constraints – Creating Oracle Table – Displaying Table Information – Altering an Existing Table – Dropping, Renaming, and Truncating Table.

Unit:3	WORKING WITH TABLE: DATA MANAGEMENT AND RETRIEVAL	12 hours

DML – adding a new Row/Record – Customized Prompts – Updating and Deleting an Existing Rows/Records -restricting Data with WHERE clause –Sorting – **Functions and Grouping**:

Built-in functions –Grouping Data.		
Unit:4	**MULTIPLE TABLES**	**12 hours**
Join & Set operators- Join-set operators. **Sub queries:** Sub query-EXIST and NOT EXIST operators. **PL/SQL: A Programming Language:** Block Structure –Comments – Data Types – Variable Declaration – Assignment operation – Bind variables – Substitution Variables – Printing – Arithmetic Operators.		
Unit:5	**CONTROL STRUCTURES AND EMBEDDED SQL**	**11hours**
Control Structures – Nested Blocks – SQ L in PL/SQL – Data Manipulation in PLSQL. **PL/SQL Cursors and Exceptions:** Cursors-Type of Cursors-Cursors Variables-Exceptions. Triggers.		
Unit:6	**Contemporary Issues**	**2 hours**
Increasing data volumes- Decentralized data management- Data security		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	Abraham Silberschatz, Henry F.Korth,S.Sudharson, "Database Concepts", Tata McGraw Hill International Editions, 1997.

Reference Books

1	Alexis Leon and Mathews Leon, "Database Management Systems", Vikas Publishing, 2008
2	Ramez Elmasri, Shamkant Navathe, "Fundamentals of Database Systems", Pearson, 2016.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/content/storage2/courses/106106095/pdf/1_Introduction.pdf
2	https://swayam.gov.in/nd2_nou19_lb03/preview
3	https://cs.stanford.edu/people/widom/DB-mooc.html

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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	M	S	M	M	M
CO3	M	S	S	M	S
CO4	S	M	M	S	S
CO5	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course code		LINUX AND SHELL PROGRAMMING	L	T	P	C
Core/Elective/Supportive		Semester III : Elective - Group-A	4	0	0	4
Pre-requisite		Basic knowledge in Computer Programming	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. To familiarize students with the Linux environment
2. To learn the fundamentals of shell scripting/programming
3. To familiarize students with basic Linux administration

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basic commands of Linux operating system and can write shell scripts	K2
2	Write shell scripts to automate various tasks	K1
3	Master the basics of Linux administration	K4
4	Identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks.	K6
5	Monitor system performance and network activities.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	WELCOME TO LINUX	11 hours

Overview of LINUX-Additional Features in LINUX .**The LINUX Operating System:** Logging In-Working with the shell.

Unit:2	LINUX SYSTEM START UP & SHUTDOWN	12 hours

Introduction Brief outline of X86 LINUX booting process. **System Logging:** Logging – Accounting-Available Graphical Tools.

Unit:3	FILE FILTERS	12 hours

File Related Commands-Introduction to Piping – Some other means of joining commands-awk commands.

Unit:4	SHELL PROGRAMMING	12 hours

Introduction-programming constructors. **The Shell:** Command line-Standard Inputs & Standard output-Filename Generation/pathname expansion.

Unit:5	THE VIM EDITOR	11 hours

Introduction to Vim features-Command Mode: Moving the cursor-Deleting & changing text -Input mode. **Computing C & C++ Programs under LINUX:** Introduction to C Compiler-Computing a Multi source C Program-How main is executed on LINUX-Compiling single source C++ Program.

