HYDERABAD INSTITUTE OF TECHNOLOGY AND MANAGEMENT

B.TECH. HR-21 COURSE STRUCTURE

ELECTRICAL AND ELECTRONICS ENGINEERING

(Applicable for the batch admitted from 2021-22 onwards)

V – Semester (III – Year)

S. No.	Subject Code	Subject	Hours Per Week			Credits	Scheme of Evaluation		
			L	T	P		Maximum Marks		
							Int.	Ext.	Tot.
1	21PC5EE15	Power systems II	3	-	-	3	30	70	100
2	21PC5EC16	Microcontroller and Applications	3	-	-	3	30	70	100
3	21PC5EE17	Power Electronics	3	-	-	3	30	70	100
4		**Professional Elective-I**	3	-	-	3	30	70	100
5		**Open Elective-1**	3	-	-	3	30	70	100
6	21PC5EC18	Microcontroller and Applications Lab	-	-	2	1	30	70	100
7	21PC5EE19	Power Electronics Lab	-	-	3	1.5	30	70	100
8	21PC5EE20	Electrical and Electronics Design-Lab	-	-	2	1	30	70	100
9	21HS5EG05	Advanced English Communication Skills-Lab	-	-	2	1	30	70	100
10	21PR5EE02	**Doing Engineering-2**	-	1	1	1.5	30	70	100
11	21PR5IN02	**Internship-2**	-	1	-	1	100	0	100
TOTAL						**22**	**400**	**700**	**1100**
Non Credit Courses									
12	21MC5HS03	Analytical Reasoning	2	-	-	0	100	0	**100**

VI – Semester (III – Year)

S. No.	Subject Code	Subject	Hours Per Week			Credits	Scheme of Evaluation		
			L	T	P		Maximum Marks		
							Int.	Ext.	Tot.
1	21ES6CS03	Python Programming	3	-	-	3	30	70	100
2	21PC6EE21	Electrical Measurements	3	-	-	3	30	70	100
3	21PC6EE22	Power systems III	3	1	-	4	30	70	100
4	21HS6MB02	Fundamentals of Engineering Management	2	-	-	2	30	70	100
5		**Professional Elective-II**	3	-	-	3	30	70	100
6		**Open elective-II**	3	-	-	3	30	70	100
7	21ES6CS04	Python Programming-Lab	-	-	3	1.5	30	70	100
8	21PC6EE23	Power Systems Lab	-	-	3	1.5	30	70	100
9	21PC6EE24	Electrical Measurements Lab	-	-	2	1	30	70	100
TOTAL						**22**	**270**	**630**	**900**
Non Credit Courses									
10	21MC6HS04	Quantitative Aptitude	2	-	-	0	100	0	**100**

Subject Code	Professional Elective-I
21PE5EE11	Utilization of Electrical Power
21PE5EE12	Analog Electronic Circuits
21PE5EE13	Digital Control Systems

Subject Code	Professional Elective-II
21PE6EE21	High VolTage Direct Current Transmission
21PE6EE22	VLSI Design
21PE6EE23	High Voltage Engineering

Sl.no	SUBJECT CODE	Open Elective-I	Offering Department
1	21OE6CS06	Computer Organization and Architecture	CSE
2	21OE5EC01	Electronics measurement & Instrumentation	ECE
3	21OE5ME01	Hybrid & Electric Vehicles	MECH
4	21OE5EE01	Fundamentals of Electric Circuit Analysis	EEE
5	21OE5HS01	Nanoscience and Technology	H&S
6	21OE5CM01	Introduction to Artificial Intelligence	CSE-AI&ML
7	21OE5CD01	Statistics for Data Science	CSE-DS
8	21OE5CO01	Introduction to IoT	CSE-IOT
9	21OE5CC01	Data Security	CSE-CS

Sl.no	SUBJECT CODE	Open Elective-II	Offering Department
1	21OE5CS09	OOPS using Java	CSE
2	21OE6EC02	Fundamentals of Digital Electronics	ECE
3	21OE6ME02	Total Quality Measurement & Six Sigma Applications	MECH
4	21OE6EE02	Fundamentals of Industrial Electronics	EEE

5	21OE6HS02	Medical Instrumentation	H&S
6	21OE6CM06	Expert Systems	CSE-AI
7	21OE6CD02	Data Mining and Data Analytics	CSE-DS
8	21OE6CO05	Sensors & Devices	CSE-IOT
9	21OE6CC02	Computer Hardware and System Essentials	CSE-CS

B.Tech III Year – I Sem	L	T	P	C
Subject Code: 21PC5EE15	3	0	0	3

POWER SYSTEMS-II

Pre-requisite: Power Systems-I and Electro Magnetic Fields

Course Objectives:

1. To analyze the performance of transmission lines.
2. To understand the voltage control and compensation methods.
3. To understand the per unit representation of power systems.
4. To examine the performance of travelling waves.
5. To know the methods of over voltage protection and Insulation coordination of transmission lines
6. To know the symmetrical components and fault calculation analysis

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

1. **CO1-** Analyze transmission line performance.
2. **CO2-** Apply load compensation techniques to control reactive power & understand the application of per unit quantities.
3. **CO3-** Design over voltage protection and insulation coordination
4. **CO4-** Determine the fault currents for symmetrical and unbalanced faults

Module I :

Performance of Lines-I

Representation of Transmission lines, short transmission lines, medium length lines, nominal T and PI- representations.

Performance of Lines-II

Long transmission lines. The equivalent circuit representation of a long Line, A, B, C, D constants, Surge Impedance Loading and its Significance, Ferranti Effect, Power flow through a transmission line.

Module II:

Voltage Control

Introduction – methods of voltage control, shunt and series capacitors / Inductors, tap changing transformers, synchronous phase modifiers.

Compensation in Power Systems

Introduction - Concepts of Load compensation – Load ability characteristics of overhead lines – Uncompensated transmission line – Symmetrical line – Radial line with asynchronous load.

Module III :

Per Unit Representation of Power Systems

The single-line diagram, impedance and reactance diagrams, per unit quantities, changing the base of per unit quantities, advantages of per unit system.

Travelling Waves on Transmission Lines

Travelling waves, open circuited line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at T-junction line terminated through a capacitance.

Module IV:

Over-voltage Protection

Over voltage due to arcing ground and Peterson coil, lightning, horn gaps, surge diverters, rod gaps, expulsion type lightning arrester, valve type lightning arrester, ground wires, ground rods.

Insulation Coordination

Surge absorbers, Insulation coordination, volt-time curves.

Module V:

Symmetrical Components

Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks

Fault Calculations

Fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three phase faults, faults with fault impedance, reactors and their location, short circuit capacity of a bus.

TEXT BOOKS:

1. John J. Grainger & W.D. Stevenson: Power System Analysis – Mc-Graw Hill International 2012.

2. C.L. Wadhwa: Electrical Power Systems – New Age International Pub. Co. Sixth Edition, 2010.

REFERENCE BOOKS:

1. Hadi Scadat: Power System Analysis – Tata Mc Graw Hill Pub. Co. 2012

2. W.D. Stevenson: Elements of Power system Analysis – McGraw Hill International Student Edition.

3. D.P. Kothari and I. J. Nagrath, Modern Power System Analysis - Tata Mc Graw Hill Pub. Co. New Delhi, Fourth edition, 2011

E books:

1. https://www.webprosindia.com/hitam/resources/PS-II%20(R18)%20M.CHIRANJIVI%20COURSE%20FILE%202021-22_4396.docx

Equivalent MOOC Courses if any:

1. https://www.coursera.org/learn/electric-power-systems
2. https://www.coursera.org/learn/renewable-power-electricity-systems

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3		3									1	1
CO2	3	2											1	1
CO3	3	3		2									1	1
CO4	2	3		3									1	1

Dr.M.Sushama

Dr. E. Vidya Sagar

Dr. Vinay Kumar T

Dr. CH. Lokeshwar Reddy

Mr. A Bala Arvind

Mr. G.Shiva Raj

Dr.O.P.Suresh (BOS Chairman)

Mr.K Suresh

Mr.S.V.Satyanarayana

Mr.Chiranjivi

Ms.Madhavi

B. Tech III Year – I Sem	L	T	P	C
Subject Code: 21PC5EC16	3	0	0	3

Microcontroller and Applications

Pre-requisite: Digital Logic Design

Course Objective: This course will enable students to:

1. To Differentiate the Computers, microprocessor and Microcontroller
2. To introduce the Architecture of 8086 Microprocessor.
3. To understand the architecture and programming of Microcontrollers.
4. To understand the interfacing on chip peripherals of Microcontroller.

Course Outcomes:

Upon completion of the course, the student should be able to

1. Demonstrate the impact of instruction set architecture on cost-performance of Computer design.
2. Explain the internal architecture, organization and Addressing modes of 8086 Microprocessors.
3. Utilize the architectural features and instruction set of 16 bit microcontroller for low power applications
4. Describe the functions of various peripherals which are interfaced with microcontroller for different applications.

Module I

Computers, Microprocessors and Microcontrollers: Introduction, Common Terminologies Associated with Computing Systems, Microprocessors and Microcontrollers, CISC and RISC Systems, Computing Languages, Memory - Random Access Memory (RAM), Read-Only Memory (ROM), Cache Memory, Memory Latency, Computer Architecture: Harvard and Von-Neumann, Evolution of Microcontrollers-4 bit to 32 bit

Module II

8086 Microprocessor: Architecture and features of 8086, Pin configuration of 8086, Minimum mode and Maximum mode, Timing diagrams, addressing modes

Module III

MSP Microcontroller Introduction and Key Features: Introduction, Low Power Applications, MSP430 RISC CPU Architecture, Details of 16-Bit RISC CPU, Clock System, Memory subsystem, Key differentiating factors between different families, Digital I/O Ports

Module IV

Programming the MSP430: Addressing Modes, Instruction Set of MSP430, Double Operand Core Instructions, Single Operand Core Instructions (Format II), Program Flow control, Emulated Instructions, Movement Instructions, Implementation of Decimal Arithmetic, Shift and Rotate Instructions, Programing in ALP

Module V

On Chip Peripherals, Interfacing and Applications of MSP430: Watchdog Timer, Timers, Real Time Clock, DAC: Digital-to-Analog Conversion, Direct Memory Access (DMA), LCD Controller, Case studies of applications of MSP 430 data Acquisition system **,** UART and SPI

Text Books:

1. "The 8051 and MSP430 Microcontrollers: Architecture, Programming and Applications", K. Uma Rao, Andhe Pallavi,Wiley Publication, 2019
2. Advanced microprocessor and Peripherals - A.K.Ray and K.M.Bhurchandi, Tata Mc Hill,2000.
3. Microprocessors and Interfacing (8086, 8051, 8096 and Advanced processors) – N.Senthil Kumar, M. Saravanan, Oxford University Press, 2012.

Reference Books:

1. Microprocessors & Interfacing, Douglas.V. Hall, 3 rd Edition, Pearson/ PHI. 2007
2. Micro Controllers – Deshmukh, Tata McGraw Hill Edition.6th reprint,2007.

CO-PO MAPPING:

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO2	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
CO3	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
CO4	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

B.Tech III Year – I Sem	L	T	P	C
Subject Code: 21PC5EE17	3	0	0	3

POWER ELECTRONICS

Pre-requisite: Basic Electrical and Electronics Engineering, Analog Electronics

Course Objectives:

1. To Design/develop suitable power converter for efficient control or conversion of power in drive applications.
2. To Design / develop suitable power converter for efficient transmission and utilization of power in power system applications.

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

1. CO1 – Understand the differences between signal level and power level devices.
2. CO2 – Analyze controlled rectifier circuits.
3. CO3 – Analyze the operation of DC-DC choppers.
4. CO4 – Analyze the operation of voltage source inverters.

Module 1: Power Switching Devices

Power Switching Devices and Protection Circuits

Concept of power electronics, scope and applications, types of power converters; Power semiconductor switches and their V-I characteristics - Power Diodes, Power BJT, SCR, Power MOSFET, Power IGBT.Thyristor ratings and protection.

Commutation and Triggering Circuits: R,RC and UJT triggering Circuits, gate drive circuits for BJT and MOSFETs. Methods of SCR commutation.

Module 2: Rectifiers

Single Phase Rectifier

Principles of single-phase half-controlled converter with R, RL, RL with FD and RLE load. Principles of single-phase fully-controlled converter with RLE load. Effect of load and source inductances on single phase rectifiers. Problems on Single phase Rectifiers.

Three Phase Rectifiers and Dual Converters

Principles of three-phase fully-controlled converter operation with RLE load. Effect of load and source inductances on Three phase rectifiers. Problems on Three phase Rectifiers. Single phase and Three phase dual converters.

Module 3: Choppers

DC-DC Converters (Choppers)

Introduction of Choppers, Control strategies in Choppers, Time Ratio Control, Step down and Step Up Choppers with problems. Types of Choppers.

SMPS: Buck converter - Power circuit, analysis and waveforms at steady state, duty ratio control of output voltage. Boost converter - Power circuit, analysis and wave-forms at steady state, relation between duty ratio and average output voltage. Buck-Boost converter - Power circuit, analysis and waveform at steady state, relation between duty ratio and average output voltage.

Module 4: Inverters

DC-AC Converters (Inverters)

Introduction, principle of operation, performance parameters, single phase half and full bridge inverters with R, RL loads. Problems on single phase inverters.

3-phase bridge inverters and PWM Techniques

120- and 180-degrees mode of operation in three phase Inverters.

Voltage control of single-phase inverters –single pulse width modulation, multiple pulse width modulation, sinusoidal pulse width modulation.

Module 5: AC Voltage Controllers and Cycloconverters

AC-AC Converters

Phase Controller (AC Voltage Regulator)-Introduction, principle of operation of single-phase voltage controllers for R, R-L loads and its applications. TRIAC as AC voltage Regulator.

Cyclo converters and Applications of Power Electronics

Cyclo converter Principle of operation of single phase cycloconverters: Mid Tap and Bridge type, relevant waveforms, Advantages and disadvantages.

Applications: UPS, SMPS, Battery Charger.

Text Books:

1. Dr.P.S.Bimbhra, “Power Electronics”, Khanna Publishers, New Delhi.
2. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.

Reference Books:

1.N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
2. MD Singh and KB Kanchandhani, “ Power Electronics”, Tata Mc Graw Hill Publishing Company Limited, New Delhi.

