COURSE STRUCTURE (R23)
AND
DETAILED SYLLABUS
(III YEAR)

ELECTRICAL AND ELECTRONICS ENGINEERING

For
B.Tech., Four Year Degree Course
(Applicable for the batches admitted from 2023-24)

LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUGV, Vizianagaram
Accredited by NAAC with "A" Grade and NBA (CSE,ECE, EEE & ME)
Jonnada (Village), Denkada (Mandal), Vizianagaram Dist – 535 005
Phone No. 08922-241111, 241112
E-Mail: lendi_2008@yahoo.com
Website: www.lendi.edu.in

R23_B.Tech III year Course Structures and Detailed Syllabus

III YEAR – I SEMESTER							
S. No.	**Course code**	**Subjects**	**Category**	**L**	**T**	**P**	**Credits**
1	R23EEE-PC3101	Power Electronics	PC	3	0	0	3
2	R23EEE-PC3102	Analog and Digital Circuits	PC	3	0	0	3
3	R23EEE-PC3103	Power Systems-II	PC	3	0	0	3
4	**Professional Elective-I**			3	0	0	3
	R23EEE-PE3101.1	Signals and Systems	PE				
	R23EEE-PE3101.2	Digital Control Systems	PE				
	R23EEE-PE3101.3	Electrical Energy in Industrial Systems	PE				
	R23EEE-PE3101.4	Special Electrical Machines	PE				
5	R23EEE-OE3101	**Open Elective-I**	OE	3	0	0	3
6	R23EEE-PC3104	Power Electronics Lab	PC	0	0	3	1.5
7	R23EEE-PC3105	Analog and Digital Circuits Lab	PC	0	0	3	1.5
8	R23EEE-ES3101	Tinkering Lab	ES	0	0	2	1
9	R23BSH-SC3101	English and Soft Skills for Job Seeker (Skill Oriented Course)	SC	0	1	2	2
10	R23EEE-SI3101	Evaluation of Community Service Internship	SI	0	0	0	2
Total				**15**	**1**	**10**	**23**

III YEAR – II SEMESTER							
S. No.	**Course code**	**Subjects**	**Category**	**L**	**T**	**P**	**Credits**
1	R23EEE-PC3201	Electrical Measurements and Instrumentation	PC	3	0	0	3
2	R23EEE-PC3202	Microprocessors and Microcontrollers	PC	3	0	0	3
3	R23EEE-PC3203	Power System Analysis	PC	3	0	0	3
4	**Professional Elective-II**			3	0	0	3
	R23EEE-PE3201.1	Discrete Time Signal Processing	PE				
	R23EEE-PE3201.2	Advanced Control Systems	PE				
	R23EEE-PE3201.3	HVDC & FACTS	PE				
	R23EEE-PE3201.4	Electric Drives	PE				
5	**Professional Elective-III**			3	0	0	3
	R23EEE-PE3202.1	Digital IC Applications	PE				
	R23EEE-PE3202.2	Programmable Logic Controller	PE				
	R23EEE-PE3202.3	Power Quality	PE				
	R23EEE-PE3202.4	Switched Mode Power Conversion	PE				
6	R23EEE-OE3201	**Open Elective-II**	OE	3	0	0	3
7	R23EEE-PC3204	Electrical Measurements and Instrumentation Lab	PC	0	0	3	1.5
8	R23EEE-PC3205	Microprocessors & Microcontrollers Lab	PC	0	0	3	1.5
9	R23EEE-SC3201	IoT Applications of Electrical Engineering (Skill Oriented Course)	SC	0	1	2	2
10	R23BSH-MC3201	Entrepreneurship and Incubation (Mandatory Course)	MC	2	0	0	0
Total				**20**	**1**	**8**	**23**
Mandatory Industry Internship of 08 weeks duration during summer vacation							

R23_EEE (Honors)