Unit:6	Contemporary Issues	2 hours

Computing C & C++ Programs under LINUX

	Total Lecture Hours	**60 hours**
Text Book(s)		
1	Mark G. Sobell , "A Practical Guide to LINUX Commands, Editors and shell programming", Pearson, 2013	
2	N.B. Venkateswarlu," Introduction to LINUX: Installation and Programming " , BS Publications, 2008	
Reference Books		
1	Mr. David Tansley, "Linux And Unix Shell Programming**",** Addison Wesley, 2000.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/117/106/117106113/	
2	https://swayam.gov.in/nd2_aic20_sp05/preview	
3	http://index-of.es/OS/Venkateswarlu%20N.Introducing%20Linux.Installation%20and%20Programming .BSP.%5BENG,601p.,2008%5D.pdf	
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Mapping with Programme Outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	M	M	M	S	M
CO2	M	S	M	M	S
CO3	S	M	M	S	M
CO4	S	S	M	M	S
CO5	M	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		RDBMS AND LINUX LAB	L	T	P	C
Core/Elective/Supportive		Semester IV: Elective - Group-A	0	0	5	4
Pre-requisite		Basic knowledge in Computer programming	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. To explain basic database concepts, applications, data models, schemas and instances.
2. To demonstrate the use of constraints and relational algebra operations and describe the basics of SQL and construct queries using SQL.
3. To emphasize the importance of normalization in databases, and to facilitate students in Database design.
4. To understand and make effective use of Linux utilities and shell scripting language to solve problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Apply the basic concepts of Database Systems and Applications	K3
2	Use the basics of SQL and construct queries using SQL in database creation and interaction	K1
3	Understand the basic commands of Linux operating system and can write shell scripts knowledge and students will be able to create file systems and directories and operate them understand.	K2
4	Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.	K5
5	Analyze and Select storage and recovery techniques of database system.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

	List of Experiments (Any 6 Experiments)	40 hours

RDBMS

1. Creating Tables and writing simple Queriesusing

   a) Comparison Operators, b) Logical Operators, c) Set Operators, d) Sorting and Grouping
2. Creation of Reports using Columnformat
3. Writing Queries using built in functions
4. Updating and altering tables using SQL.
5. Creation of Students Information table and write PL/SQLBlock find the Total, Average marks and Results.
6. Write a PL/SQL block to prepare the ElectricityBill.

7. Splitting the table: Write a PL/SQL block to split the students information table into two, one with the Passed and other failed.
8. Joining the Tables-Write a PL/SQL Block to join two tables, First table contain Roll Number, Name, Total and Second Table contains the Roll. No and Address.
9. Create a Database Trigger to check the data validity of Record.
10. Recursive Functions write a Recursive Function to find
    a) Factorial of N
    b) Fibonacci Series with N terms.
11. Write a Recursive function to create as sequence of Roll No's using sequence.
12. Write a Database Trigger to implement the Master Detail Relationship.
13. Front and tools.
14. High level programming language extension
15. Menu Design.
16. Data definition, Manipulation of base tables and views.

	List of Experiments (Any 6 Experiments)	**35 hours**

LINUX

1. Write a Shell script to Wish the User according to Present Time. (i.e GOOD MORNING, GOOD AFTERNOON etc)
2. Write a shell program to print the sum of all digits
3. Write a shell program which informs as soon as a specified user whose name is given along the command line is logged into the system
4. Write a shell program to print the following series
    i. 2 2
    ii. 3 3 3
    iii. 4 4 4 4
    iv. 5 5 5 5 5
    v. 6 6 6 6 6 6
5. Write a shell program which takes a source file name & directories names as command line arguments & print the message.
6. Write a shell script which removes empty files from PWD & changes other file time stamps to current time
7. Write a shell program which reads a digit & prints its BCD code
8. Write a shell program which reads a filename along the command line & prints frequency

of the occurrence of words

9. Write shell script to see current date time username & current directories.
10. Write script to determine whether given file exist or not, file name is supplied as command line argument, also check for sufficient number of command line argument.