Web Resources: www.mathworks .com

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	1											1	2
CO2	2	2	3		2								2	2
CO3	1	2	3		2								2	2
CO4	1	2	3		2								2	2

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B. Tech III Year – I Sem	L	T	P	C
Subject Code: 21PC5EC18	0	0	2	1

Microcontroller and Applications Lab

Prerequisite: Digital Logic Design

Course Objective: This course will enable students to:

1. To study programming based on 8086 Microprocessor and MSP430.
2. To study 8086 microprocessor based ALP using arithmetic, logical, shift, string operations,
3. To study to interface MSP 430 with I/O and other devices.
4. To study serial communication using MSP430

Course Outcomes: Upon successful completion of the course, the student is able to

1. Develop assembly language programs for various applications using 8086 Microprocessor
2. Apply appropriate techniques, resources, and Code Composer Studio based IDE for modelling system designs with understanding of limitations.
3. Analyze usage of various resources like GPIO, Timers, Interrupts, ADC, UART, Comparator
4. Make an effective report based on experiments.

List of Experiments:

1. 16-bit Signed and unsigned Arithmetic operations, ASCII –arithmetic operations
2. Arithmetic operations – Multi byte Addition and Subtraction
3. Logical operations, Sum of Squares, Sum of Cubes
4. Write ALP to find smallest, largest number, arrange numbersin Ascending order, Descending order in a given series.
5. Using string operation and Instruction prefix: Move Block,Reverse string, String comparison
6. Introduction to MSP430 launch pad and ProgrammingEnvironment. (Study Experiment)
7. Read input from switch and Automatic control/flash LED(soft-ware delay).
8. Read Temperature of MSP430 with the help of ADC.
9. PWM Generator
10. Enabling serial communication with UART on Lunchbox
11. Interfacing the 7-segment display to MSP430
12. Interfacing the stepper motor to MSP430

Text Books:

1. The 8051 and MSP430 Microcontrollers: Architecture, Programming and Applications, K. Uma Rao, Andhe Pallavi,Wiley Publication, 2019.
2. Advanced microprocessor and Peripherals - A.K.Ray and K.M.Bhurchandi, 3rd edition Tata Mc Hill,2013.

Reference Books:

1. Microprocessors & Interfacing, Douglas.V. Hall, 3 rd Edition, Pearson/ PHI. 2007
2. Micro Controllers – Deshmukh, Tata McGraw Hill Edition, 6th reprint, 2007.

Web Resources:

1. http://freevideolectures.com/Course/3018/Microprocessors-and-Microcontrollers

CO-PO/PSO Mapping Chart **(3/2/1 indicates strength of correlation)** **3 – High; 2 – Medium; 1 – Low**														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	-	-	**3**	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	**3**	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	**3**	-	-	-	-

B.Tech III Year – I Sem

L	T	P	C
0	0	3	1.5

Subject Code: 21PC5EE19

POWER ELECTRONICS LAB

Pre-requisite: Power Electronics

Course Objectives:

1. Apply the concepts of power electronic converters for efficient conversion/control of power from the source to load.

2. Design the power converter with suitable switches meeting a specific load requirement

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

1. CO1 – Understand the operating principles of various power electronic converters.
2. CO2 – Use power electronic simulation packages and hardware to develop the power converters.
3. CO3 – Analyze and choose the appropriate converters for various applications
4. CO4 – Analyze Power Semiconductor circuits for domestic and Industrial applications.

Any Eight Experiments Should be Conducted

1. Study of Characteristics of SCR, MOSFET & IGBT
2. Gate firing circuits for SCR's
3. Single Phase AC Voltage Controller with R and RL Loads
4. Single Phase half controlled &fully controlled bridge converter with R and RL loads
5. Forced Commutation circuits (Class A, Class B, Class C, and Class D & Class E)
6. Single Phase Cyclo-converter with R and RL loads
7. Single Phase series& parallel inverter with R and RL loads
8. Single Phase Bridge inverter with R and RL loads
9. DC Jones chopper with R and RL Loads
10. Three Phase half-controlled bridge converter with R-load
11. Single Phase dual converter with RL loads
12. (a)Simulation of single-phase Half wave converter using R and RL loads (b)Simulation of single-phase full converter using R, RL, and RLE loads (c)Simulation of single-phase Semi converter using R, RL, and RLE loads

Any Two experiments should be conducted

13. (A) Simulation of Single-phase AC voltage controller using R and RL loads
(b) Simulation of Single phase Cyclo-converter with R and RL-loads
14. Simulation of Buck chopper
15. Simulation of single-phase Inverter with PWM control
16. Simulation of three-phase fully controlled converter with R and RL loads, with and without freewheeling diode. Observation of waveforms for Continuous and Discontinuous modes of operation.
17. Study of PWM techniques
18. MOSFET based Chopper

Text Books:

1. M. H. Rashid, Simulation of Electric and Electronic circuits using PSPICE – by M/s PHI Publications.
2. User's manual of related software's

Reference Books:

1. Reference guides of related software's
2. Rashid, Spice for power electronics and electric power, CRC Press

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Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3		2	3									
CO2	3	1	2	2	3									
CO3	2	3	2	3	3									
CO4	2	3	3	3	3									3

B.Tech III Year – I Sem	L	T	P	C
Subject Code: 21PC5EE20	0	0	2	1

ELECTRICAL AND ELECTRONICS DESIGN LAB

Pre-requisite: Basics of Electrical Engineering

Course Objectives:

1. To enhance practical knowledge related to different subjects
2. To develop hardware skills such as soldering, welding etc.
3. To prepare students for working on different hardware projects.

Course Outcomes:

1. CO1 – Able to fabricate basic electrical circuit elements/networks
2. CO2 – Able to Trouble shoot the electrical circuits
3. CO3 – Able to understand hardware skills such as soldering, winding etc.
4. CO4 – Able to get debugging skills.

Any SIX Experiments Should be Conducted

1. Design and fabrication of electromagnet for different inductance values.
2. Design and fabrication of single-phase Induction/three phase motor stator.
3. Start delta starter wiring for automatic and manual operation.
4. Wiring of distribution box with MCB, ELCB and MCCB.
5. Wiring of 40 W tube, T-5, LED and available latest luminaries.
6. Assembly of various types of contactors with wiring.
7. Assembly of DOL and 3-point starter with NVC connections and overload operation.
8. Microcontroller Interface circuit for temperature level/speed measurement
9. Design and development of low pass/high pass filters with an application.

Any FOUR experiments should be conducted

9. Design and development of 5 V regulated power supply.
10. Design and development of precision rectifier.
11. Peak detector using op-amplifiers.
12. Zero crossing detector using op-amplifiers.
13. Find the Fourier transform of a square pulse. (Plot its Magnitude and phase spectrum).
14. Generate the discrete sequences of the following signals
(i) Unit step (ii) Unit impulse (iii) Ramp (iv) Periodic sinusoidal sequences.
15. Perform operations on the following signals i) Addition ii) Multiplication iii) Time scaling iv) Time shifting

Text Books:

1. Badriram and D.N. Vishwakarma, Power System Protection and Switchgear, TMH 2001
2. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons
3. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 2003.

Reference Books:

1. C.Russel Mason – "The art and science of protective relaying, Wiley Eastern
2. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
3. Electronic Devices Conventional and current version -Thomas L. Floyd 2015, pearson

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	2											
CO2	3	3	2	2										2
CO3	3	2	3											
CO4	3	3	2	1										

B.Tech III Year -I/II Sem **L T P C**

Subject Code:21HS5EG05 **0 0 2 1**

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

(Common to CSE/EEE/ECE/CSM/CSD/CSC/CSO/ME)

1. INTRODUCTION:

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information to organize ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Writing formal letters.
- Transferring information from non-verbal to verbal texts and vice-versa.
- Taking part in social and professional communication.

2. OBJECTIVES:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.
- Learn conversation skills
- Learn reading strategies
- Learn time management
- Learn stress management
- Learn career planning

Course outcomes

- Express conversational skills
- Specify reading strategies
- Perform time management
- Perform stress management
- Explore career planning

3. SYLLABUS:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Fundamentals of 7c's of effective Communication, Behaviour skills and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language - Concise - Clear - Concerts - Coherent - Complete - Correct.

   Behaviour Skills - Grooming - Formal and Informal Communication - Body language - Time Management.

   – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension and Business English** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading& effective googling,6.listening in effective communication,Style of Communication.

   Business Conversation with dialogues reading and speaking activity
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/Technical report writing/* – planning for writing – improving one's writing.
4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/**Group Writing, info-graphics,**

   e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice,Career Planning, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

4. MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructuralfacilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

5. SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and used.

- Oxford Advanced Learner's Compass, 7th Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dream tech
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)

TEXT BOOKS:

1. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd.2nd Edition
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5thEdition.

REFERENCE BOOKS:

1. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar andHemalatha Nagarajan. Pearson 2007
2. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
3. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press2009.
4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
5. English Vocabulary in Use series, Cambridge University Press 2008.
6. Handbook for Technical Communication by David A. McMurrey & Joanne Buckley. 2012.Cengage Learning.
7. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.

8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata McGraw-Hill 2009.
10. Business English Vocabulary Builder: Idioms, Phrases. Book by Jackie Bolen
11. **HOLISTIC FRAMEWORK Behavioural skills 4 K E Y S T O C O L L E G E A N D C A R E E R R E A D I N E S S**
12. The Seven C's of Why (English, Paperback, Batten Chris)

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1										3				
CO2									2	2				
CO3										3				
CO4										3				

	L	T	P	C
B.Tech III Year – I Sem				
Subject Code: 21PR5EE02	**0**	**1**	**1**	**1.5**

ARDUINO PROGRAMMING
(DOING ENGINEERING -2)

Pre-requisite: Basics of C programming language

Course Objectives:

1. To train the students to write the code for different applications.
2. To make the students how Arduino IDE software is interconnected with hardware components.
3. To make the students, understand the usage of different sensors for specific applications.
4. To develop the Software/hardware prototype for various applications.

Course Outcomes:

1. CO1 – Demonstrate the Hardware components of various Sensors & actuators

2. CO2 – Develop a Program for various sensors with the Arduino using Software (Arduino IDE)

3. CO3 – Develop a Program for relays and RFID with the Arduino using Software (Arduino IDE)

4. CO4 – Design a Prototype according to the application.

Any Ten Experiments Should be Conducted

1. Study of Arduino Uno Board, Multimeter, Battery, Servo motor.
2. Write a program for Blinking of LED with Buzzer using Arduino
3. Write a program for Blinking of Tri-Colour LED using Arduino
4. Write a program for Interfacing LDR Sensor using Arduino
5. Write a program for Interfacing Soil moisture sensor using Arduino
6. Write a program for Interfacing Smoke and Alcohol Sensor using Arduino
7. Write a program for Interfacing 16x2 LCD display using Arduino
8. Write a program for Interfacing ultrasonic sensor using Arduino9. Write a program for Interfacing IR sensor using Arduino
10. Write a program for Interfacing PIR sensor using Arduino

11. Write a program for Interfacing Relay using Arduino

12. Write a program for Interfacing temperature sensor using Arduino

13. Write a program for Interfacing RFID using Arduino

14. Write a program for Interfacing L293D Motor Driver using Arduino

15. Write a program for Interfacing of Seven Segment display using Arduino

TEXTBOOKS:

1. Exploring Arduino: Tools and Techniques for Engineering Wizardry by Jeremy Blum.

2. "Simon Monk" -Programming Arduino-Getting Started with Sketches.

REFERENCE BOOKS:

1. "Paul Bradt and David Bradt" Science and Engineering Projects using the Arduino and Raspberry Pi.

2. "Jack Purdum, Ph.D." Beginning of C for Arduino, Second Edition, Learn C Programming for the Arduino.

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation)
3 – High; 2 – Medium; 1 - Low

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2		3	3								2	2
CO2	2	2		3	3									2
CO3	2	2		3	3									2
CO4	2	2		3	3								2	2

B. Tech III Year- I Sem	L	T	P	C
Subject Code: 21MC5HS03	2	0	0	0

ANALYTICAL REASONING

(Common to CSE/EEE/ECE/CSM/CSD/CSC/CSO/ME)

Pre-requisite: Nil

Course Objectives:

1. Improve logical thinking to solve various questions and puzzles in Reasoning.
2. To help the student understand the importance of having his language skills kept ready for effective use
3. To understand the concept of employability skills
4. To enrich their problem solving, critical and analytical skills

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

1. Improve logical thinking to solve various questions and puzzles in Reasoning.
2. To help the student understand the importance of having his language skills kept ready for effective use
3. To understand the concept of employability skills
4. To enrich their problem solving, critical and analytical skills

Module 1:

Coding and Decoding

Coding and Decoding, Arrow Method, Chinese coding, Series, Analogy, Odd man out

Articles and Tenses: Introduction, usage of articles, Omission of Articles, Types of tenses, Forms and Usage of tenses.

Module 2:

Direction Sense: Introduction, Distance method, Facing Method and Shadow Method.

Blood Relations: Introduction, Direct, Puzzle and Coded models.

Module 3:

Voices and Forms of Speech: Introduction, conversion of active and passive voice, conversions of direct and indirect speech.

Module 4:

Data Arrangements: Linear Arrangement, Circular Arrangement, Multiple Arrangements.

Syllogisms: Introduction, Tick-Cross method, Inferential Technique, Venn-Diagram method.

Module 5:

Visual Reasoning: Patterns, Folded Images, Cubes and Analytical Reasoning.

Sentence Correction: Subject-Verb Agreement, Pronoun Antecedent, Parallelism, Verb-Time Sequence Error, Determiners and Modifiers.

Text Books:

1. R.S. Aggarwal, Vikas Aggarwal, Quick Learning Objective General English, S.Chand, 2003.

2. R.S. Aggarwal, A Modern Approach to Logical Reasoning, Revised Edition, S Chand & Co Ltd.

Reference Books:

1. Edgar Thorpe, Test of Reasoning for all competitive examinations, 6th Edition, McGraw Hill Education, 2017.

2. Arun Sharma, How to Prepare for Logical Reasoning for CAT and other Management Examinations, 4th edition, McGraw Hill Education, 2017.

3. Simbo Nuga, English Grammar and Verbal Reasoning – The Toolkit for Success, Trafford Publishing, 2013

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1						1					2	3		
CO2						1					2	3		
CO3						1					2	3		
CO4						1					2	3		

B.Tech III Year – I Sem	L	T	P	C
Subject Code: 21PE5EE11	3	0	0	3

UTILIZATION OF ELECTRIC POWER

Pre-requisite: Power Electronics and Drives, Electrical Machines, Power systems

Course Objectives:

1. To understand the fundamentals of DC Machines, illumination, electric welding and electric heating.

2. To analyze all varieties of Electric drives and their application to electric traction system.

3. To draw the speed time curves for the evaluation and estimation of train speeds.

Course Outcomes:

1. CO1- Analyze the operating principles and characteristics of traction motors with respect to speed, temperature, loading condition

2. CO2- Acquaint With the different types of heating, welding and illumination techniques

3. CO3- Analyze the basic principle of electric traction including speed– time curves of different traction services

4. CO4- Compute the tractive effort required for a given weight of the train, acceleration and track condition.

Module 1: ELECTRIC DRIVES

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives,

Industrial loads: Types of industrial loads, continuous,intermittent and variable loads, load Equalization.