Track- I							
S. No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23EEE-HN2201	Electric Vehicle Technology and Mobility	3	0	0	3
2	III-I	R23EEE-HN3101	Modelling and Analysis of Electrical Machines	3	0	0	3
3	III-II	R23EEE-HN3201	Modeling and Analysis of Power Semiconductor Devices and Converters	3	0	0	3
4	IV-I	R23EEE-HN4101	Grid Interface of Electric Vehicles	3	0	0	3
5	II Year to IV Year	R23EEE-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23EEE-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track II (Networks)							
S. No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23EEE-HN2202	Embedded System Design	3	0	0	3
2	III-I	R23EEE-HN3102	VLSI Design Technology	3	0	0	3
3	III-II	R23EEE-HN3202	Industrial Electronics	3	0	0	3
4	IV-I	R23EEE-HN4102	Advanced Microcontroller based Systems	3	0	0	3
5	II Year to IV Year	R23EEE-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23EEE-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track-III							
S. No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23EEE-HN2203	Renewable Energy Systems & Sources	3	0	0	3
2	III-I	R23EEE-HN3103	Flexible AC Transmission Systems	3	0	0	3
3	III-II	R23EEE-HN3203	Advanced Power System Protection	3	0	0	3
4	IV-I	R23EEE-HN4103	Distributed Generation and Micro Grid	3	0	0	3
5	II Year to IV Year	R23EEE-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23EEE-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

R23_Minors Degree offered by EEE

S. No	Year & Semester	Course Code	Subject Name	L:T:P	Credits
1	II-II	R23EEE-MT2201	Fundamentals of Special Electrical Machines	3:0:0	3
2	III-I	R23EEE-MT3101	Fundamentals of Power Systems	3:0:0	3
3	III-II	R23EEE-MT3201	Fundamentals of Electrical Measurements and Instrumentation	3:0:0	3
4	III-II	R23EEE-ML3202	Fundamentals of Electrical Measurements and Instrumentation Lab	0:0:3	1.5
5	IV-I	R23EEE-MT4101	Fundamentals of Power Electronics	3:0:0	3
6	IV-I	R23EEE-ML4102	Fundamentals of Power Electronics Lab	0:0:3	1.5
7	II year to IV year	R23EEE-MM0001	Minors MOOCS-1	0:0:0	3
Total Credits					**18**

R23_Open Electives Courses for EEE

Offering Department: Electronics and Communications Engineering						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23ECE-OE0001	Basics of Communication Systems	3	0	0	3
2	R23ECE-OE0002	Micro Processors and Interfacing	3	0	0	3
3	R23ECE-OE0003	Digital System Design using Verilog	3	0	0	3
4	R23ECE-OE0004	Fundamentals of Digital Image Processing	3	0	0	3
5	R23ECE-OE0005	Introduction to Internet of Things	3	0	0	3
6	R23ECE-OE0006	Wireless Sensor Networks	3	0	0	3
7	R23ECE-OE0007	Satellite Communication	3	0	0	3
8	R23ECE-OE0008	Fundamentals of Embedded Systems	3	0	0	3

Offering Department: Mechanical Engineering						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23MEC-OE0001	Operations Research	3	0	0	3
2	R23MEC-OE0002	3D Printing Technology	3	0	0	3
3	R23MEC-OE0003	Statistical quality control	3	0	0	3
4	R23MEC-OE0004	Hybrid Vehicle Technologies	3	0	0	3
5	R23MEC-OE0005	Industrial Robotics	3	0	0	3
6	R23MEC-OE0006	Nano Materials	3	0	0	3
7	R23MEC-OE0007	AI and ML In Manufacturing	3	0	0	3
8	R23MEC-OE0008	Automation in Manufacturing	3	0	0	3