	Total Practical Hours	**75 hours**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	http://www.nrcmec.org/pdf/Manuals/CSE/student/4-1%20lp16-17.pdf
2	http://www.becbapatla.ac.in/uploads/BCE1571460572746.pdf
3	http://www.cmrec.ac.in/downloads/academic2017-18/cse/lab/iv/lp.PDF

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Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	M	S	M	M	S
CO2	S	M	S	S	M
CO3	M	S	M	S	S
CO4	S	S	M	S	M
CO5	S	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		SATELLITE AND NETWORK COMMUNICATION	L	T	P	C
Core/Elective/Supportive		Semester I : Elective - Group-B	4	0	0	4
Pre-requisite		Basic Knowledge of Communication	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Introduce the basic concepts of Satellite Communication.
2. Familiar with the Communication satellite subsystems and Application of satellites.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the orbital mechanics and basic concepts of satellite communication	K2
2	Gain knowledge of the working of a Satellite communication system and its other subsystems.	K2
3	Understanding of how a satellite communication system successfully transfers information from one earth station to another.	K2
4	Know the applications of satellites in different areas.	K2
5	Analyze wireless LANs	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	SATELLITE ORBITS AND INCLINATION	11 hours

Introduction - Satellite Frequency Allocation and Band spectrum –Characteristics of satellite communication system – Advantages –Active and Passive satellites- Orbit – Orbital parameters – Satellite location with Respect to Earth – Look Angles - Satellite Placement in GEO stationary Orbit - Satellite Station Keeping.

Unit:2	COMMUNICATION SATELLITE SUBSYSTEMS	11 hours

Electric Power Supply - Attitude and Orbit Control – Propulsion Sub System - Repeaters - Telemetry Tracking and Command (TTC) Systems - Thermal Control System – Earth Station Design – Earth Station Subsystems – Monitoring and Control.

Unit:3	SATELLITE APPLICATIONS	12 hours

Satellite Applications - Different Areas – Satellite Television - Telephone service – Data Communication Service – Satellites for Earth Observation – Weather Forecast – Scientific studies – Military Applications.

Unit:4	NETWORK CONCEPTS	12 hours

Introduction-Network Criteria- Physical Structures-Network Categories-Protocols and Standards-Network Models: Layered Tasks-The OSI Model-Peer to Peer Process-Layers in OSI Model-Digital to Digital Conversion and Analog to Digital Conversion Techniques.

Unit:5	WIRELESS LANS AND OTHER LANS	12 hours

IEEE Standards-Standard Ethernet-Changes in the Standard-Fast Ethernet-High Bit Ethernet-Introduction to Blue tooth- Connecting Devices-Back Bone Networks-Virtual LANs - ATM LANs

Unit:6	**Contemporary Issues**	**2 hours**
Earth Station Design		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	Behrouz A Ferouzan ,"Data Communications and Networking," Tata Mc Graw Hill, 2012
2	Agarwal "Satellite Communication", Khanna Publishers, 2007

Reference Books

1	Uyless Black, "Data Communication and Distributed Networks", Prentice Hall India, 2012
2	Uyless Black , "Computer Networks", Prentice Hall India ,II Edition, 2011.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/117/105/117105131/
2	https://nptel.ac.in/courses/106/105/106105082/

Course Designed By:
Dr. D.Sathes Kumar, Department of ECS, Government Arts College, OOTY.
Dr. K.Shanmugasundaram, Department of Electronics, SRMV College of Arts and Science, CBE

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	M	S
CO2	S	M	S	S	M
CO3	M	S	M	S	S
CO4	S	S	M	S	M
CO5	S	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		WIRELESS SENSOR NETWORKS	L	T	P	C
Core/Elective/Supportive		Semester II : Elective - Group-B	4	0	0	4
Pre-requisite		Knowledge in Wireless Communication	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Provide knowledge about the Sensor networking concepts and components
2. Learn about Transport Control Protocols &its various Security issues in Wireless Sensor Networks &Applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand wireless sensor networks and Infrastructure	K2
2	Understand the concept of wireless internet.	K2
3	Analyze different routing protocols.	K4
4	Know about transport layer protocols and challenges for providing QOS.	K2
5	Understand the security issues in wireless sensor networks and WSN applications	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	WIRELESS LANS, PANS AND MANS	11 hours

Introduction - Fundamentals of WLAN – Technical issues - Network Architecture - IEEE 802.11- Physical layer - Mac layer mechanism - CSMA/CA - Bluetooth – Specification - Transport layer - Middleware Protocol Group - Bluetooth profiles - WLL – Generic WLL architecture - Technologies - Broadband Wireless access - IEEE 802.16 – Differences Between IEEE 802.11 and 802.16 - Physical layer - Data link layer.