Module 2: ELECTRIC HEATING AND WELDING

Electric Heating: Advantages and methods of electric heating, resistance heating induction heating and dielectric heating.
Electric Welding: Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding

Module 3: ILLUMINATION

Illumination Fundamentals: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integratingsphere, sources of light.

Illumination Methods: Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescenttubes, Basic principles of light control, Types and design of lighting and flood lighting.

Module 4: ELECTRIC TRACTION

Traction-I: System of electric traction and track electrification. Review of existing electric traction systems inIndia. Special features of traction motor

Electric Braking: Methods of electric braking-plugging rheostatic braking and regenerative braking.

Module 5: ELECTRIC TRACTION

Traction-II: Mechanics of train movement. Speed-time curves for different services – trapezoidal and
Quadrilateral speed time curves.

Calculations of tractive effort, power, specific energy consumption forgiven run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion

Text Books:

1. Utilization of Electrical Energy - by E. Opens haw Taylor, University Press.
2. Art & Science of Utilization of Electrical Energy - by Par tab, Dhanpat Ravi Sons.

REFERENCE BOOKS:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V. Suryanarayana, New Age International (P) Limited, Publishers, 1996.

2. Generation, Distribution and Utilization of Electrical Energy - by C.L. Wadhwa New Age International (P) Limited, Publishers, 1997

Web Resources: NPTEL

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2											2	2
CO2	3	2											1	2
CO3	3	3											2	2
CO4	3	3											2	2

B.Tech III Year – I Sem

L	T	P	C
3	0	0	3

Subject Code: 21PE5EE12

ANALOG ELECTRONIC CIRCUITS

Prerequisite: AP, ADE

Course Objectives: The objectives of the course are to:

1. Describe the basic concepts of BJT, MOSFET Circuits and IC design Philosophy.
2. Analyse the BJT and MOSFET Characteristics.
3. Analyse the Amplifiers using MOSFET.
4. Apply the different biasing techniques of BJT, MOSFET and IC Design.

Course Outcomes: Upon completing this course, the student will be able to

CO1: Acquire qualitative knowledge about the MOS transistor design characteristics.

CO2: Application of MOSFET's as amplifier and understand their characteristics.

CO3: Understand the operation of OP-Amps and design.

CO4: Get acquainted with latest transistor logic families.

Module-I

MOS Field-Effect Transistors: Device structure and physical operation, current-voltage characteristics, the MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation and models.

Module-II

Single Stage MOSFET Amplifiers: Estimating 3dB frequency of amplifiers, Basic MOSFET amplifier configurations, MOSFET internal capacitances and high frequency model. Low Frequency and High Frequency Response of MOSFET Amplifiers.

Module-III

Differential Amplifiers: The MOS differential pair, small signal operation of the MOS differential pair, other non-ideal characteristics of MOS differential amplifier, the MOS differential amplifier with active load, multistage MOS amplifiers.

Module-IV

Operational Amplifiers: The ideal op amp, the inverting and non-inverting configuration, difference and instrumentation amplifiers, summing, scaling and averaging amplifiers, integrators, differentiators, logarithmic amplifiers, Comparators and waveform generators.

Module-V

IC Design Philosophy: Comparison of the MOSFET and the BJT, IC biasing-current sources, current mirrors and current-steering circuits. Transistor-Transistor Logic circuits, Metal-Oxide Semiconductor, Complementary MOS, CMOS Transmission Gate circuits.

TEXT BOOKS:

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.

REFERENCE BOOKS:

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013.

2. R. L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10/e, Pearson, 2009.

3. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson, 2008.

Web Resources:

1. http://www.faadooengineers.com/threads/4615-Electronic-Devices-and-Circuit-Theory-Boylestad-and-Nashelsky

2. https://docplayer.net/53934331-J-b-gupta-electronic-devices-and-circuits.html

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2									1			2	
CO2		3								2			3	
CO3		3								2			3	
CO4	3									2			3	

B.Tech III Year – I Sem

Subject Code: 21PE5EE13

L	T	P	C
3	0	0	3

DIGITAL CONTROL SYSTEMS

Pre-requisite: Control Systems

Course Objectives:

1. To understand the fundamentals of digital control systems, z-transforms
2. To understand state space representation of the control systems,concepts of controllability and observability
3. To study the estimation of stability in different domains
4. To understand the design of discrete time control systems, compensators, state feedback controllers,state observers through various transformations

Course Outcomes:

At the end of course student will be able to do

1. Obtain discrete representation of LTI systems.
2. Analyze stability of open loop and closed loop discrete-time systems.
3. Design and analyze digital controllers.
4. Design state feedback and output feedback controllers.

Module I: Discrete Representation Of Continuous Systems

Introduction, examples of digital control system. Discrete representation of continuous systems. Sample and hold circuit.

Mathematical Modeling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

Module II: Discrete System Analysis

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

State space Representation of discrete systems, Solving Discrete time State space equations. State Transition matrix and its Properties. Methods of computing State Transition matrix.

Module III: Stability of Discrete Time System

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis.Effect of pole zero cancellation on the controllability& observability.

Module IV: Design of Digital Control System

Design of Digital PID Controller, Design of discrete state feedback controller.

Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

Module V: Design of Discrete time Control Systems

Design based on frequency response method-bi linear Transformation. Design Procedure in W-plane, Lead, Lag and Lead-Lag Compensators

Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems

TEXTBOOKS:

1. K.Ogata,"DigitalControlEngineering",PrenticeHall,EnglewoodCliffs,1995.
2. M.Gopal,"DigitalControlEngineering",Wiley Eastern,1988.
3. DIGITAL CONTROL SYSTEMS : *Design, Identification and implementation* Ioan D. Landau and Gianluca Zito

REFERENCEBOOKS:

1. G.F.Franklin,J.D.PowellandM.L.Workman,"DigitalControlofDynamicSystems",Addison-Wesley
2. B.C.Kuo, "DigitalControlSystem", Holt,Rinehart andWinston.

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 –Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2											2	2
CO2	3	3			3								2	
CO3	3	3			3								2	
CO4	3	2			3								2	

B. Tech III Year–V Sem	L	T	P	C
Subject Code: 21OE5CS06	3	0	0	3

Computer Organization and Architecture

Pre-requisite: NIL

Course Objective:

1. The purpose of the course is to introduce principles of computer organization and the basic architectural concepts
2. Understand the representation fixed-point and floating-point numbers in computer and develop hardware algorithms using them for fixed-point and floating-point arithmetic.
3. The course would display understanding of instruction set of RISC processor and develop understanding of how memory is organized and managed in a modern digital computer, including cache, virtual and physical memory.
4. It discusses input-output units and how they communicate with the processor, and howtheir performance is computed.

Course Outcomes:

1. Understand the theory and architecture of Digital computer system
2. Define different number systems, compliments, combinational circuits and Sequential circuits
3. Explain and use fixed point addition, subtraction, multiplication (Booth's) and division (Restoring and non-restoring) algorithms
4. Explain the concept of Computer I/O Organization, Memory, RISC, CISC Characteristics

Module I:

Digital Computers: Introduction to digital computers, need of Computer Organization and Computer Architecture, Basic of Computer Architecture and Organisation, Von Neumann Computers

Data Representation: Data Types, (r-1)'s Compliment, r's compliment, Fixed point Representation, conversion of Fractions, Floating point representation, Gray code, Error detection code

Module II:

Digital Logic Circuits -I: Logic gates, Boolean Algebra, Map simplification, Combinational circuits-Half Adder and Full Adder, Decoders and Multiplexers

Digital Logic Circuits -II: Flip-Flops- SR, JK, D, T and Edge triggered, Excitation Tables, Registers, Shift Registers, Binary Counters

Module III:

Computer Arithmetic -I: Addition and subtraction, multiplication Algorithms, Division Algorithms

Computer Arithmetic –II: Floating – point Arithmetic operations. Decimal Arithmetic unit, Decimal Arithmetic operations.

Module IV:

Basic Computer Organization: Instruction Codes, Computer Registers, Computer Instructions, Timing and control, Instruction Cycle, Memory- Reference Instructions, Input-Output and Interupt

Input-Output Organization: Priority interrupt, Peripheral devices, Input output interface, Data transfer schemes, Program control and interrupts, Direct memory access transfer, Input/output processor.

Module V:

Memory Unit: Memory Hierarchy, Main Memory, Auxiliary Memory, Associate Memory and Cache Memory

Computer Architecture: CISC Characteristics, RISC Characteristics.

Text Books:

1. Computer System Architecture by Morris Mano, Prentice hall, 3rd Edition, (2007)
2. Computer Organization by Carl Hamacher, Zvonko Vranesic, SafwatZaky, Tata McgrawHill, 5th Edition, (2011)

References:

1. Computer Architecture: A Quantitative Approach by Hennessy, J. L, David A Patterson, and Goldberg, Pearson Education, 4th Edition, (2006)
2. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.

CO-PO/PSO Mapping Chart:

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*		
CO-PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO-1	2													**2**	
CO-2	2	2	3											2	
CO-3	2	2	2											2	
CO-4	2	2	2											2	

B. Tech III Year – V Sem	L	T	P	C
Subject Code: 21OE5EC01	3	0	0	3

ELECTRONIC MEASUREMENTS & INSTRUMENTATION

(OPEN ELECTIVE)

Prerequisite: Basic Electrical and Electronics

Course Objectives: This course will enable students to:

1. Learn and understand functioning of various measuring system and metrics for performance analysis.
2. Acquire knowledge of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
3. To Compare various measuring bridges and their balancing conditions.
4. Learn and understand the use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

Course Outcomes: Upon completion of the course, the student should be able to

1. Explain the instrument and measurements of the parameters
2. Describe signal generators and analyzers
3. Categorize oscilloscopes for different applications
4. Apply the transducers for measurement of different parameters

MODULE I : Performance characteristics of instruments

Static characteristics: Accuracy, Resolution, Precision, Expected value, Error, Sensitivity.

Dynamic Characteristics: Speed of response, Fidelity, Lag and Dynamic error.

Types of errors in measurements and their analysis. Design of multi-range AC , DC meters (voltmeter &ammeter) and ohmmeter(series &shunt type) using D'arsonval movement. True rms meter.

MODULE II

Bridge circuits : Wheat stone bridge, measurement of very low resistance, Measurement of inductance- Maxwell's bridge, Anderson bridge. Measurement of capacitance-Schearing Bridge. Wien Bridge, Errors and precautions in using bridges.

Q-meter: principle of operation, measurement methods and sources of errors.

Counters : principle of operation -modes of operation- totalizing mode, frequency mode and time period mode- sources of errors.

MODULE III

Specifications and designing aspects of Signal Generators: AF sine and square wave signal generators, Function Generators, Random noise generators, arbitrary waveform generators.

Wave Analyzers: Harmonic Distortion Analyzers, Spectrum Analyzers, Digital Fourier Analyzers.

MODULE IV:

General purpose CROs: Block diagram, functions and implementation of various blocks, specifications, various controls and their functions, types of probes used in CROs. Measurement of frequency and phase difference using Lissajous patterns.

Special purpose CROs: sampling oscilloscope, analog storage oscilloscope, digital storage oscilloscope.

MODULE V:

Transducers: Transducers, Active & Passive transducers: Resistance, Capacitance, inductance; Strain gauges, LVDT, Piezo Electric transducers.

Measurement of physical parameters: Temperature, force, pressure, velocity, acceleration and displacement.

Textbooks :

1. Electronic instrumentation, second edition - H.S. Kalsi, Tata McGrawHill,2004.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrickand W.D. Cooper, PHI, 5th Edition, 2002.
3. Electronic Measurements And Instrumentation- A.K. Sawhney, Dhanpat Rai&CO(P) Limited, Jan2015.

Reference books:

1. Electronic Instrumentation & Measurements - David A. Bell, PHI, 3rd Edition,2013.
2. Electrical and Electronic Measurement and Instrumentation A.K. Sawhney. Dhanpat Rai & Co, 12thEdition,2002.

CO-PO &PSO Mapping:

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	-	-	-	-	-	-	-	-	-	1	2	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	2	-	-	-	-	-	-	-	-	-	1	2	-

B. Tech III Year–V Sem	L	T	P	C
Subject Code: 21OE5ME01	3	0	0	3

Hybrid & Electric Vehicles

Pre-requisites: IC engines, automobile engineering, basic electrical electronics engineering

Objectives: To understand the fundamental concepts, and principles, of hybrid and electric vehicles.

To know the various aspects of hybrid and electric drive trains such as their configuration,

Students should understand various automotive systems and the basics of the drive train in automobiles.

Module I

Introduction: Layout of the automobile–introduction chassis and body components. Types of Automobile engines–Power unit -working of two stroke and four stroke engine–Introduction to engine lubrication–engine servicing

Fuel System: Fuel supply systems working in IC engines,–fuel injection an its types.

Cooling System: Cooling Requirements, Air Cooling, Forced Circulation System–Radiators–Types–Cooling Fan-water pump, thermostat, evaporative cooling-antifreeze solutions.

Module II

Ignition System: Function of an ignition system, battery ignition system, constructional features ofstorage, battery, auto transformer, contact breaker points, condenser, and spark plug.

Electrical System: Charging circuit, generator, current – voltage regulator – starting system, Bendixdrive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge–oil pressure gauge, engine temperature indicator etc.

Transmission System: -components and working principle. The layout of the power transmission system in a conventional and hybrid vehicle (fuel vs electrical)-introduction of components

Suspension System: Objects of suspension systems –, Dependent and Independent suspension system, air suspension system. Vehicle stability assist supplemental restraint system (SRS).

Module III

Braking System: Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic..

Steering System: Steering geometry – Ackerman Steering Mechanism, Davis Steering Mechanism ,Hydraulic and electric power steering-working principle ,construction and working.

Introduction To Hybrid Vehicles:

History of hybrid and electric vehicles, social and The environmental importance of hybrid and electric vehicles, the impact of modern drive-trains on energy supplies.

Module IV

Hybrid Electric Drive-Trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Trains: Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Module V

Energy Storage: Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Energy Management Strategies: Energy Management Strategies: Introduction to energy

management strategies used in hybrid and electric vehicles, classification of different energy management strategies,

TEXTBOOKS:

1. Automobile Engineering/WilliamHCrouse.
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi & Yosuf Ali, Frontline Publications.
3. T. Denton, Electric and Hybrid Vehicles, Routledge, 2016

Reference Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016
3. K. Netwon, W. Steeds, T. K.Garrett, ―Automotive Engineering‖, Butterworth-Heinamann, 13th Edition, 2016.