Offering Department: Computer Science and Engineering & Allied Branches						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23CSE-OE0001	Python Programming	3	0	0	3
2	R23CSE-OE0002	Data Structures Using C	3	0	0	3
3	R23CSE-OE0003	Operating System Concepts	3	0	0	3
4	R23CSE-OE0004	Introduction to Java Programming	3	0	0	3
5	R23CSE-OE0005	Database Management Systems Concepts	3	0	0	3
6	R23CSE-OE0006	Unix & Shell Programming	3	0	0	3
7	R23CSE-OE0007	Software Engineering	3	0	0	3
8	R23CSE-OE0008	Introduction to Data mining	3	0	0	3
9	R23CSE-OE0009	Fundamentals of Web Technologies	3	0	0	3
10	R23CSE-OE0010	Fundamentals of Computer Networks	3	0	0	3
11	R23CSE-OE0011	Basics of Cloud Computing	3	0	0	3
12	R23CSE-OE0012	Introduction to Machine Learning	3	0	0	3
13	R23CSE-OE0013	Essentials of Cyber Security	3	0	0	3
14	R23CSE-OE0014	Introduction to React JS	3	0	0	3
15	R23CSE-OE0015	Deep Learning	3	0	0	3
16	R23CSE-OE0016	DevOps	3	0	0	3
17	R23CSE-OE0017	Mobile Computing	3	0	0	3
18	R23CSE-OE0018	Java Full Stack Development	3	0	0	3
19	R23CSE-OE0019	Human Computer Interface	3	0	0	3
20	R23CSE-OE0020	Cryptography and Network Security	3	0	0	3
21	R23CSE-OE0021	Quantum Computing	3	0	0	3
22	R23CSE-OE0022	Big data Analytics	3	0	0	3
23	R23CSE-OE0023	Block Chain Technology	3	0	0	3
24	R23CSE-OE0024	Multimedia Application Development	3	0	0	3
25	R23CSE-OE0025	Mobile Adhoc Networks	3	0	0	3
26	R23CSS-OE0001	Operating Systems	3	0	0	3
27	R23CSS-OE0002	Redhat Linux	3	0	0	3
28	R23CSS-OE0003	Cloud Computing	3	0	0	3
29	R23CSS-OE0004	Distributed Operating System	3	0	0	3
30	R23CIT-OE0001	Basics of Computer Networks	3	0	0	3
31	R23CIT-OE0002	Cryptography and Network Security	3	0	0	3
32	R23CIT-OE0003	Mobile Computing	3	0	0	3
33	R23CIT-OE0004	Wireless sensor networks	3	0	0	3
34	R23CSM-OE0001	An Introduction to Artificial Intelligence	3	0	0	3
35	R23CSM-OE0002	Introduction to Machine Learning with Python	3	0	0	3
36	R23CSM-OE0003	Foundation of Deep Learning for Engineering Applications	3	0	0	3
37	R23CSM-OE0004	Natural Language Processing- Frontiers Approach	3	0	0	3

R23_B.Tech III-Year, I-Semester Syllabus

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PC3101	Power Electronics	3:0:0	3

Course Objectives:

- To study the characteristics of power semi conductor devices and the TURN ON and TURN OFF process of the switches.
- To study the process of converting fixed AC to variable DC using thyristor as a switch.
- To analyze the process for step down and step up the DC voltage.
- To study and analyze the operation of Single Phase and Three Phase voltage source inverter.
- To analyze the operation of AC-AC converters.

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

1. Analyze the characteristics of power semiconductor devices and the processes of Turn-on and Turn-off of semiconductor switches (L4)
2. Examine the controlled rectifier circuits with different Loads (L3)
3. Demonstrate DC-to-DC chopper circuits for different range of applications (L3)
4. Analyze AC-AC converters for diverse industrial and renewable energy applications (L4)
5. Demonstrate the operation of single and three phase voltage source inverters and control schemes (L3).

UNIT-I

Power Semiconductor Switching Devices

Silicon controlled rectifiers (SCR), Static and Dynamic characteristics of SCR; Gate characteristics of SCR; SCR Turn-on and Turn-off methods; Snubber Circuit, SCR Family; Firing circuits of SCR**;** Transistor Family: Power MOSFET, Power IGBT.

UNIT-II

Operation of Single-Phase and Three-Phase Controlled Rectifiers: Single-phase half-wave uncontrolled &controlled rectifier with R and RL loads; Single-phase full-wave controlled rectifiers: center tapped and Bridge configurations with R, RL and RLE load with and without freewheeling diode; Single phase semi controlled rectifier with R,RL and RLE load; Effect of source inductance in single phase fully controlled bridge rectifier with continuous conduction; Dual Converters; Three phase controller rectifiers-Three phase half wave and full wave-controlled rectifiers with Rand RL loads, Three phase semi-converter; Numerical Problems.

UNIT-III

DC-DC Choppers

Elementary chopper-Duty ratio-control strategies: time ratio control and current limit control- Analysis of Buck, Boost, and Buck-Boost converters in continuous and discontinuous conduction modes of operation-output voltage equations-inductor current and output voltage ripple-Critical inductance and capacitances-Numerical Problems.

UNIT-IV

AC Voltage Controllers and Cyclo Converters

Single-phase AC-AC regulator-phase angle control and integrated cycle control with R and RL load – For continuous and discontinuous conduction- 3-Phase AC-AC regulators with R-load only-single phase step up and step down cyclo-converter with R load.