Unit:2	WIRELESS INTERNET	11 hours

Introduction – Wireless Internet- Address mobility - Inefficiency of transport layer and application layer protocol - Mobile IP – Simultaneous binding - Route optimization- Mobile IP variations – Handoffs - IPv6 advancements - IP for wireless domain - Security in mobile IP - TCP in wireless domain – TCP over wireless - TCPs –traditional – Snoop - indirect - Mobile Transaction-Oriented - Impact of mobility.

Unit:3	AD-HOC WIRELESS NETWORK AND WIRELESS SENSOR NETWORK	12 hours

Introduction - issues – Medium access scheme – Routing - Multicasting - Transport layer protocol - Pricing scheme - QoS provisioning - Self-organization – Security – Addressing - Service discovery - Energy management - Deployment consideration - Ad-hoc wireless internet.

Unit:4	WIRELESS SENSOR NETWORK	12 hours

Introduction – Applications of sensor network, comparisons with MANET - Issues and design challenges - Architecture – Layered and clustered- Data dissemination - Data gathering Mac protocols - Location discovery - Quality of sensor network – Coverage and exposure - Zigbee standard.

Unit:5	**RECENT ADVANCES IN WIRELESS NETWORK**	**12 hours**
UWB radio communication- Operation of UWB systems - Comparisons with other technologies - Major issues - Advantages and disadvantages, Wi-fi systems- Service provider models, issues, interoperability of wi-fi and WWAN, multimode 802.11 – IEEE 802.11a/b/g – Software radio-based multimode system, Meghadoot architecture -802.11 phone, Fundamentals of UMTS. Basics of IOT and IOT devices.		
Unit:6	**Contemporary Issues**	**2 hours**
Software radio-based multimode system		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	William Stallings, "Wireless Communication and Networks", Prentice Hall, 2nd edition, 2009.
2	C.Siva Ram Murthy and B.S. Manoj, "Ad-hoc wireless networks-architecture and protocols", Pearson, 2014

Reference Books

1	Kaveh Pahlavan and Prashant Krishnamurthy, "Principle of Wireless network- A unified approach", Prentice Hall, 2006.
2	Rappaport, "Wireless Communications: Principles and Practice", Pearson, 2010

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	http://www.digimat.in/nptel/courses/video/106105160/L22.html
2	https://www.tutorialspoint.com/Wireless-Networks

Course Designed By:
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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	M	S	S	M
CO3	M	S	M	S	S
CO4	S	S	M	S	M
CO5	S	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		DIGITAL COMMUNICATION TECHNIQUES	L	T	P	C
Core/Elective/Supportive		Semester III : Elective - Group-B	4	0	0	4
Pre-requisite		Basic knowledge of Communication	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Understand the basics of signal-space analysis and digital transmission.
2. Understand the coherent and non-coherent receivers and its impact on different channel characteristics.
3. Know the basics of Multicarrier and Multiuser Communications

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Analyze different Shift keying techniques	K3
2	Develop the ability to understand the concepts of signal space analysis for coherent and non- coherent receivers	K2
3	Conceptually appreciate different Equalization techniques	K2
4	Analyze different block codes and Convolutional codes.	K4
5	Apply the generation of OFDM signals and the techniques of multiuser detection.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	COHERENT AND NON-COHERENT COMMUNICATION	11 hours

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – Non coherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M-DPSK-BER Performance Analysis. Carrier Synchronization- Bit synchronization.

Unit:2	EQUALIZATION TECHNIQUES	11 hours

Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signals- Equalization algorithms – Viterbi Algorithm – Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms.