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

1. Understand the working of IC engines,
2. Demonstrate the working of power transmission and brakes.
3. Understand the models to describe conventional, and hybrid vehicles and their performance.
4. Understand the different strategies related to energy storage systems.

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation)
3 – High; 2 – Medium; 1 –Low

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1											2	2
CO2	3	1											2	2
CO3	3	1											2	2
CO4	3	1											2	2

	L	T	P	C
B.Tech III Year – V Sem				
Subject Code: 21OE5EE01	**3**	**0**	**0**	**3**

FUNDAMENTALS OF ELECTRICAL CIRCUIT ANALYSIS

Pre-requisite: Basic Mathematics & Physics

Course Objectives:

1) To introduce the concepts of electrical circuits and their components
2) To Analyze electrical circuits with the help of network theorems
3) To understand DC circuits and single-phase AC circuits
4) To analyse the magnetic circuits

Course Outcomes:

At the end of course student will be able to do

1. CO1 – To understand the electrical circuits with DC excitation.
2. CO2 – To analyze electrical circuits with the help of network theorems
3. CO3 – To analyze electrical circuits with AC excitation
4. CO4 – To analyse the magnetic circuits.

Module I: D.C. Circuits

Introduction to Electrical Circuits: Current, Voltage, Power, Energy, Ohm's law, types of elements, Kirchoff laws, types of sources, resistive networks, inductive networks, capacitive networks, series, parallel circuits, analysis of simple circuits with dc excitation.

Network Analysis: Mesh and Nodal analysis, Voltage and current divide rule, source transformation technique, and star-delta and delta star transformation, simple problems.

Module II:Network Theorems

Network Theorems -I: Superposition, reciprocity, Thevenin's, Norton's theorems for DC excitations, numerical problems.

Network Theorems -II: Tellegen's, Maximum power transfer, Milliman's for DC excitations, numerical problems.

Module III:A.C. Circuits

Single Phase AC Circuits: Representation of sinusoidal waveforms, Average and RMS values, peak factor, and Formfactor. Real power, Reactive power, Apparent power, power factor, Numerical problems.

RLC Analysis:Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, and RLC combinations for both series and parallel, Numerical problems.

Module IV:Magnetic Circuits

Absolute and Relative Permeability of a Medium, Laws of Magnetic Force,Flux Density (B),Faraday's laws of electromagnetic induction –concept of self and mutual inductance – dot convention

Coefficient of coupling –composite magnetic circuit - Analysis of series and parallel magnetic circuit, Simple Problems.

Module V: Network Topologies

Network Topology-I
Basic definitions of graph theory, Incidence Matrices, Branch path incidence matrices**,** and numerical problems.

Network Topology-II
Cut set matrices, Relation between branch currents I_b and loop currents I_l, Tie set matrices, the relation between branch voltages and node voltages. Duality concept and numerical problems.

TEXTBOOKS:

1. A Chakrabarty, "Electric Circuits", Dhanipat Rai & Sons, 6th Edition, 2010. L.S. Bobrow, Fundamentals of Electrical Engineering", Oxford University Press, 2011
2. M E Van Valkenberg, "Network Analysis", PHI, 3rd Edition, 2014.

REFERENCE BOOKS:

1. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition, 2010.
2. David A Bell, "Electric circuits", Oxford University Press, 7th Edition, 2009.
3. Electrical Engineering Fundamentals, Vincent Deltoro, Second Edition, Prentice-Hall India, 1989

Web Resources:

1. **https://nptel.ac.in/courses/108/104/108104139/**

2. https://nptel.ac.in/courses/117/106/117106108/

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2			3								2	2
CO2	2	3											2	
CO3	2	3											2	
CO4	2	1											2	

B.Tech III Year – V Sem	**L**	**T**	**P**	**C**
Subject Code: 21OE5CM01	**3**	**0**	**0**	**3**

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Course Objectives

1. To provide a strong foundation of fundamental concepts in artificial intelligence.
2. To provide a basic exposition to the goals and methods of Artificial intelligence
3. To provide the exposition to uncertainty management, decision making and learning methods.
4. To provide different knowledge representation, reasoning, and learning techniques.

Course Outcomes

1. Discuss basic concepts of Artificial Intelligence, AI principles, AI Task domains and application.
2. Apply searching techniques, constraint satisfaction problem and game playing techniques which involve perception, reasoning and learning.
3. Explain working of uncertainty management, decision making and learning methods.
4. Apply different knowledge representation, reasoning, and learning techniques to real world problems.

MODULE-I

Introduction: Artificial Intelligence, AI Problems, AI Techniques, the Level of the Model, Criteria for Success. Problem Space and Search, Defining the Problem as a State Space Search, Problem Characteristics; Tic-Tac-Toe Problem, Production Systems.

Basic Search Techniques: Solving Problems by searching; Issues in The Design of Search Programs; Uniform search strategies; Breadth first search, depth first search, depth limited search, bidirectional search, Best First search, comparing search strategies in terms of complexity.

MODULE-II

Special Search Techniques: Heuristic Search, greedy best first search, A* search Problem Reduction, AO*Algorithm; Hill climbing search, Simulated Annealing search; Genetic Algorithm; Constraint Satisfaction Problems; Adversarial search, Games, Optimal decisions and strategies in games, Minimax search, Alpha, beta pruning.

Knowledge Representation: Procedural Vs Declarative Knowledge, Representations & Approaches to Knowledge Representation, Forward Vs Backward Reasoning, Matching Techniques, Partial Matching, Fuzzy Matching Algorithms and RETE Matching Algorithms.

MODULE-III

Symbolic Logic: Propositional Logic, First Order Predicate Logic: Representing Instance and is-a Relationships, Computable Functions and Predicates, Syntax & Semantics of FOPL, Normal Forms, Unification &Resolution, Representation Using Rules, Natural Deduction.

Structured Representations of Knowledge: Semantic Nets, Partitioned Semantic Nets, Frames, Conceptual Dependency, Conceptual Graphs, Scripts, CYC.

MODULE-IV

Reasoning under Uncertainty: Introduction to Non-Monotonic Reasoning, Truth Maintenance Systems, Logics for Non-Monotonic Reasoning, Model and Temporal Logics.

Statistical Reasoning: Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Probabilistic Inference, Bayesian Networks, Dempster-Shafer Theory.

Fuzzy Logic: Crisp Sets, Fuzzy Sets, Fuzzy Logic Control, Fuzzy Inferences & Fuzzy Systems.

MODULE-IV

Experts Systems: Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems- Rule Based, Model Based, Case Based and Hybrid Expert Systems, Knowledge Acquisition and Validation Techniques, Black Board Architecture, Knowledge Building System Tools, Expert System Shells, Fuzzy Expert systems.

Learning: Types of learning, general learning model, Learning by induction; generalization, specialization, example of inductive learner.

Text Book:

1. Artificial Intelligence, George F Luger, Pearson Education Publications
2. Artificial Intelligence, Elaine Rich and Knight, Mcgraw-Hill Publications

References:

1. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI
2. Multi Agent systems- a modern approach to Distributed Artificial intelligence, Weiss. G, MIT Press.
3. Artificial Intelligence: A modern Approach, Russell and Norvig, Printice Hall

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low

CO/PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO2	PSO3
CO-1		3										2	2		
CO-2	3												2		
CO-3		3										2	2		
CO-4	3											2	2		

B.Tech III – V Sem **L T P C**
Subject Code: 21OE5CD01 **3 0 0 3**

Statistics for Data Science

Course Objective

1. The Number Theory basic concepts useful for cryptography etc
2. The theory of Probability, and probability distributions of single and multiple random variables 3. The sampling theory and testing of hypothesis and making inferences
4. Stochastic process and Markov chains.

Course Outcomes:

1. Apply the number theory concepts to cryptography domain
2. Apply the concepts of probability and distributions to some case studies
3. Correlate the material of one unit to the material in other units
4. Resolve the potential misconceptions and hazards in each topic of study.

Module I

Greatest Common Divisors and Prime Factorization: Greatest common divisors, The Euclidean algorithm, The fundamental theorem of arithmetic, Factorization of integers and the Fermat numbers
Congruences: Introduction to congruences, Linear congruences, The Chinese remainder theorem, Systems of linear congruences

Module II

Simple Linear Regression and Correlation: Introduction to Linear Regression, The Simple Linear Regression Model, Least Squares and the Fitted Model, Properties of the Least Squares Estimators, Inferences Concerning the Regression Coefficients, Prediction, Simple Linear Regression Case Study
Random Variables and Probability Distributions: Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Statistical Independence. Discrete probability
Distributions: Binomial Distribution, Poisson distribution.

Module III

Continuous Probability Distributions: Normal Distribution, Areas under the Normal Curve, Applications of the Normal Distribution, Normal Approximation to the Binomial, Fundamental Sampling
Distributions: Random Sampling, Sampling Distributions, Sampling, Distribution of Means and the Central Limit Theorem, Sampling Distribution of S2, t–Distribution, F Distribution.

Module IV

Estimation & Tests of Hypotheses: Introduction, Statistical Inference, Classical Methods of Estimation. Estimating the Mean, Standard Error of a Point Estimate, Prediction Intervals, Tolerance Limits, Estimating the Variance, Estimating a Proportion for single mean, Difference between Two Means, between Two Proportions for Two Samples and Maximum Likelihood Estimation.

Module V

Stochastic Processes and Markov Chains: Introduction to Stochastic processes- Markov process. Transition Probability, Transition Probability Matrix, First order and Higher order Markov process, n step transition probabilities, Markov chain, Steady state condition, Markov analysis.

TEXT BOOKS:

1. Kenneth H. Rosen, Elementary number theory & its applications, sixth edition, Addison Wesley, ISBN 978 0-321-50031-1
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists, 9th Ed. Pearson Publishers.
3. S. D. Sharma, Operations Research, Kedarnath and Ramnath Publishers, Meerut, Delhi

REFERENCE BOOKS:

1. S C Gupta and V K Kapoor, Fundamentals of Mathematical statistics, Khanna publications 2. T.T. Soong, Fundamentals of Probability And Statistics For Engineers, John Wiley & Sons Ltd, 2004.
3. Sheldon M Ross, Probability and statistics for Engineers and scientists, Academic Press.

CO-PO &PSO Mapping:

Course Name - Course Outcomes / Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO 2	PSO 3
CO1	M	L			L										
CO2	M	L			L										
CO3	M	L			L										
CO4	M	L			L										

B. Tech III Year – V Sem	L	T	P	C
Subject Code: 21OE5CO01	3	0	0	3

FUNDAMENTALS OF IOT

PREREQUISITE: Basics of computers

COURSE OBJECTIVE:

1. The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time.
2. The course enables student to understand the basics of Internet of things and protocols.
3. Introduces some of the application areas where Internet of Things can be applied.
4. Students will learn about the middleware for Internet of Things. To understand the concepts of Web of Things

COURSE OUTCOMES:

1. Interpret the concepts of IoT
2. Analyze the importance of Protocols in IoT
3. Understand the IoT architecture
4. Apply IoT concepts in Industry applications and IoT platforms

Module 1:

Introduction to IOT - IoT and its importance, Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications

Overview of Governance, Privacy and Security Issues.

Module II

IOT PROTOCOLS - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – **Protocols** – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security

Module III

IOT ARCHITECTURE - IoT Open-source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models

IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.

Module IV

WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT

Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.

Module V:

IOT APPLICATIONS – Qualitative study of sensors, IoT applications for industry: Future Factory Concepts, Smart Objects, Smart Applications.

Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

TEXT & REFERENCES:

Text:

- Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.
- Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet ofThings", Springer, 2011.
- David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a HighlyConnected World", Cambridge University Press, 2010.
- Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applicationsand Protocols", Wiley, 2012.

References:

- Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
- Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", 1st Edition, Apress Publications, 2013
- CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1

Course Outcomes (CO)	**CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low**													
	Program Outcomes (POs)												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3								2	2			1	
CO2	3	1			3				2	2			2	
CO3	3	1			2				2	2			2	
CO4	3	1	3		3				2	2			1	

B. Tech III Year–V Sem	**L**	**T**	**P**	**C**
Subject Code: 21OE5CC01	**3**	**1**	**-**	**4**

DATA SECURITY

Prerequisite(s): Nil

Course Objectives:

• To introduce different classical cryptographic techniques and its theoretical security analysis.
• To provide and demonstrate different cryptanalysis attacks against the cryptographic techniques, and their attack models.
• To show the impact of these ciphers on society during the time of their use.

Course Outcomes:

At the end of the course, students are able to:

CO1: Identify the basic language & terminologies of cryptography.
CO2: Demonstrate Encryption and Decryption methods using various ciphers of classical cryptography.
CO3: Perform cryptanalysis of classical cryptography.
CO4: Understand the concept of digital signatures.

Module 1:

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks.
Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric keycryptography, steganography, key range and key size, possible types of attacks.

Module 2:

Symmetric key Ciphers: Algorithms Types, Algorithm Modes, Data Encryption Standards, International Data Encryption Algorithm (IDEA), RC4, RC5, Blowfish,
Case Study: Secure Multiparty Calculation.

Module 3:

Asymmetric key Ciphers - I: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Comparison of symmetric and symmetric Key Cryptography.

Module 4:

Asymmetric key Ciphers - II: Digital signatures, Elgamal Digital Signature Scheme, Attacks on Digital Signature, Knapsack Algorithm, Problems with Public key Exchange.

Module 5:

Public – Key Infrastructure : Digital Certificates, private - Key management, The PKIX Model, Public Key Cryptography Standards(PKCS) , XML, PKI and security.

Text Books:

1. Padmanabhan T R, Shyamala C and Harini N, "Cryptography and Security", Wiley Publications 2011.
2. Josef Pieprzyk, Thomas Hardjono and Jenifer Seberry, "Fundamentals of Computer Security", Springer 2010.

Resources:

1. Douglas R Stinson, "Cryptography: Theory and Practice", CRC Press 2005.
2. Alfred J Menezes, Paul C Van Oorshot and Scott A. Vanstone, "Handbook of Applied Cryptography", CRC press 1996.

CO-PO/PSO Mapping:

CO-PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO2	PSO3
CO-1			2				3								
CO-2				2			1								
CO-3				3				1							
CO-4		1						3							

B.TechIIIYear–II Sem	L	T	P	C
SubjectCode: 21ES6CS03	3	0	0	3

PYTHON PROGRAMMING
(Common To All Branches)

Prerequisite: Programming for Problem solving Using C

Course Objectives:

1. Acquire programming skills in core Python.
2. Acquire Object-oriented programming skills in Python.
3. Develop the skill of designing graphical-user interfaces (GUI) in Python.
4. Develop the ability to write database applications in Python.