UNIT-V

DC-AC Inverters

Single-phase voltage source inverter-single phase half bridge and full bridge inverters with R and RL load-Fourier Analysis of single-phase inverter output voltage-Three phase square wave inverters-120^0 conduction and 180^0 conduction modes of operation-PWM inverters-modulation index- Multi-level Inverter: Five Level Diode Clamped Inverter only; Numerical Problems.

Text Books:

1. Power Electronics–by P.S. Bhimbra, Khanna Publishing on January 1, 2022.
2. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, latest edition November 28, 2017, for some Indian editions.
3. N.Mohanand T.M.Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.

Reference Books:

1. R.W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics": 3rd Edition (2020)
2. Power Electronics: Essentials & Applications": 1st Edition (2009) L.Umanand.
3. Power Electronics: by M.D.Singh, K.B.Khanchandani, Tata McGraw - Hill Publications.

Web Resources:

1 https://swayam.gov.in/nd1_noc20_ee97/preview

2 https://nptel.ac.in/courses/108/105/108105066/

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

S. NO.	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	3	3	1	2	-	-	2	-	-	1	3	2
CO2	3	3	3	3	1	2	-	-	2	-	-	1	3	2
CO3	3	3	3	3	1	2	-	-	2	-	-	1	3	2
CO4	3	3	3	3	1	2	-	-	2	-	-	1	3	2
CO5	3	2	2	3	1	2	-	-	2	-	-	1	3	2
CO*	3	3	3	3	1	2	-	-	2	-	-	1	3	2

***** *For Entire Course vs. PO & PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R23EEE-PC3102	Analog and Digital Circuits	3:0:0	3

Course objectives:

- To explain the operation of different types of FET and analyze the response of nonlinear wave shaping circuits for different signals.
- To explain the operation of operational amplifier and its applications.
- To discuss different simplification methods for minimizing Boolean functions.
- To outline procedures for the analysis and design of combinational circuits.
- To outline procedures for the analysis and design of sequential logic circuits and different types of ADC and DACs.

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

1. Analyze the operation and characteristics of non-linear wave-shaping circuits and field-effect transistors. (L4)
2. Analyze the operation and characteristics of operational amplifiers and associated circuits. (L4)
3. Apply Boolean laws, k-map & Q-M methods to minimize switching functions (L3)
4. Design combinational circuits and Boolean functions using decoders and multiplexers. (L3)
5. Develop various synchronous and asynchronous sequential logic circuits using Flip-Flops and data converters (ADCs and DACs) (L3)

UNIT-I

Non- Linear Wave-Shaping Circuits: Diode Clippers, Clipping at two independent levels, Transfer Characteristics of Clippers, Clamping Circuits using diodes with different inputs, clamping circuit theorem.

Field Effect Transistors: Junction Field Effect Transistors, MOSFETs, Differences between JFETs and MOSFETs.

Applications: TV transmitter and receiver for processing picture signals, noise eliminations applications, and power supplies.

UNIT-II

Operational Amplifier: Basic information about op-amps – Ideal Operational Amplifier – General operational amplifier stages (Block Diagram), Parameters. Open and close loop Configurations, Schmitt triggers and oscillators.

Applications: Op-amps are used as amplifier, Op-amps used as voltage regulator current regulator

UNIT-III

Boolean Algebra: Boolean operations, Boolean functions, complements and dual of Boolean functions, min-terms and max-terms, sum-of-products and product-of-sum representations, NAND /NOR implementations.

Minimization of Boolean Functions: Karnaugh map, don't-care conditions, prime implicants, minimization of functions using Quine - McClusky method.

Applications: Boolean functions are used in designing Integrated circuits, Karnaugh maps are used for easy generation of error correcting codes.

UNIT-IV

Combinational Circuits: Binary parallel adder (Ripple Adders), Binary Adder-Subtractor,

Carry Look-Ahead Adder, Code Converters, Magnitude Comparator, BCD Adder, Decoders, & implementing Boolean functions using decoders, Encoders & Priority Encoders, Multiplexers, & implementing Boolean functions using multiplexers, De-Multiplexers

Applications

1. Combination logic is used in circuits to perform Boolean algebra on input signals and on stored data.
2. Combinational circuits are used in ALU's, data transmission, home alarm, car parking slot systems, multiple access techniques.

UNIT-V

Sequential Circuits: Introduction, Latches –RS latch and JK latch, Flip-flops-RS, JK, T and D flip flops, Master-slave flip-flops.