Unit:3	BLOCK CODED DIGITAL COMMUNICATION	12 hours

Architecture and performance – Binary block codes – Orthogonal – Biorthogonal - Trans orthogonal - Shannon's channel coding theorem - Channel capacity - Matched filter - Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes – Hammning – Golay – Cyclic - BCH - Reed – Solomon codes. Space time block codes.

Unit:4	CONVOLUTIONAL CODED DIGITAL COMMUNICATION	12 hours

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram – Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold methods – Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.

Unit:5	**MULTICARRIER AND MULTIUSER COMMUNICATIONS**	**12 hours**
Single Vs multicarrier modulation, orthogonal frequency division multiplexing (OFDM), Modulation and demodulation in an OFDM system, An FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation. Introduction to CDMA systems, multiuser detection in CDMA systems – optimum multiuser receiver, suboptimum detectors, successive interference cancellation.		
Unit:6	**Contemporary Issues**	**2 hours**
FFT algorithmic implementation of an OFDM system		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	Bernard Sklar, Fredric J. Harris “Digital Communications: Fundamentals and Applications”, Pearson, 2020
2	John G. Proakis, “Digital Communication”, Fifth Edition, Mc Graw Hill Publication, 2008.
3	M.K.Simon, S.M.Hinedi and W.C.Lindsey, “Digital communication techniques; Signal Design and Detection”, Prentice Hall of India, New Delhi,1995
4	Richard Van Nee & Ramjee Prasad, “OFDM for Multimedia Communications” Artech House Publication, 2001.

Reference Books

1	Simon Haykin, “Digital communication Systems”, John Wiley, 2013
2	Stephen G. Wilson, “Digital Modulation and Coding”, Pearson, 1996

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/117/105/117105144/
2	https://nptel.ac.in/courses/108/102/108102096/

Course Designed By:
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Mapping with Programme Outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	M	M	S
CO2	S	S	S	S	M
CO3	S	S	M	S	S
CO4	S	S	M	S	M
CO5	S	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		DIGITAL COMMUNICATION LAB	L	T	P	C
Core/Elective/Supportive		Core	0	0	5	4
Pre-requisite		Semester IV: Elective - Group-B	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. To identify the various encoding schemes for a given data stream
2. To design and conduct experiments, analyse and interpret data
3. To analyze various digital modulation and demodulation techniques

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand basic theories of Digital communication system in practical	K2
2	Analyze ethical principles and commit to professional ethics and responsibilities and norms of the practice.	K4
3	Design a system, component or process as per needs and specifications	K6
4	Apply appropriate techniques, skills and tools with an understanding of the limitations	K3
5	Understand and implement different modulation and demodulation techniques	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

	List of Experiments (Any 6 Experiments)	75 hours

1. Pulse Amplitude Modulation and Demodulation.
2. Pulse Width Modulation and Demodulation.
3. Pulse Position Modulation and Demodulation.
4. Time Division Multiplexing.
5. Pulse Code Modulation and Demodulation.
6. Differential Pulse Code Modulation and De modulation.
7. Delta Modulation and Demodulation
8. Amplitude Shift Keying
9. Frequency Shift Keying Methods.
10. Phase Shift Keying.
11. Differential Phase Shift Keying.
12. Quadrature Phase-Shift Keying
12. Linear Block Code-Encoder and Decoder.
13. Binary Cyclic Code - Encoder and Decoder.
14. Convolution Code - Encoder and Decoder.

15. Companding.
16. Source Encoder and Decoder.
17. Modulation and demodulation in an OFDM system.
18. Study of Minimum Shift Keying (MSK) Modulation and Demodulation Process.