Course Outcomes:

1. Understand operators, precedence of operators, associativity while evaluating expressions in program statements.
2. Visualize the capabilities of procedural as well as object-oriented programming in Python and demonstrate the same in real world scenario.
3. Demonstrate indexing and slicing mechanisms for extracting a portion of data in a sequence.
4. Extend the knowledge of Python programming to build successful career in software development.

Module I

Python Basics, Objects- Python Objects, Standard Types, Other Built-in Types, Internal Types, Standard Type Operators, Standard Type Built-in Functions, Categorizing the Standard Types, Unsupported Types

Numbers - Introduction to Numbers, Integers, Floating Point Real Numbers, Complex Numbers, Operators, Sequences - Strings, Lists, and Tuples, Mapping and Set Types

Module II

Conditional Statements : Selection/Conditional Branching Statements: if, if-else, nested if, if-elif-else statement(s),
Iterative Statements – while and for loop, Nested loops, break and continue statement, pass Statement, else Statement used with loops.

Module III

Functions: Communicating with functions, Variable Scope and lifetime, return statement, Types of arguments, Lambda functions, and Recursive functions

Classes and Objects – Defining Classes, Creating Objects, Data Abstraction and Hiding through Classes, Class Method and self-Argument, Class variables and Object variables,_init()_and_del_() method.

Module IV

FILES: File Objects, File Built-in Function [open()], File Built-in Methods, File Built-in Attributes, Standard Files, Command-line Arguments.

Exceptions: Exceptions in Python, Detecting and Handling Exceptions, Context Management, , Raising Exceptions, Related Modules
Regular Expressions: Introduction, Special Symbols and Characters, Res and Python

Module V

Multithreaded Programming: Introduction, Threads and Processes, Python, Threads, and the Global Interpreter Lock, Thread Module, Threading Module, Related Modules

GUI Programming: Introduction, Tkinter and Python Programming, Brief Tour of Other GUIs, Related Modules and Other GUIs

Text Books:

1. Reema Thareja, "Python Programming - Using Problem Solving Approach", Oxford Press, 1st Edition, 2017.Du
2. sty Philips, "Python 3 Object Oriented Programming", PACKT Publishing, 2nd Edition, 2015.

Reference Books:

1. Yashavant Kanetkar, Aditya Kanetkar, "Let Us Python", BPB Publications, 2nd Edition, 2019.
2. Martin C. Brown, "Python: The Complete Reference", McGraw Hill, Indian Edition, 2018.
3. Michael H.Goldwasser, David Letscher, "Object Oriented Programming in Python", Prentice Hall, 1st Edition, 2007.
4. Taneja Sheetal, Kumar Naveen, "Python Programming – A Modular Approach", Pearson, 1st Edition, 2017
5. R Nageswar Rao, "Core Python Programming", Dreamtech Press, 2018.

CO-PO/PSO Mapping

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low															
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1			M										L		
CO2			M										L		
CO3					M								L		
CO4					M								L		

B.Tech III Year – IISem	L	T	P	C
Subject Code: 21PC6EE21	3	0	0	3

ELECTRICAL MEASUREMENTS

Pr-requisite:Basic Electrical Engineering, Analog Electronics, Electrical Circuit Analysis & Electro -Magnetic fields.

Course Objectives:

1) To introduce the basic principles of all measuring instruments

2) To deal with the measurement of voltage, current, Power factor, power, energy, and magnetic measurements.

3) To understand the basic concepts of smart and digital metering.

Course Outcomes:

At the end of the course,the student will be able to do

1) CO1 – Understand different types of measuring instruments, their construction, operation, and characteristics
2) CO2 – Identify the instruments suitable for typical measurement
3) CO3 – Apply the knowledge about transducers and instrument transformers to use them effectively.
4) CO4 – Apply the knowledge of smart and digital metering for industrial applications.

Module I:Introduction to Measuring Instruments

MC and MI Instruments: Classification – deflecting, control, and damping torques – Ammeters and Voltmeters – PMMC, moving iron type instruments – expression for the deflecting torque and control torque – Errors and compensations.

Extension of the range of instruments: Extension of the range of instruments using shunt and series multipliers-Multi Range Ammeter, Multi-Range Dc Voltmeter, Potential Divider Arrangement, Aryton Shunt.

Module II:Potentiometer s & Instrument Transformers

DC Potentiometer s: Principle and operation of D.C. Crompton's potentiometer – standardization – Measurement of unknown resistance, current, voltage

AC Potentiometer s: A.C. Potentiometer s: polar and coordinate type's standardization – applications. CT and PT – Ratio and phase angle errors

Module III:Measurement of Power & Energy

Measurement of Power: Single-phase dynamo-meter watt-meter, LPF and UPF, Double element and three-element dynamo-meter watt-meter, the expression for deflecting and control torques – Extension of range of watt-meter using instrument transformers.

Measurement of Energy: Single-phase induction type energy meter – driving and braking torques – errors and compensations.

Module IV:DC & AC Bridges

DC Bridges: Method of measuring low, medium, and high resistance – sensitivity of Wheat-stone's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method.

AC Bridges: Measurement of inductance- Maxwell's bridge, Hay's bridge, Anderson's bridge. Measurement of capacitance and loss angle –Schering Bridge, Wien's bridge.

Module V:Transducers& Introduction to Digital Meters

Transducers : Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Principle and operation of LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor.

Introduction to Digital Meters: Cathode Ray Oscilloscope and its applications, Digital Multimeter, Clamp-on meters, Digital Storage Oscilloscope**.**

TEXTBOOKS:

1) A. K. Sawhney, "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publications, 2005.
2) S. C. Bhargava, "Electrical Measuring Instruments and Measurements", BS Publications, 2012

REFERENCE BOOKS:

1) R. K. Raj put, "Electrical & Electronic Measurement & Instrumentation", S. Chand and Company Ltd., 2007.

2) Buckingham and Price, "Electrical Measurements", Prentice–Hall, 1988.

3) Reissland, M. U, "Electrical Measurements: Fundamentals, Concepts, Applications", New Age International (P) Limited Publishers, 1st Edition 2010.

4) E.W. Golding and F. C. Widdis, "Electrical Measurements and Measuring Instruments", fifth Edition, Wheeler Publishing, 2011**.**

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2										1		
CO2	2	3										2	2	
CO3	2	3										2	2	
CO4	3	2										2	1	

B. Tech III Year – II Sem	L	T	P	C
Subject Code: 21PC6EE22	3	1	0	4

POWER SYSTEMS-III

Pre-requisites: Power Systems-I, Power Systems-II

Course Objectives:

1. To introduce all kinds of circuit breakers and relays for protection of Generators, Transformers and feeder bus bars from Over voltages and other hazards.
2. To describe neutral grounding for overall protection.
3. To understand the phenomenon of Over Voltages and its classification.

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

1. **CO1-** Compare and contrast electromagnetic, static and microprocessor-based relays
2. **CO2-** Apply technology to protect power system components.
3. **CO3-** Select relay settings of over current and distance relays.
4. **CO4-** Analyze quenching mechanisms used in air, oil and vacuum circuit breakers

Module I

Protective Relays

Introduction, Need for power system protection, effects of faults, zones of protection, primary and backup protection, classification of protective relays and schemes, current transformers, potential transformers.

Operating Principles and Relay Construction

Basic relay terminology, Electromechanical Relays Attracted Armature Relays; Induction Relays, Thermal relays.

Module II

Over-Current Protection

Time-current characteristics, current setting, over-current protective schemes, directional relay, protection of parallel feeders, protection of ring mains, Phase fault and earth fault protection, and Directional Earth fault relay.

Module III

Distance Protection: Impedance relay, reactance relay, MHO relay, input quantities for various types of distance relays, Effect of arc resistance, Effect of power swings, effect of line length and source impedance on the performance of distance relays, selection of distance relays, Auto Reclosing.

AC Machines Protection: Protection of Generators: Stator and Rotor Protection of transformers: External, Internal faults and Buchholz Relay.

Module IV

Static Relays

Amplitude and Phase comparators, Duality between AC and PC, Static amplitude comparator, Integrating and instantaneous comparators, static phase comparators, static over current relays, static directional relays, static differential relays, and static distance relays.

Microprocessor Based Relays: Advantages, over current relays, directional relays, distance relays.

Module V

Circuit Breakers

Introduction, arcing in circuit breakers, arc interruption theories, re-striking and recovery voltage, resistance switching, current chopping, interruption of capacitive current, oil circuit breaker, air blast circuit breakers, SF6 circuit breaker, operating mechanism,

Fuses: Introduction, fuse characteristics, types of fuses, application of HRC fuses.

TEXT BOOKS:

1. Badriram and D.N. Vishwakarma, Power System Protection and Switchgear, TMH 2001.

2. U.A.Bakshi, M.V.Bakshi: Switchgear and Protection, Technical Publications, 2009.

REFERENCE BOOKS:

1. C.Russel Mason – "The art and science of protective relaying, Wiley Eastern, 1995
2. L.P.Singh "Protective relaying from Electromechanical to Microprocessors", New Age.

International **E books:**

Equivalent MOOC Courses if any:

1. https://www.coursera.org/learn/electric-power-systems
2. https://www.coursera.org/learn/renewable-power-electricity-systems

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2											1	1
CO2	2	2											1	1
CO3	3	3											1	1
CO4	2	2											1	1

B. Tech III Year- II Sem	L	T	P	C
Subject Code: 21HS6MB02	2	0	0	2

FUNDAMENTALS OF ENGINEERING MANAGEMENT
(Common to CSE/ECE/EEE/ME/ CSM/CSD/ CSC/CSO Branches)

Pre-requisite: Nil

Course Objective: To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills for Engineers.

Course Outcomes:

1. Comprehend the concepts & principles of management in real life industry.
2. Describe the interaction of organizational designs and competitive strategies
3. Apply the concept of operations management in manufacturing and service sector and will be able to plan and implement production and service related decisions.
4. Demonstrate strong conceptual knowledge in the functional area of Human Resource Management, Marketing management and Project Management.

Module I: Introduction to Management & Planning

Introduction to Management: Evolution of Management, Nature & Scope-Functions of Management-Role of Manager-levels of Management-Managerial Skills - Challenges

Planning & Strategic Management: Planning - Planning Process - Types of Plans - MBO

Module II: Organization Structure & HRM

Organization Structure: Organization Design - Organizational Structure - Departmentation - Delegation - Centralization – Decentralization - Re centralization - Organizational Culture - Organizational climate - Organizational change.

Human Resource Management-HR Planning - Recruitment & Selection - Training & Development-Performance appraisal-Job satisfaction-Stress Management Practices

Module III: Operations & Quality Management

Operation Management: Introduction to Operations Management - Principles and Types of Plant Layout - Methods of production (Job Batch and Mass production) - Method study and Work Measurement

Quality Management – TQM - Six sigma - Deming's Contribution to Quality – Inventory Management – EOQ - ABC Analysis - JIT System-Business Process Re-engineering (BPR)

Module IV: Marketing Management

Marketing Management: Introduction to Marketing-Functions of Marketing-Marketing vs. Selling- Marketing Mix - Marketing Strategies - Product Life Cycle - Market Segmentation.

Distribution Decisions, Promotion and Communication Strategies:

Types of Marketing - Direct Marketing - Network Marketing - Digital Marketing - Channels of Distribution - Supply Chain Management (SCM)

Module V: Enterprise Resource Planning

ERP Introduction, Benefits, Origin, Evolution and Structure: Conceptual Model of ERP, the Evolution of ERP, the Structure of ERP.

ERP Marketplace Dynamics: Market Overview, Marketplace Dynamics, the Changing ERP Market. ERP- Functional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain and Customer Relationship Applications.

TEXT BOOKS & REFERENCES:

Text Books:

1. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.
2. Fundamentals of Management, Stephen P.Robbins, Pearson Education, 2009.
3. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.

Reference Books:

1. Alexis Leon, "ERP Demystified", Tata McGraw Hill
2. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
3. Industrial Engineering and Management: Including Production Management, T.R.Banga, S.C Sharma , Khanna Publishers.

Web Resources

1. http://nptel.ac.in/courses/109105121/
2. http://nptel.ac.in/courses/122105021/

CO-PO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low												
Course Outcomes (COs)	**Program Outcomes (POs)**											
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1									2		2	
CO2									2	2	2	
CO3									2		2	
CO4									1		2	

B.TechIIIYear–II Sem	L	T	P	C
SubjectCode: 21ES6CS04	0	0	3	1.5

PYTHON PROGRAMMING LAB
(Common To All Branches)

Prerequisite: Basic Programming Skills.

Course Objectives:

To learn the fundamentals of computers.

1. Acquire programming skills in core Python.
2. Acquire Object-oriented programming skills in Python.
3. Develop the skill of designing graphical-user interfaces (GUI) in Python.
4. Develop the ability to write database applications in Python.

Course Outcomes:

1. CO1 - Acquire programming skills in core Python.
2. CO2 - Acquire Object-oriented programming skills in Python.
3. CO3 - Develop the skill of designing graphical-user interfaces (GUI) in Python.
4. CO4 - Develop the ability to write database applications in Python.

List of Experiments:

Experiment – 1: OPERATORS

a. Read a list of numbers and write a program to check whether a particular element is present or not using membership operators.
b. Read your name and age and write a program to display the year in which you will turn 100 years old.

Experiment – 2: CONTROL STRUCTURES

a. Read your email id and write a program to display the no of vowels, consonants, digits and white spaces in it using if…elif…else statement.
b. Write a Program to find the sum of a Series 1/1! + 2/2! + 3/3! + 4/4! +…….+ n/n!. (Input :n = 5, Output : 2.70833)

Experiment – 3: LIST

a. Read a list of numbers and print the numbers divisible by x but not by y (Assume x = 4 and y = 5).
b. Read a list of numbers and print the sum of odd integers and even integers from the list.(Ex: [23, 10, 15, 14, 63], odd numbers sum = 101, even numbers sum = 24)

Experiment – 4: TUPLE

a. Given a list of tuples. Write a program to find tuples which have all elements divisible by K from a list of tuples. test_list = [(6, 24, 12), (60, 12, 6), (12, 18, 21)], K = 6, Output : [(6, 24, 12), (60, 12, 6)]
b. Given a list of tuples. Write a program to filter all uppercase characters tuples from given list of tuples. (Input: test_list = [("GFG", "IS", "BEST"), ("GFg", "AVERAGE"), ("GfG",), ("Gfg", "CS")], Output : [('GFG', 'IS', 'BEST')]).