Registers and Counters: Registers, Shift registers, ripple counters, synchronous counters, Modulus-n Counter, Ring counter, Johnson counter, Up-Down counter.

Analysis and Design of Synchronous Sequential Circuits: Moore and Mealy machine models, State Equations, State Table, State diagram, State reduction & assignment, Design of State machines.

Analog to Digital and Digital to Analog Converters: Introduction, Different types of ADCs, Different types of DACs - DAC and ADC Specifications, sample and hold circuits.

Applications:

1. Flip flops are used in multi vibrators, triggering circuits, frequency divider circuits, data Storage and data transfer circuits.
2. Counters are used in Frequency counters, Digital clocks, Time measurement, A to D Converters, Digital triangular wave generator.
3. DACs can in Televisions and mobile phones to convert digital data to analog audio signal.
4. ADCs can used in microcontrollers, digital signal processing.

Textbooks:

1. M. Morris Mano and Michael D. Ciletti, Digital Design, 4th Edition, Pearson Education, 2013.
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education (India Private Limited), 4th edition, 2012.
3. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition,2003
4. J. Millman, C.C.Halkias, "Millman's Integrated Electronics", Tata McGraw-Hill, 2nd Edition, 2001

References:

1. Switching and Finite Automata Theory, Z. Kohavi, Tata McGraw Hill.
2. "Electron Devices and Circuits‖, S.K.Kataria & Sons", 2 nd Edition,2012. Salivahanan, N. Suresh Kumar,A. Vallavaraj
3. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.
4. John. M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
5. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma ; SK Kataria& Sons;2nd Edition,2010

Web Resources:

1. https://nptel.ac.in/courses/106/105/106105185

2. https://www.springer.com/gp/book/9780387285931
3. https://nptel.ac.in/courses/108/105/108105132

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

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
CO1	3	2	2	2	-	-	-	-	2	-	-	1	2	3
CO2	3	3	3	3	-	-	-	-	2	-	-	2	3	3
CO3	3	3	3	3	-	-	-	-	2	-	-	2	3	3
CO4	3	3	2	2	-	-	-	-	2	-	-	2	2	3
CO5	3	3	2	2	-	-	-	-	2	-	-	2	2	3
CO*	3	3	2	2	-	-	-	-	2	-	-	2	2	3

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R23EEE-PC3103	Power Systems-II	3:0:0	3

Course Objectives:

- To compute inductance/capacitance of transmission lines and to understand the concepts of GMD/GMR.
- To study the short, medium and long length transmission lines, their models and performance.
- To study the effect of travelling waves on transmission lines.
- To study the factors affecting the performance of transmission lines and power factor improvement methods.
- To discuss the Lightning phenomena and protection and study the performance of overhead insulators.

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

1. Compute the transmission line parameters (L3)
2. Estimate the performance of transmission lines (L4)
3. Analyze different types of transients in power systems (L4)
4. Analyze the various factors governing the performance of Transmission lines. (L4)
5. Understand the different types of insulators and analyze the lightning phenomena, protection(L4)

UNIT-I

Transmission Line Parameters

Conductor materials - Types of conductors – Calculation of resistance for solid conductors – Calculation of inductance for single phase and three phase– Single and double circuit lines– Concept of GMR and GMD–Symmetrical and asymmetrical conductor configuration with and without transposition–Bundled conductors–Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Capacitance calculations for symmetrical and asymmetrical single and three phase–Single and double circuit lines–Numerical Problems

UNIT – II

Performance of Short, Medium and Long Length Transmission Lines

Classification of Transmission Lines – Short, medium, long line and their model representations – Nominal-T–Nominal-Pie and A, B, C, D Constants for symmetrical and Asymmetrical Networks– Mathematical Solutions to estimate regulation and efficiency of all types of lines – Long Transmission Line–Rigorous Solution – Evaluation of A,B,C,D Constant. Power flow through transmission line, Equivalent circuits, and Power circle diagrams.

UNIT-III

Power System Transients

Types of System Transients – Wave Length and Velocity of Propagation of Waves-Travelling or Propagation of Surges – Attenuation–Distortion– Reflection and Refraction Coefficients – Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction– Lumped Reactive Junctions.

UNIT-IV

Various Factors governing the Performance of Transmission line

Skin and Proximity effects – Description and effect on Resistance of Solid Conductors – Ferranti effect – Charging Current –Shunt Compensation –Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss – Radio Interference.