	Total Practical Hours	**75 hours**

Course Designed By:
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Mapping with Programme Outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	M	S	M	M	S
CO2	S	M	S	S	M
CO3	M	S	M	S	S
CO4	S	S	M	S	M
CO5	S	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		VLSI DESIGN	L	T	P	C
Core/Elective/Supportive		Semester I: Elective - Group-C	4	-	-	4
Pre-requisite		Fundamental knowledge of ICs	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Study the design and realization of combinational & sequential digital circuits.
2. Architectural and performance tradeoffs involved in designing and realizing the circuits in CMOS.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of digital building blocks using MOS transistor.	K2
2	Understand the fundamentals of CMOS circuits and its characteristics	K2
3	Analyze the CMOS Delay and power strategies.	K4
4	Design and construct Combinational and Sequential Circuits	K6
5	Design arithmetic building blocks and memory subsystems	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION TO MOS TRANSISTOR	12 hours

MOS Transistor - CMOS logic- Inverter - Pass Transistor and Transmission gate – Tristates Layout Design Rules - Gate Layouts - Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects - DC Transfer characteristics

Unit:2	DELAY AND POWER	11 hours

Delay: Introduction – Transient Response – RCF Delay Model - Linear Delay Model – **Power**: Introduction – Dynamic Power – Static Power – Energy Delay Optimization – Low Power Architectures

Unit:3	COMBINATIONAL CIRCUIT DESIGN	12 hours

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor circuits - **Circuit Pitfalls**: Threshold Drops - Ratio Failures - Leakage - Charge Sharing - Power Supply Noise - Hot Spots - Minority Carrier Injection - Back-Gate Coupling - Diffusion Input Noise Sensitivity - Process Sensitivity - Domino Noise Budgets

Unit:4	SEQUENTIAL CIRCUIT DESIGN	11 hours

Introduction - Static latches and Registers - Dynamic latches and Registers - Pulse Registers, Sense Amplifier Based Register – Pipelining - Schmitt Trigger - Monostable Sequential Circuits - Astable Circuits.

Unit:5	DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM	12 hours

Arithmetic Building Blocks: Data Paths – Adders – Multipliers – Shifters – ALUs - Power and speed tradeoff's - **Designing Memory and Array structures**: Memory Architectures and Building Blocks - Memory Core - Memory Peripheral Circuitry.

Unit:6	**Contemporary Issues**	**2 hours**
Design of Arithmetic Building Blocks		
	Total Lecture Hours	**60 hours**

Text Book(s)	
1	Neil H. E. Weste, David Money Harris, “CMOS VLSI Design”, Pearson, 2017
2	Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, ‖Digital Integrated Circuits:A Design perspective‖, Second Edition , Pearson , 2016

Reference Books	
1	Wayne Wolf, Modern VLSI Design: System-on-Chip Design, Prentice-Hall, 2002
2	Etienne S, Sonia D Bendhia, “Basics of CMOS Cell Design”, McGraw-Hill, 2007
3	Douglas A. Punknell and Kamran Eshraghian , “Basic VLSI Design” PHI, 2009

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/101/117101058/
2	https://nptel.ac.in/courses/108/107/108107129/

Course Designed By:
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Mapping with Programme Outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	M	S	S	S
CO2	S	S	S	M	S
CO3	S	S	S	S	S
CO4	S	S	S	S	M
CO5	S	S	S	M	S

*S-Strong; M-Medium; L-Low

Course code		LOW POWER VLSI DESIGN	L	T	P	C
Core/Elective/Supportive		Semester II: Elective - Group-C	4	0	0	4
Pre-requisite		Basic knowledge of VLSI Design	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. To study the concepts of device behavior and modeling
2. To study the concepts of low voltage, low power logic circuits.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basic concept of Low Power Design	K2
2	Capability to recognize advanced issues in VLSI systems	K2
3	Understand CMOS technology and digital CMOS design styles.	K2
4	Analyze the development of Low Power Design	K4
5	Analyze the Low power in Algorithm and Architectural level	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION TO LOW POWER DESIGN	11 hours

Need for low power VLSI chips - Sources of power dissipation on Digital Integrated circuits - Emerging Low power approaches - Physics of power dissipation in CMOS devices - Dynamic dissipation in CMOS - Transistor sizing & Gate oxide thickness - Impact of technology Scaling - Technology and Device innovation

Unit:2	SIMULATION POWER ANALYSIS AND PROBABILISTIC POWER ANALYSIS	12 hours

SPICE circuit simulators - Gate level logic simulation - Capacitive power estimation - Static state power - Gate level capacitance estimation - Architecture level analysis - Monte Carlo simulation - Random logic signals - Probability and frequency - Probabilistic power analysis techniques - Signal entropy.