Experiment – 5: SET

a. Write a program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
b. Write a program to perform union, intersection and difference using Set A and Set B.

Experiment – 6: DICTIONARY

a. Write a program to do the following operations:
   i. Create a empty dictionary with dict() method
   ii. Add elements one at a time
   iii. Update existing key's value
   iv. Access an element using a key and also get() method
   v. Deleting a key value using del() method
b. Write a program to create a dictionary and apply the following methods:
   i. pop() method
   ii. popitem() method
   iii. clear() method

Experiment – 7: STRINGS

a. Given a string, write a program to check if the string is symmetrical and palindrome or not. A string is said to be symmetrical if both the halves of the string are the same and a string is said to be a palindrome string if one half of the string is the reverse of the other half or if a string appears same when read forward or backward.
b. Write a program to read a string and count the number of vowel letters and print all letters except 'e' and 's'.

Experiment – 8: USER DEFINED FUNCTIONS

a. Write a function merge_dict(dict1, dict2) to merge two Python dictionaries.
b. Given a list of n elements, write a linear_search() function to search a given element x in a list.

Experiment – 9: BUILT-IN FUNCTIONS

a. Write a program to demonstrate the working of built-in statistical functions mean(), mode(), median() by importing statistics library.
b. Write a program to demonstrate the working of built-in trignometric functions sin(), cos(), tan(), hypot(), degrees(), radians() by importing math module.

Experiment – 10: **CLASS AND OBJECTS**

a. Write a program to create a BankAccount class. Your class should support the following methods for
   i) Deposit
   ii) Withdraw
   iii) GetBalanace
   iv) PinChange
b. Write a program to create an employee class and store the employee name, id, age, and salary using the constructor. Display the employee details by invoking employee_info () method and also using dictionary (_dict_).

Reference Books:

1. Michael H Goldwasser, David Letscher, "Object Oriented Programming in Python", Prentice Hall, 1st Edition, 2007.
2. Yashavant Kanetkar, Aditya Kanetkar, "Let us Python", BPB publication, 1st Edition, 2019.
3. Ashok Kamthane, Amit Kamthane, "Programming and Problem Solving with Python", McGraw Hill Education (India) Private Limited, 2018.
4. Taneja Sheetal, Kumar Naveen, "Python Programming – A modular approach", Pearson, 2017.
5. R Nageswara Rao, "Core Python Programming", Dreamtech press, 2017 Edition.

CO-PO/PSO Mapping Chart:

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low															
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1			1										1		
CO2		1											1		
CO3					2								1		
CO4					2								1		

B.Tech III Year – II Sem	L	T	P	C
Subject Code: 21PC6EE23	0	0	3	1.5

POWER SYSTEM LAB

Prerequisite: Power Systems-I, Power Systems-II, Power Systems-III

Course Objectives:

1. To perform voltage distributions across insulator strings
2. To understand the high frequency transients
3. Perform testing of CT, PT's and Insulator strings
4. To find sequence impedances of 3-Φ synchronous machine and Transformer
5. To perform fault analysis on Transmission line models and Generators.

Course Outcomes: After completion of this lab the student is able to

1. Perform various transmission line calculations
2. Understand Different protection methods.
3. Analyze the experimental data and draw the conclusions.

List of experiments/demonstrations:

Note: Any ten experiments should be conducted

1. Characteristics of IDMT Over-Current Relay.
2. Differential protection of 1-Φ transformer.
3. Characteristics of Micro Processor based Over Voltage/Under Voltage relay.
4. A,B,C,D constants of a Long Transmission line
5. Finding the sequence impedances of 3-Φ synchronous machine.
6. Finding the sequence impedances of 3-Φ Transformer. Determination of Hybrid parameters.

In addition to above Six Experiments, any four of the following experiments to be conducted

1. Estimation of TARIFF based on load curve.
2. Calculation of fault currents of transmission line
3. Calculation of R, L, C, Zs of 3-phase Transmission Line
4. Comparison of lumped and distributed transmission lines
5. Simulation of Compensated Line

Text Books:

1. C.L. Wadhwa: Electrical Power Systems –Third Edition, New Age International Pub. Co., 2001.

2. Hadi Sadat: Power System Analysis –Tata Mc Graw Hill Pub. Co. 2002.

Reference Books:

1. D. P. Kothari: Modern Power System Analysis-Tata Mc Graw Hill Pub. Co. 2003

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes ***	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2			2								1	1
CO2	3	1											1	1
CO3	3	1			2								1	1

B.Tech III Year – II Sem

Subject Code: 21PC6EE24

L	T	P	C
0	0	2	1

ELECTRICAL MEASUREMENTS LAB

Pre-requisite: Measurements and Instrumentation

Course Objectives:

1. To calibrate LPF Watt Meter, energy meter, P. F Meter using electro dynamo meter type instrument as the standard instrument
2. To determine unknown inductance, resistance, and capacitance by performing experiments on D.C Bridges & A. C Bridge
3. To determine three-phase active & reactive powers using the single wattmeter method practically.
4. To determine the ratio and phase angle errors of the current transformer and potential transformer.

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

1. CO1 – Able to choose instruments
2. CO2 – Able to test any instrument
3. CO3 – Analyze the accuracy of any instrument by performing experiment
4. CO4 – Able to Calibrate PMMC instrument using D.C potentiometer

Any Eight Experiments Should be Conducted

1. Calibration and Testing of single-phase energy Meter
2. Calibration of dynamometer power factor meter
3. Crompton D.C. Potentiometer – Calibration of PMMC ammeter and PMMC voltmeter
4. Kelvin's double Bridge – Measurement of resistance – Determination of Tolerance
5. Dielectric oil testing using H.T. testing Kit
6. Schering Bridge & Anderson Bridge
7. Measurement of 3 - Phase reactive power with single-phase wattmeter
8. Measurement of displacement with the help of LVDT
9. Calibration LPF wattmeter – by Phantom testing
10. Measurement of 3-phase power with single wattmeter and two CTs

Any Two experiments should be conducted

11. C.T. testing using mutual Inductor – Measurement of % ratio error and phase angle of given CT by Null method
12. PT testing by comparison – V. G. as Null detector – Measurement of % ratio error and phase angle of the given PT
13. Resistance strain gauge – strain measurements and Calibration
14. Transformer turns ratio measurement using AC bridges
15. Measurement of % ratio error and phase angle of given CT by comparison

Text Books:

1. “G. K. Banerjee”, “Electrical and Electronic Measurements”, PHI Learning Pvt. Ltd., 2nd Edition, 2016

2. “S. C. Bhargava”, “Electrical Measuring Instruments and Measurements”, BS Publications, 2012

Reference Books:

1. “A. K. Sawhney”, “Electrical & Electronic Measurement & Instruments”, Dhanpat Rai & Co. Publications, 2005

2. “R. K. Rajput”, “Electrical & Electronic Measurement & Instrumentation”, S. Chand and Company Ltd., 2007

3. “Buckingham and Price”, “Electrical Measurements”, Prentice – Hall, 1988

4. “Reissland, M. U”, “Electrical Measurements: Fundamentals, Concepts, Applications”, New Age International (P) Limited Publishers, 1st Edition 2010

5. “E.W. Golding and F. C. Widdis”, “Electrical Measurements and measuring Instruments”, fifth Edition, Wheeler Publishing, 2011.

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation)
3 – High; 2 – Medium; 1 - Low

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1												
CO2	2	3												
CO3		3												
CO4		3												

B. Tech III Year- II Sem	L	T	P	C
Subject Code: 21MC6HS04	2	0	0	0

QUANITATIVE APTITUDE
(Common to CSE/EEE/ECE/CSM/CSD/CSC/CSO/ME)

Course Description

Course Overview

This course provides the basic skills required in solving the problems of Aptitude required by various companies for Campus Recruitment and competitive tests. The contents of course include solving problems on different concepts such as Permutations and Combinations, Averages, Percentages and Logarithms etc.

Course Pre/co-requisites

No prior knowledge is required.

Course Objectives:

• To categorize, apply and use thought process to distinguish between concepts of Quantitative methods.

• To prepare and explain the fundamentals related to various possibilities and probabilities related to quantitative aptitude.

• To critically evaluate numerous possibilities related to puzzles.

Course Outcomes (COs)

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

1. Apply the concepts of ratios, proportions and percentages to solve problems.
2. Solve problems on Logarithms, permutations, combinations, clocks, and calendars.
3. Able to recall and use the concepts to solve problems numerical estimation with respect to company specific and competitive tests
4. Interpret data using graphs and charts.

Module 1:

Arithmetic ability:-Algebraic operations- BODMAS – Fractions – Number system - Divisibility rules LCM&GCD (HCF), Simplification.

Ratio and Proportion: Ratio, Proportion, Variations, Problems on A

Module II:

Percentages, Simple Interest (SI) and Compound Interest (CI): Fundamentals of Percentage, Percentage change, SI and CI, Relation between SI and CI.

Profit and Loss, Partnerships: Basic terminology in profit and loss, Types of partnership, Problems related to partnership

Module III:

Time and Work, Pipe and Cistern, Speed, Time and Distance, Problems on trains & boats, Calendar problems, Clock problems.

Average, Mixtures and Alligation: Averages, Weighted average, Difference between mixture and alligation, Problems on Mixtures and alligation

Module IV:

Data Interpretation: Introduction, Tabulation, Bar Graph, Pie Charts, Line Graphs, Combined Graphs.

Geometry: Lines and Angles, Triangle, Trigonometry, Circle, Height and Distance, Quadrilateral and Polygon

Module V:

Permutations and Combinations: Fundamentals counting principle, Definition of Permutation, Seating arrangement, Problems related to alphabets, Rank of the word, Problems related to numbers, Circular permutation, Combination.

Logarithms: Fundamental formulae of logarithms and problems, finding number of terms on expanding a given number.

Books and Materials

Text Book

1. R.S Aggarwal, Quantitative Aptitude for competitive examinations, 2017 edition, S.Chand.

Reference Books

1. Abhijit Guha, Quantitative Aptitude for competitive examinations, 6th Edition, McGraw Hill Education.
2. Dinesh Khattar, The Pearson guide to Quantitative Aptitude for Competitive Examinations, 3rd Edition, Pearson Education.

Websites:

1. www.m4maths.com
2. www.Indiabix.com

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1						2					2	3		
CO2						2					2	3		
CO3						2					2	3		
CO4						2					2	3		

B.Tech III Year – II Sem

Subject Code: 21PE6EE21

L	T	P	C
3	0	0	3

HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

Pre-requisite: Power System-I, Power System-II, Power Electronics

Course Objectives:

1) To compare EHV AC and HVDC systems
2) To analyzeGraetz circuit and also explain 6 and 12 pulse converters
3) To control HVDC systems with various methods
4) To describe various protection methods for HVDC systems and Harmonics

Course Outcomes:

At the end of course student will be able to do

1. CO1 – Analyse EHV AC and HVDC system and to describe various types of DC links
2. CO2 – AnalyseGraetz circuit for rectifier and inverter mode of operation
3. CO3 – Describe various methods for the control of HVDC systems
4. CO4 – Describe various protection methods for HVDC systems, classify Harmonics and design different types of filters

Module I:HVDC Concepts

Comparitive Analysis of AC and DC: Basic Concepts, Necessity of HVDC systems, Terminal equipment and Apparatus required for HVDC Systems, Types of HVDC Links, Comparison of AC and DC Transmission: Technical and Economic Comparison, Application of DC Transmission System

Analysis of HVDC Converters: Analysis of Graetz circuit without and with overlap angle μ, Characteristics of 6 Pulse and 12 Pulse converters, Analysis of 12 pulse converter. Power Flow in HVDC link. Deriving complete Equivalent circuit of HVDC link.

Module II:Converter and HVDC System Control

HVDC System Control: Principle of DC Link Control, System Control Hierarchy and basic Philosophy, Current Control and extinction angle control, Firing angle control (IPC and EPC). Complete characteristics of Converter as Rectifier/Inverter.

Compounding of Converters: Principle of DC link control, Necessity of control in DC link, Constant α, β and ϒ control. Compounding of Rectifier and Inverter, Inverter Extinction Angle Control (EAG), Starting and stopping of DC link, Power Reversal in Dc link, Correction to Inverter characteristics.

Module III:Harmonics in HVDC

Characteristic Harmonics: Generation of Harmonics, Characteristics harmonics, calculation of AC current Harmonics and DC Voltage Harmonics.

Non-Characteristic Harmonics: Non Characteristics harmonics, adverse effects of harmonics, Effect of Firing Angle errors, imbalance in AC supply voltage, imbalance in converter transformer reactance. Effect of Pulse number on harmonics.

Module IV:Harmonic Suppression in HVDC and Multi terminal HVDC Systems

Filters: Design Criteria for AC Filters, Filter Configuration, Design of Single tuned filters, Minimum cost of Tuned AC filters.

Multi terminal HVDC Systems (MTDC): Types of MTDC systems. Parallel operation of MTDC systems.

Module V:Faults and Protection Schemes in HVDC Systems

Faults in HVDC: Nature and type of Faults, Faults on AC side of converter station. Converter Faults (Malfunction of valves,Commutation failure and short circuits). Faults on DC side of system.

Protection of HVDC: DC circuit Breakers, Metallic Return Transfer Breaker (MRTB), over current Protection system and Differential protection system, Over voltage Protection.

TEXT BOOKS:

1) Kamakshaiah, “Hvdc Transmission”, McGraw-Hill Education (India) Pvt Limited, 2011.
2) K. R. Padiyar, “HVDC Power Transmission Systems”, Technology and system Interactions, New Age International (P) Limited, and Publishers, 1990.

REFERENCE BOOKS:

1) "S. Rao", EHVAC and HVDC Transmission Engineering and Practice, Khanna publications, 3rd Edition 1999.
2) "Jos Arrillaga", HVDC Transmission, The institution of electrical engineers, IEE power & energy series 29, 2nd edition 1998.
3) "E. W. Kimbark", Direct Current Transmission, John Wiley and Sons, volume 1, 1971.
4) "E. Uhlmann", Power Transmission by Direct Current, B. S. Publications, 2009

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 –Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2											2	2
CO2	3	3			3								2	
CO3	3	3			3								2	
CO4	3	2			3								2	

B.Tech III Year – II Sem	L	T	P	C
Subject Code: 21PE6EE22	3	0	0	3

VLSI DESIGN

Prerequisite: EDC, STLD

Course Objectives: The objectives of the course are to:

5. Create models of moderately sized CMOS circuits that realize specified digital functions.
6. Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects
7. Design static CMOS combinational and sequential logic at the transistor level, including mask layout.
8. Compare the trade-offs of sequencing elements including flip-flops and latches
9. Design functional units including adders, multipliers, ROMs, SRAMs, and PLAs.