UNIT – V

Overhead Line Insulators

Types of Insulators– String efficiency and Methods for its improvement– Voltage distribution Calculation of string efficiency–Capacitance grading and Static Shielding, Numerical Problems.Types of over voltages, Lightning phenomena and protection and Lightning arresters and surge absorbers

Text Books:

1. Electrical power systems, C.L.Wadhwa, New Age International (P) Limited, 6th Edition, 2010, Reprint 2014.
2. A Text Book on Power System Engineering, M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakrabarti, DhanpatRai& Co. Pvt. Ltd., 1999.

Reference Books:

1. Power System Engineering, D. P. Kothari and I. J. Nagrath, McGraw Hill Education (India) Pvt. Ltd., 2nd Edition, 2008, 23rd Reprint 2015.
2. Electric Power Transmission System Engineering: Analysis and Design, Turan Gonen, 2nd Edition, CRC Press, Taylor & Francis group, 2009, 1st Indian Reprint 2010.

Web Links:

1. https://nptel.ac.in/courses/108/102/108102047
2. https://nptel.ac.in/courses/108/105/108105058

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

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
CO1	3	3	3	1	-	-	1	-	-	-	-	2	3	3
CO2	3	3	2	1	-	-	1	-	-	-	-	2	3	3
CO3	3	3	2	1	-	-	1	-	-	-	-	2	3	3
CO4	3	3	1	1	-	-	1	-	-	-	-	2	2	3
CO5	3	3	2	1	-	-	1	-	-	-	-	2	3	3
CO*	3	3	2	1	-	-	1	-	-	-	-	2	3	3

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R23EEE-PE3101.1	Signals and Systems	3:0:0	3

Course Objectives:

1. Explain the basic properties of signals and systems and identify the systems based on their properties
2. Develop expertise in time domain and frequency domain approaches to the analysis of continuous and discrete systems through Fourier series and Fourier transform tools..
3. Development of the mathematical skills to solve problems involving convolution and correlation.
4. Apply the Laplace Transform as mathematical tool to convert time domain signals into s-domain signals.
5. Analyze DT systems & their realization using Z-transform.

Course Outcomes:

1. Analyze the signal characteristics, operations on signals, system properties, and Fourier series applications. (L4)
2. Apply Fourier transforms for spectral analysis and the sampling theorem for signal reconstruction. (L3)
3. Analyze linear time-invariant systems using convolution and correlation concepts. (L4)
4. Analyze continuous-time signals using Laplace transform to obtain their pole-zero plot with ROC and characterize LTI systems.(L3)
5. Analyze discrete-time signals using Z-transform to obtain their pole-zero plot with ROC and LTI system characterization.(L3)

UNIT-I: INTRODUCTION TO SIGNALS & SYSTEMS AND FOURIER SERIES: Definition of Signals and Systems, Classification of Signals, Basic continuous and discrete time signals (Exponential, Complex Exponential, Sinusoidal, impulse, step, signum, ramp, rectangular, triangular and sinc), basic operations on continuous and discrete time signals, Classification of Systems, Trigonometric Fourier series and Exponential Fourier series representation of continuous time periodic signals, Complex Fourier spectrum, Dirichlet's conditions, properties of Fourier series.

UNIT–II: FOURIER TRANSFORM AND SAMPLING THEOREM: Development of the Fourier transform representation of an aperiodic signal, Inverse Fourier transform, Fourier transform of standard signals, Fourier transforms involving impulse function and Signum function, Fourier transform of periodic signals, properties of Fourier transforms. Sampling theorem, signal reconstruction, aliasing, introduction to band pass sampling.

UNIT–III: ANALYSIS OF LINEAR TIME INVARIANT SYSTEMS: Linear system, Response of a linear system, linear time-invariant (LTI) system, linear time variant (LTV) system, impulse response, Transfer function of a LTI system. Properties of linear time-invariant systems, Filter characteristics of linear systems (Ideal LPF, HPF and BPF). Distortion less transmission through a system, Signal bandwidth, System bandwidth, Relationship between bandwidth and rise time. Cross-correlation and auto-correlation functions, properties of correlation function, Parseval's theorem, Energy and Power Spectral Densities, Relation between auto correlation function and energy/power spectral density function. Relationship between convolution and correlation.

UNIT-IV: LAPLACE TRANSFORMS :Review of Laplace transforms, Partial fraction expansion, Inverse Laplace transform, Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Relation between L.T's, and F.T. of a signal. Laplace transform of certain signals using waveform synthesis, Analysis and characterization of LTI systems using Laplace – transforms.