Unit:3	LOW POWER DESIGN	12 hours

Circuit level: Power consumption in circuits - Flip Flops and Latches design - High capacitance nodes - Low power digital cells library - **Logic level**: Gate reorganization - Signal gating - Logic encoding - State machine encoding - Pre computation logic.

Unit:4	LOW POWER ARCHITECTURE AND CLOCK DISTRIBUTION	12 hours

Power and Performance management - switching activity reduction - Parallel architecture with voltage reduction - Flow graph transformation - Low power arithmetic components - Power dissipation in clock distribution - Single driver vs Distributed buffers - Zero skew vs tolerable skew - Chip and package co-design of clock network

Unit:5	ALGORITHM AND ARCHITECTURAL LEVEL METHODOLOGIES	11 hours

Introduction - Design flow - Algorithmic level analysis and optimization - Architectural level estimation and synthesis.

Unit:6	**Contemporary Issues**	**2 hours**
Chip and package co-design of clock network		
	Total Lecture Hours	**60 hours**

Text Book(s)

1	Gary Yeap, "Practical Low Power Digital VLSI Design", Springer, 2012
2	Kaushik Roy and Sharat C. Prasad, "Low-Power CMOS VLSI Circuit Design" ,Wiley-Interscience, 2000
3	Rabaey, M. Pedram, "Low Power Design Methodologies", Kluwer Academic Publications, 1996.

Reference Books

1	Dimitrios Soudris, Christian Piguet, Costas Goutis, "Designing CMOS circuits for low power", Kluwer Academic Publishers,2002.
2	Christian Piguet, "Low-power CMOS circuits: technology, logic design and CAD tools", CRC Press, Taylor & Francis Group, 2006.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/105/106105034/
2	https://nptel.ac.in/courses/117/101/117101004/

Course Designed By:
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Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	M	M	S
CO3	S	S	M	S	S
CO4	S	M	M	M	S
CO5	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		VLSI DESIGN USING VERILOG	L	T	P	C
Core/Elective/Supportive		Semester III: Elective - Group-C	4	0	0	4
Pre-requisite		Knowledge of basic Digital electronic circuits	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Study and design digital circuits using Verilog HDL
2. Learn the design of VLSI circuits

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The ability to code and simulate any digital function in Verilog HDL	K4
2	Model digital systems in verilog HDL at different levels of abstraction	K5
3	Know the simulation techniques and test bench creation.	K2
4	Understand the design flow from simulation to synthesizable version	K2
5	Analyze the process of synthesis and post-synthesis	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	BASICS	11 hours

Synthesis – Design Process – Logic Value System – Logic value system – Bit-widths – Value Holders and Hardware Modeling –Logical operators – Arithmetic operators – Relational operators – Equality operators – Shift operators – Bitwise operators – Concatenation Operator – Operator Precedence

Unit:2	VERILOG CONSTRUCTS TO GATES	11 hours

Conditional Expression - Always Statement - If Statement - Inferring Latches from If Statements - Case Statement: Casez - Casex - Inferring Latches from Cases Statement - Full Case - Parallel Case - Non Constant as Case Item - Loop Statement - Functions - Tasks - Using Values X and Z - The Value x - The Value z

Unit:3	ADDITIONAL FEATURES OF VERILOG	12 hours

Arrays of Primitives - Arrays of Modules - Hierarchical Dereferencing - Parameters Substitution - Procedural Continuous Assignment - Intra Assignment Delay - Indeterminate Assignments and Race Condition – wait Statement – fork join Statement – Named Events – Constructs Supported by Synthesis Tools

Unit:4	MODELING EXAMPLES	12 hours

Modeling Combinational Logic - Modeling sequential logic - Modeling a memory - Writing Boolean equations - Modeling a counter - Modeling a parameterized adder - Modeling a parameterized comparator – Modeling a decoder – Modeling a multiplexer.