Course Outcomes: Upon completing this course, the student will be able to

CO1: Acquire qualitative knowledge about the fabrication process of integrated circuit using MOS transistors.

CO2: Analysis of transfer characteristics of different logic gates using CMOS inverter

CO3: Draw the layout of any logic circuit which helps to estimate parasitic of any logic circuit

CO4: Design simple logic circuit using PLA, PAL, FPGA and CPLD

Module-I:

Introduction: Introduction to IC Technology, MOS and related VLSI Technology, Basic MOS Transistors, Enhancement and Depletion modes of transistor action, IC production process, MOS and CMOS Fabrication processes, BiCMOS Technology, Comparison between CMOS and Bipolar technologies.

Basic Electrical Properties Of MOS and Bi-CMOS Circuits: Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit. The Pass transistor,

Module-II

NMOS Inverter, Pull-up to Pull-down Ratio for NMOS inverter driven by another NMOS inverter. Alternative forms of pull-up, The CMOS Inverter, MOS transistor circuit model, Bi-CMOS Inverter

MOS and Bi-CMOS Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 μm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits

Module-III

Basic Circuit Concepts: Sheet Resistance for MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitance's, Fan-in and fan-out characteristics, Choice of layers, Transistor switches

Realization of logic gates using NMOS, PMOS and CMOS technologies, Scaling factors for device parameters, Limits due to sub threshold currents

Module-IV

Subsystem Design: Architectural issues, switch logic, Gate logic, clocked sequential circuits, system considerations, general considerations of subsystem design processes, an illustration of design processes

Design of Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters. Array Subsystems: SRAM, DRAM, ROM, Serial Access Memories.

Module-V

Programmable Logic Devices: PLAs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Design Approach, Parameters influencing low power design, ASIC design flow, FPGA design flow

CMOS Testing: CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques

TEXT BOOKS:

1. Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, PHI, 2005 Edition 2. CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E Weste, David Harris, Ayan Banerjee, 3rd Ed, Pearson, 2009.

REFERENCE BOOKS: 1. CMOS logic circuit Design - John .P. Uyemura, Springer, 2007. 2. Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997.

Web Resources:

- http://www.vlsi-expert.com/
- http://pages.hmc.edu/harris/cmosvlsi/4e/index.html

E Books:

1. http://www.freebookcentre.net/electronics-ebooks-download/Design-of-VLSI-Circuits.html
2. http://www.freebookcentre.net/electronics-ebooks-download/Introduction-to-VLSI-Circuits-Design.html

Mooc Courses:

1. https://nptel.ac.in/courses/117106092
2. https://www.coursera.org/lecture/vlsi-cad-logic/welcome-and-introduction-CBOe2

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes ***	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**		**1**		2								3	
CO2	**3**				**2**				**2**				2	
CO3	**2**			**2**	**2**				2				2	
CO4	**3**		2						**2**				2	

B.Tech III Year – II Sem

Subject Code: 21PE6EE23

L	T	P	C
3	0	0	3

HIGH VOLTAGE ENGINEERING

Pre-requisite: Power Systems, Electro Magnetic Fields

Course Objectives:

1) To deal with the detailed analysis of Breakdown occurring in gaseous, liquids and solid dielectrics
2) To inform about generation and measurement of High voltage and current
3) To introduce High voltage testing methods

Course Outcomes:

At the end of course student will be able to do

1) CO1 –Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.

2) CO2 – Apply different methods for the generation and measurement of high voltages.

3) CO3 –Analyse how over-voltages arise in a power system and its protection methods.

4) CO4 – Apply various tests on H. V. equipment and on insulating materials.

Module I:Breakdown in Insulators

Breakdown in Gases: Gases as Insulating Media, Collision Process, Ionization Processes, Townsend's Current Growth Equation, Current Growth in the Presence of Secondary Processes, Townsend's Criterion for Breakdown, Time Lags for Breakdown, Streamer Theory of Breakdown in Gases, Paschen's Law.

Breakdown in Liquid and Solid Insulating Materials: Liquids as Insulators, Pure Liquids and Commercial Liquids, Conduction and Breakdown in Pure Liquids, Conduction and Breakdown in Commercial Liquids.Introduction to solid insulators, Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown.

Module II:Generation of High Voltages

Generation of High DC Voltages: Generation of High Direct Current Voltages - Half wave rectifier, Full wave rectifier, Voltage Doublers Circuit, Voltage Multiplier Circuit, Vande-Graff Generator.

Generation of High Alternating Voltages,Impulse Voltages: Generation of High Alternating Voltages - Cascade transformer, Resonant transformer. Generation of Impulse Voltages-Impulse generator with multiple stages (Marx circuit)

Module III:Measurement of High Voltages & Partial discharges

Measurement Of DC& AC voltages: Measurement Of DC Voltages-Micro ammeter with series resistance, Resistance potential divider, Generation voltmeter, Measurement Of AC Voltages-Series impedance ammeter, Sphere gaps.

Partial discharge measurements: Partial discharge – Introduction, Discharge Detection using Straight Detectors, Balanced Detection Method.

Module IV:LIGHTNING AND SWITCHING OVER-VOLTAGES

LIGHTNING: Causes for Over voltages- Lightning Phenomenon,Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges.

SWITCHING OVER-VOLTAGES: Over voltage due to Switching Surges, Protection against over-voltages, Surge diverters.

Module V:High Voltage Testing of Electrical Apparatus

High Voltage Testing of Electrical Apparatus -I: Introduction, Testing of insulators and bushings, testing of cables.

High Voltage Testing of Electrical Apparatus-II: Testing of isolators and circuit breakers, Testing of transformers.

TEXT BOOKS:

1. M. S. Naidu and V. Kamaraju, “High Voltage Engineering”, McGraw Hill Education, 2013.

2. C. L. Wadhwa, “High Voltage Engineering”, New Age International Publishers, 2007.

REFERENCE BOOKS:

1. D. V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers, 1993.
2. E. Kuffel, W. S. Zaengl and J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication, 2000.
3. R. Arora and W. Mosch “High Voltage and Electrical Insulation Engineering”, John Wiley & Sons, 2011.
4. Various IS standards for HV Laboratory Techniques and Testing.

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 –Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2			2								2	2
CO2	3	3											2	
CO3	3	3											2	
CO4	3	2											2	

HR 21

	L	T	P	C
B.Tech III Year – VI Sem				
Subject Code: 21OE6CS09	**3**	**0**	**0**	**3**

Object Oriented Programming Using Java

Prerequisites: Programming in C

Course Objectives:
1. Understand fundamental concepts and object oriented concepts in Java
2. Implementing the concept of packages and exception handling in Java.
3. Implement the concept of multithreading and inter process communication in Java.
4. Develop GUI applications.

Course Outcomes:
1. Solve the given problem using OOPS technique.
2. Explain the concept of Package and Exception Handling.
3. Implement Multi threading and Inter process communication in java
4. Develop GUI based applications using applet, AWT , Event handling and swing.

Module - I
History and Evolution of java: Java's lineage, Java and internet, Byte code, Java buzzwords, Evolution of java.
Object oriented programming - data, types, variables, Arrays,operators, control statements, type conversion and casting, Introduction to classes, objects, methods, constructor, this and static keywords , garbage collection, overloading methods, parameter passing, access control, command line arguments,exploring String class
Inheritance: member access and inheritance, Multilevel Inheritance, super and final keywords, method overriding, dynamic method dispatch, abstract classes and methods.

Module- II
Packages and Interfaces: Defining, Creating and Accessing a Package, understanding CLASSPATH, importing packages, Differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces.
Exception handling: Concepts of exception handling and its benefits, usage of try, catch, throw, throws and finally, built in exceptions, creating own exceptions.

Module -III
Multithreading: Differences between multi-threading and multi programming, thread life cycle, creating threads using thread class and Run able interface, thread priorities, synchronization , inter thread communication.
I/O Streams: Stream classes, Byte and character streams, File class, reading and writing files,reading and writing from console, serialization.

Module -IV
Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, creating applets, passing parameters to applets.

AWT: class hierarchy, user interface components- labels, buttons, scrollbars, text components, checkbox, checkbox groups, choices, lists panels – scroll pane, dialogs, menu bar, Layout Managers- Flow Layout, Border Layout, Grid Layout, Card Layout, Grid Bag Layout.
Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes.

Module- V

Swings: Introduction, limitations of AWT, MVC architecture, components, containers, exploring swing- J Applet, J Frame and J Component, Image Icon, J Label, J Text field, J Button, J Checkbox, J List, J Radio button, J Combo Box, J Tabbed Pane, J Scroll Pane.
The Collections Framework (java.util)- Collections overview, Collection Interfaces, Generics The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array De-queue. Accessing a Collection via an iterator, Using an Iterator, The For-Each alternative, Map Interfaces and Classes, Comparators, Collection algorithms, Arrays, The Legacy Classes and Interfaces- Dictionary, Hash table, Properties, Stack, Vector More Utility classes, String Tokenizer, Date, Calendar, Random, Scanner

Text Books:
1. The Complete Reference JAVA 2, Author: Herbert Schield , ninth edition Publishers: TataMec-Hill
2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, PearsonEducation.

Reference Books:
1. An Introduction to JAVA Programming (Chapter 6) Author: Y.Daniel Liang , Publishers:Tata Mec-Hill.
2. Programming with JAVA (2nd Edition) Author: E. Balagurusamy Publishers: Tata Mec-Hill.
3. Internet and Java Programming, R.Krishna Murthu and S.Prabhu, New Age Publishers

CO-PO/PSO Mapping:

Course Outcomes(COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***		
	PO 1	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	**2**														**1**
CO2	**2**														**1**
CO3	**2**														**1**
CO4	**3**	**1**	**1**	**1**	**3**										**3**

B. Tech III Year – VI Sem	**L**	**T**	**P**	**C**
Subject Code:21OE6EC02	3	0	0	3

Fundamentals of Digital Electronics

(Open Elective)

Prerequisite: Basic knowledge on computers

Course Objectives:

This course provides in-depth knowledge of Digital logic techniques of digital circuits, which is the basis for design of any digital circuit.

1. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
2. To impart the concepts of combinational, sequential logic circuits.
3. To learn the concepts of sequential circuits, enabling them to analyse sequential systems in terms of state machines.

Course Outcomes: Upon completion of the course, the student should be able to

1. Explain the numerical information in different forms and Boolean Algebra theorems
2. Solve Boolean expressions using Boolean Theorems-maps
3. Design and analyze combinational and sequential circuits
4. Implement logic families and realization of logic gates

Module I: Number Systems & Boolean Algebra:

Number Systems: Number base conversions: Binary, Octal, Decimal, Hexa-decimal, Complements of Numbers, Codes- Weighted and Non-weighted codes and its Properties, Parity check code and Hamming code.
Boolean algebra: Basic Theorems and Properties, Switching Functions- Canonical and Standard Form, Algebraic Simplification, Digital Logic Gates, EX-OR gates, Universal Gates. The Karnaugh Map Method, don't care map entries, Prime and Essential Implicants.

Module II: Combinational Logic Circuits:
Basic Arithmetic Circuits- Half adder, Full adder, Half subtractor, Full subtractor, 4-bit parallel adder/subtractor. BCD Adder
Combinational logic circuits: 2-bit comparator, Multiplexers, Implementation of Boolean functions using Multiplexers, Decoders, Implementation of Boolean functions using Decoder, Demultiplexers, Encoder, Priority Encoder, Code converters.

Module III: Sequential Circuits Fundamentals:
Introduction to Sequential Circuits: Basic Architectural Distinctions between Combinational and Sequential circuits, SR Latch, Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops,
Flip flop Conversions: Excitation Table of all Flip Flops, Timing and Triggering Consideration, Conversion from one type of Flip-Flop to another.

Module IV: Sequential Logic Applications:

Sequential Logic Applications: Registers and Counters: Shift Registers – Left, Right and Bidirectional Shift Registers, Universal shift register, Applications of Shift Registers

Design of Counters: Design and Operation of Ring and Twisted Ring Counter, Operation of Asynchronous and Synchronous Counters.

Module V: Design and Analysis of Sequential Machines: Introduction to Finite State Machines- Mealy Machine and Moore Machine, State diagram, State Assignment and minimization, Design Procedure and Realization using Flip-Flops.

Introduction to CMOS Technology: CMOS technology, Working states of CMOS, Types of CMOS, AND, OR and NOT Gates using CMOS.

Text Books:

1. Switching and Finite Automata Theory - Zvi Kohavi & Niraj K. Jha, 3rd Edition, Cambridge, 2010.
2. Modern Digital Electronics – R. P. Jain, 3rd Edition, Tata McGraw-Hill, 2007.

Reference Books:

1. Digital Design- Morris Mano, PHI, 4th Edition,2006
2. Introduction to Switching Theory and Logic Design – Fredriac J. Hill, Gerald R. Peterson, 3rd Ed, John Wiley & Sons Inc.
3. Fundamentals of Logic Design- Charles H. Roth, Cengage Learning, 5th, Edition, 2004.
4. Switching Theory and Logic Design – A Anand Kumar, PHI, 2013

Web Resources:

1. http://blog.digitalelectronics.co.in/
2. www.nesoacademy.org/electronics-engineering/digital-electronics/digital
3. https://www.slideshare.net/JournalsPubwwwjourna/international-journal-of-digital-electronics-vol-2-issue-2
2. https://lecturenotes.in/subject/203/switching-theory-and-logic-design-stld
3. http://www.infocobuild.com/education/audio-video-courses/electronics/DigitalCircuitsSystems
4. https://nptel.ac.in/courses/117105080/

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-
CO4	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-

B. Tech III Year–VI Sem	**L**	**T**	**P**	**C**
Subject Code: 21OE6ME02	**3**	**0**	**0**	**3**

TOTAL QUALITY MANAGEMENT & SIX SIGMA APPLICATIONS

Pre-requisite: Management Science &Production Technology, Machine Tools

Course Objectives:

1. To understand the quality concepts and tools
2. To discuss about techniques relating to total quality management.
3. To understand the Principles and Practices of TQM
4. To understand the implementation of ISO 9000 AND Six sigma in a system

Module I

Introduction: The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems.
Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control.

Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

Module II

Customer Focus and Satisfaction: Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships.

Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure.

Module III

Organizing for TQM**:** The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools

Seven Tools of TQM: Stratification, check sheet, Scatter diagram, lshikawa diagram, pane to diagram, Kepner& Tregoe Methodology.

Module IV

The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

Use of Quality Cost information, Accounting Systems and Quality Management.

Module V

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q- 90. Series Standards, benefits of ISO9000 certification, the third party audit.

Documentation ISO9000 and services, the cost of certification implementing the system.

Six sigma and applications of sixsigma.

Text Books:

1. Total Quality Management / Joel E. Ross/Taylor and Franscis Limited.
2. Total Quality Management/P. N. Mukherjee/PHI
3. "Lean Six Sigma: Combining Six Sigma with Lean Speed" by Michael L. George, David Rowlands, and Bill Kastle, published by McGraw-Hill Education
4.

Reference Books:

1. Beyond TQM / Robert L.Flood
2. Statistical Quality Control / E.L. Grant.
3. Total Quality Management:A Practical Approach/H. Lal
4.

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

1) Understand the fundamental principles of Total Quality Management.
2) Analyze the different quality approaches
3) Evaluate the different tools in Total Quality Management
4) Describe the importance and implementing of ISO9000 in the system and Six sigma

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2						1	2	2	2	2	2	
CO2	3	2	2					1	2	2	2	2	2	
CO3	3	2	2					1	2	2	2	2	2	
CO4	3	2	2					1	2	2	2	2	2	

** If more PSOs are there in a particular branch, required no of columns can be added.*

B.Tech III Year – VI Sem

Subject Code: 21OE6EE02

L	T	P	C
3	0	0	3

FUNDAMENTALS OF INDUSTRIAL ELECTRONICS
OPEN ELECTIVE II
ALL BRANCHES EXCEPT EEE

Pre-requisite: Basic Electrical and Electronics Engineering or Analog and Digital Circuits

Course Objectives:

1) To Design/develop suitable power converter for efficient control or conversion of power in drive applications.
2) To Design / develop suitable power converter for efficient transmission and utilization of power in Industrial applications.

Course Outcomes: At the end of course student will be able to do

1) CO1 – Understand the differences between signal level and power level devices.
2) CO2 – Analyze controlled rectifier circuits.
3) CO3 – Analyze the operation of DC-DC choppers.
4) CO4 – Analyze the operation of voltage source inverters.

Module I:Power Switching Devices and Protection Circuits

Power Switching Devices:

Types of power converters; Power semiconductor switches and their V-I characteristics - Power Diodes, Power BJT, Power MOSFET, Power IGBT. SCR VI Characteristics, Switching characteristics.

Thyristor voltage and current ratings and protection using Snubber Circuit.

Module II:Triggering and Commutation

Triggering Circuits: R, RC and UJT triggering circuits

Commutation Circuits: Types of Commutation circuits (Class A, B,C,D,E,F)

Module III:Rectifiers

Single Phase Rectifier: Principles of single-phase half-controlled converter with R, RL and RLE load. Principles of single-phase fully-controlled converter with RLE load. Problems on Single phase Rectifiers.

Three Phase Rectifier: Principles of three-phase fully-controlled converter operation with RLE load. Problems on Three phase Rectifiers.

Module IV:Choppers, AC Voltage Converters and Cycloconverters

DC-DC Converters (Choppers)
Introduction of Choppers, Control strategies in Choppers, Time Ratio Control, Step down and Step Up Choppers with problems.

AC Voltage Converters and Cycloconverters
Phase Controller (AC Voltage Regulator)-Introduction, principle of operation of single-phase voltage controllers for R, R-L loads.

Cyclo-converter- Principle of operation of single phase cyclo-converters: Mid Tap and Bridge type, relevant waveforms.

Module V:Inverters and Applications

DC-AC Converters (Inverters)
Introduction, principle of operation, performance parameters, single phase half and full bridge inverters with R, RL loads. Problems on single phase inverters.
Applications: UPS, SMPS, Battery Charger.

TEXT BOOKS:

1. Dr.P.S.Bimbhra, "Power Electronics", Khanna Publishers, New Delhi.
2. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.

Reference Books:

1.N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
2. MD Singh and KB Kanchandhani, " Power Electronics", Tata Mc Graw Hill Publishing Company Limited, New Delhi.

Web Resources: www.mathworks .com

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	1											1	2
CO2	2	2	3		2								2	2
CO3	1	2	3		2								2	2
CO4	1	2	3		2								2	2

B. Tech III Year–VI Sem	L	T	P	C
Subject Code: 21OE6CM06	3	0	0	3

Expert Systems

Prerequisite:

1. Artificial Intelligence

Course Objectives:

1. Understand Expert Systems and their applications.
2. Illustrate Fuzzy Logic Concepts with an example.
3. Understand the Genetic Algorithm and its applications.
4. Explain the components of Expert System building and its tools.

Module-I

Overview of Expert Systems:

Introduction to Expert System: Characteristics of Expert System, Advantages and Disadvantages of Expert Systems, Different types of Expert Systems: Rule-based Expert Systems, Knowledge-based Expert Systems, Model-based, Case-based, and Hybrid Expert Systems, Working Architecture of Expert Systems, Components of Expert Systems, Applications of Expert Systems, Techniques for extracting the knowledge from Domain Experts.

Module – II

Knowledge Representation:

Representations and Mapping: General goal of Knowledge Representation, Approaches to Knowledge Representation: Simple Relational Knowledge, Inheritable Knowledge, Inferential Knowledge, Procedural Knowledge or Operational Knowledge, Classification of Knowledge Representation Systems: Logics (Predicate Logic, Description Logic, Nonmonotonic Logic); Procedural Schemas (Production rules), Structural Schemas (Weak slot-and-filler structures, Strong slot-and-filler structures), Knowledge-Based Systems.

Module - III

Fuzzy Logic:

Introduction to Fuzzy Logic, Fuzzy set theory, Fuzzy sets: Operation on Fuzzy sets, Scalar cardinality, fuzzy cardinality, union and intersection, complement, equilibrium points, aggregation, projection, composition, decomposition, cylindrical extension, fuzzy relation, Fuzzy membership functions, Fuzzy Expert Systems, Fuzzy Decision Making, Applications of Fuzzy System, De-fuzzification.

Module – IV

Genetic Algorithms:

Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem; Genetic algorithms operators-methods of selection, crossover and mutation, Simple GA(SGA), Different types of GA, generation gap, steady state GA, Applications of GA.

Module – V

Development of Expert System:

Nature of Expert System tools, Types of tools available for expert system building, Stages in the development of expert system tools. Building an Expert system, Stages of Expert system development, Tasks in building the Expert System.

Text Books:

1. Principles of Expert Systems by Peter, J.F. Lucas & Linda C. van der Gaag, 2014.
2. Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering by Nikola K. Kasabov, 1998.
3. Introduction to Genetic Algorithms by S. N. Sivanandam and S. N. Deepa 2008.

Reference Text Books:

1. David Goldberg. V Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education, 2009.
2. Zimmermann. H.J, "Fuzzy set theory-and its Applications"- Springer international edition, 2011.

Web Resources & E-Books:

1. https://www.geeksforgeeks.org/
2. https://www.sciencedirect.com/journal/expert-systems-with-applications/

MOOC's Courses:

1. NPTEL Course on "Introduction to Fuzzy Set Theory, Arithmetic and Logic".
2. NPTEL Course on "Fundamentals Of Artificial Intelligence"

Course Outcomes:

Upon completing this course, the student will be able to

1. Describe the Expert Systems and their applications.
2. Use Knowledge Representation to solve the problem.
3. Illustrate the Fuzzy Logic and Genetic Algorithms with an example.
4. Discuss the Expert System building and its tools.

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation)
3 – High; 2 – Medium; 1 - Low

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	3	2													2
CO3	3	2													2
CO4	2														

B.Tech III – VI Sem	L	T	P	C
Subject Code: 21OE6CD02	3	0	0	3

Data Mining and Data Analytics

Course Objective

1. Understand the concepts of Data Mining
2. Familiarize with association rule mining
3. Familiarize various classification algorithms
4. Understand the concepts of Cluster analysis
5. Implement the Data mining concepts with various domains

Course Outcomes:

1. Discuss varies Data Mining Principles.
2. Analyze the impact of data analytics for business decisions and strategy.
3. Apply the Association, Clustering rules for mining the data.
4. Design various classification techniques.

Module I

Introduction to Data warehouse, Difference between operational database systems and data warehouses. Data warehouse Characteristics, Data warehouse Architecture.
Introduction: What is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing, Data Cleaning, Missing data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Data Transformation; Measures of Similarity and Dissimilarity – Basics.

Module II

Data Analytics: Introduction to Analytics, Introduction to Tools and Environment, Application of Modeling in Business, Databases & Types of Data and variables. Data Modeling Techniques, Missing Imputations etc. Need for Business Modeling.

Module III

Regression – Concepts, Blue property assumptions, Least Square Estimation, Variable Rationalization, and Model Building etc.
Logistic Regression: Model Theory, Model fit Statistics, Model Construction, Analytics applications to various Business Domains etc.

Module IV

Association Rule Mining & Classification: Mining Frequent Patterns–Associations and correlations – Mining Methods–Mining Various kinds of Association Rules– Correlation Analysis.
Classification: Classification and Prediction – Basic concepts–Decision tree induction– Bayesian classification, Lazy learner.

Module V

Clustering and Applications: Cluster analysis–Types of Data in Cluster Analysis– Categorization of Major Clustering Methods– Partitioning Methods.
Hierarchical Methods– Density–Based Methods, Grid–Based Methods, Outlier Analysis.

TEXT BOOKS:

1. Data Mining – Concepts and Techniques – Jiawei Han & Micheline Kamber, 3rd Edition Elsevier.
2. Data Mining Techniques – ArunKPujari

REFERENCE BOOKS

1. Introduction to Data Mining, Tan, Steinbach and Kumar, Addision Wisley, 2006.
2. Data Mining Analysis and Concepts, M. Zaki and W. Meira

CO-PO &PSO Mapping:

Course Name - Course Outcomes / Program Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	M												M		
CO2	M	H											H		
CO3	H		M											M	
CO4	M													H	

B.Tech III Year – VI Sem	L	T	P	C
Subject Code: 21OE6CO05	3	0	0	3

SENSORS AND DEVICES

Prerequisite: IoT, ADE

Course Objectives:

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web-based services on IoT devices

Course Outcomes:

- Understand the IoT value chain structure (device, data cloud), application areas and technologies involved.
- Analyse IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules
- Market forecast for IoT devices with a focus on sensors
- Explore Internet of Things with the help of preparing projects designed for Raspberry Pi

MODULE-I:

Introduction to Internet of Things- Definition and Characteristics of IoT, Sensors, Physical Design of IoT – IoT Protocols, IoT communication models, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems

Types: Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

MODULE-II:

IoT - Software defined networks, network function virtualization, difference between SDN and NFV for IoT

M2M Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

MODULE-III:

IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi

Programming – Interfaces (serial, SPI, I2C), Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.

MODULE-IV:

Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, speed control of DC Motor, unipolar and bipolar Stepper motors

Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors

MODULE-V:

IoT Physical Servers and Cloud Offerings– Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT

Course project on IoT Application

TEXT BOOKS:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn W allace, O'Reilly (SPD), 2014, ISBN: 9789350239759
3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

REFERENCE BOOKS:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Program Outcomes (POs)													**Program Specific Outcomes***	
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO-1	3												1	
CO-2	3	1											2	
CO-3	3	1											2	
CO-4	3	1											1	

B. Tech III Year–VI Sem	L	T	P	C
Subject Code: 21OE6CC02	3	0	0	3

COMPUTER HARDWARE AND SYSTEM ESSENTIALS

Prerequisites: Nil

Course Objectives:

• Computer hardware essentials is designed to introduce students to a basic understanding of the different types of computing devices, computer components (CPU, memory, power supplies, etc.), and operating systems.
• It also introduces building a fully functional Linux and Installing applications.
• Understand the basic of circuit building.

Course Outcomes:

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

CO1: Understanding the working principles of different computing devices (desktop computers, laptops, etc.).
CO2: Understand connection interfaces between peripheral devices, storage devices, displays.
CO3: Understand the procedure for Installation of OS - Linux and supporting, upgrading and new applications.
CO4: Understand the concepts of number system and circuit building.

Module 1:

Components of Computer System: Computer Memory: Secondary storage device types, Basic Principles of operation: Sequential Access device, Direct Access device -Magnetic disks,Optical disks, memory storage devices, Ports: Serial and Parallel Ports, Specialized Expansion Ports: SCSI, USB, MIDI, Expansion Slots and Boards, PC Cards, Plug and Play, HDMI ports, networking ports. System software: bootstrap module, configuration.

Module 2:

OS loading: typical Linux virtual machine. Installing a Linux virtual machine. Using package manager to install/update software. Understanding disk partitions and obtaining partition information using system tools. Obtaining essential system resource utilization and information using system tools and proc file system: disk utilization, memory utilization, process information, CPU utilization.

Module 3:

Operating System: Introduction, Objectives, classification and functions of Operating System, Basics of popular operating system (LINUX, WINDOWS). Kernel prompt, Shell commands.

The User Interface: Task Bar, Icons, Menu, Running an Application. Operating System Simple Setting: Changing System Date and Time, Changing Display Properties, To Add or

Remove a Windows Component, Changing Mouse Properties, Adding and removing Printers. File and Directory Management: Creating and renaming of files and directories, Common utilities. Interrupts statements in various OS and its uses.

Module 4:

Number systems - Signed and Unsigned numbers arithmetic, Binary, Decimal, Octal, Hex, BCD etc. Introduction to logic circuits: Variables and functions, Inversion- Truth tables – Logic Gates and Networks - Boolean algebra - Synthesis using gates - Design examples – Optimized implementation of logic functions: Karnaugh map - Strategy for minimization – Minimization of product of sums forms - Incompletely specified functions - Multiple output circuits – Tabular method for minimization.

Module 5:

Combinational circuit building blocks: Multiplexers - Decoders - Encoders, Sequential circuit building blocks: Flipflops-SR, JK, D and T- Registers - Counters
- A simple sequential circuit design example from state diagram.

Textbook:

1. Brookshear JG. Computer science: an overview. Eleventh Edition, Addison-Wesley Publishing Company; 2011.
2. Givone DD. Digital Principles and Design.Tata McGraw Hill Publishing Company Limited; 2003.
3. Mano MM, Ciletti MD. Digital Design with Introduction to the Verilog HDL.Fifth Edition, Pearson Education; 2015.

References:

1. Norton, Peter. Introduction to computers. Sixth edition, Tata McGraw-HILL; 2008.
2. Wakerly JF. Digital Design Principles and Practices. Fourth Edition, Pearson Education; 2008.
3. Sinha, Pradeep K., and Priti Sinha. Computer fundamentals. BPB publications; 2010.

CO-PO/PSO Mapping:

CO-PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO2	PSO3
CO-1			2				3								
CO-2				2											
CO-3					2	2									
CO-4		1						3							