Unit:5	MODEL OPTIMIZATIONS AND VERIFICATION	12 hours

Resource Allocation – Common Sub-expressions – Moving Code – Common Factoring – Commutativity and Associativity – Dead-code elimination and Constant folding – Flip-flop and Latch optimizations – Design Size – Using Parentheses – A Test Bench – Delays in Assignment Statements – Unconnected Ports – Missing Latches

Unit:6	**Contemporary Issues**	**2 hours**
Parameters Substitution - Procedural Continuous Assignment		
	Total Lecture Hours	**60 hours**

Text Book(s)	
1	Bhasker J, " Verilog HDL Synthesis, A Practical Primer" , Star Galaxy Publishing, 2018
2	Micheal D. Ciletti, " Advanced Digital Design with the Verilog HDL", Pearson, 2011

Reference Books	
1	Stephen Brown and ZvonkoVranesic, "Fundamentals of Digital Logic with Verilog", McGraw Hill , 2017
2	Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Prentice Hall, 2003

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105165/
2	https://onlinecourses.nptel.ac.in/noc19_cs72/preview

Course Designed By:
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Dr. K.Shanmugasundaram, Department of Electronics, SRMV College of Arts and Science, CBE

Mapping with Programme Outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	S	S	S	S	S
CO4	S	M	S	M	S
CO5	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		VLSI SYSTEM DESIGN LAB	L	T	P	C
Core/Elective/Supportive		Semester IV: Elective - Group-C	-	-	5	4
Pre-requisite		Knowledge of basic Mathematics, Digital Electronic circuits and Programming languages	Syllabus Version		2023 -24	

Course Objectives:

The main objectives of this course are to:

1. Design and Test of multiplexers, coders and Test of flip-flops
2. Learn the design of FPGA based design methodology.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Design and test digital logic circuits on FPGA.	K6
2	Design combinational and sequential circuits at circuit level	K6
3	Implement efficient techniques at circuit level for improving power and speed of combinational and sequential circuits	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

	List of Experiments (Any 12 Experiments)	75 hours

1. Synchronous counter
2. Asynchronous counter
3. Clock divider and generator
4. FIFO Design
5. Multiplexer design
6. Encoder
7. Decoder
8. Comparator
9. Latches and flip flops
10. ALU Design
11. Parity generator
12. UART Module
13. SPI module
14. Memory module
15. Sequence detector

	Total Practical Hours	75 hours

Course Designed By: Course Designed By: Dr. K. Rajendran, Department of Electronics, LRG Government Arts College for Women, Tiruppur

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Annexure

BHARATHIAR UNIVERSITY : : COIMBATORE 641046

DEPARTMENT OF ELECTRONICS AND COMMUNIATION SYSTEM

MISSION

- Excellence in education, grounded in ethics and critical thinking, for improvement of life.
- Build a learning ambience to enhance innovations, problem solving skills, leadership qualities, team-spirit and moral responsibilities
- Facilitate industry institution interaction in teaching, learning and consultancy to accomplish the technological needs of the society.
- To promote research culture in the emerging areas of Electronics and interdisciplinary domains

* ELECTIVE SUBJECTS

Colleges can choose any one of the Group subjects as Electives

Course Code	Sem.	Title of the Course
		GROUP - A
	I	Web Technology
	II	Relational Data Base Management System
	III	LINUX and Shell Programming
	IV	RDBMS and LINUX Lab
		GROUP - B
	I	Satellite and Network Communication
	II	Wireless Sensor Networks
	III	Digital Communication Techniques
	IV	Digital Communication Lab
		GROUP - C
	I	VLSI Design
	II	Low Power VLSI Design
	III	VLSI Design Using Verilog
	IV	VLSI System Design Lab