UNIT–V: Z–TRANSFORMS: Concept of Z- Transform of a discrete sequence. Distinction between Fourier and Z transforms. Region of convergence for the Z-Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z Transforms, Analysis and characterization of LTI systems using Z – transforms.

TEXT BOOKS:

1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edition.
3. Signals & Systems- Anand Kumar PHI 3rd Edition.

REFERENCE BOOKS:

1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition.
2. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015
3.Signals and Systems – K Raja Rajeswari, B VisweswaraRao, PHI, 2009.
4. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition,2008.
5. Signals and Systems – T K Rawat , Oxford University press, 2011.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

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
CO1	3	3	3	2	1	2	-	-	2	-	-	2	3	3
CO2	3	3	2	1	-	-	-	-	2	-	-	2	3	3
CO3	3	2	3	2	-	-	-	-	2	-	-	2	2	3
CO4	3	3	2	1	-	-	-	-	2	-	-	1	1	3
CO5	3	3	2	2	-	-	-	-	2	-	-	1	3	3
CO*	3	3	2	2	1	2	-	-	2	-	-	2	3	3

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3101.2	Digital Control Systems	3:0:0	3

Course Objectives:

- To understand the concepts of digital control systems.
- To apply the concepts of z–transformations.
- To apply the concepts of state–space analysis.
- To analyze the stability of the digital control systems.
- To analyze digital control systems in the w–plane and the design of state feedback Controller

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

1. Explain the concepts of digital control systems (L2).
2. Apply the concepts of z–transformations (L3)
3. Apply the concepts of state–space analysis (L3).
4. Analyze the stability of the digital control systems (L4).
5. Analyze digital control systems in the w–plane and the design of state feedback controller (L4).

UNIT-I

Signal Processing in Digital Control Systems: Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Sample and hold devices – Sampling theorem and data reconstruction – Frequency domain characteristics of zero order hold.

UNIT-II

Z–transformations: z–Transforms – Theorems – inverse z–transforms – difference equations– Block diagram representation – Pulse transfer functions of open loop and closed loop responses.

UNIT-III

State space analysis and the concepts of Controllability and observability: State space representation of digital control system – conversion of state variable models to transfer functions and vice versa – State transition matrix and methods of evaluation – solution of state difference equations – concepts of controllability and observability (without proof)

UNIT–IV

Stability Analysis of Discrete System: Mapping between the s–Plane and the z–Plane – Primary strips and Complementary strips – Stability criterion – Modified Routh's stability criterion and Jury's stability test.

UNIT-V

Design of discrete–time control systems by conventional methods and State feedback Controllers:

Transient and steady state specifications – Design using frequency response in the w–plane for lag and lead compensators, Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula.

Textbooks:

1. Discrete–Time Control systems – K. Ogata, Pearson Education, 2nd Edition, 2015.
2. Digital Control and State Variable Methods by M.Gopal, TMH, 4th Edition, 2017.

Reference Books:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2012.
2. Modern Control System Theory – by M. Gopal, New Age International Publishers, 5th edition, 2024.

Web Links:

1. https://howthingsfly.si.edu/flight-dynamics/roll-pitch-and-yaw
2. https://www.aircraftsystemstech.com/2017/05/autopilot-systems.html
3. https://en.wikiversity.org/wiki/Aircraft_piloting/Attitude_flying
4. https://archive.nptel.ac.in/courses/108/103/108103008/

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	1	1	-	-	-	-	2	-	-	3	3	3
CO2	3	3	1	1	-	-	-	-	2	-	-	3	3	3
CO3	3	3	1	1	-	-	-	-	2	-	-	3	3	3
CO4	3	3	1	1	-	-	-	-	2	-	-	3	3	3
CO5	3	3	1	1	-	-	-	-	2	-	-	3	3	3
CO*	3	3	1	1	-	-	-	-	2	-	-	3	3	3

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3101.3	Electrical Energy in Industrial Systems	3:0:0	3

Course Objectives:

- To learn the operating principles and characteristics of motors with respect to speed, temperature, loading conditions
- To study the laws of illumination and their applications for various lighting schemes.
- To explain the methods of electric heating and electric welding.
- To understand the basic principle of electric traction including speed–time curves of different traction services.
- To introduce various energy storage technologies including thermal, electrical, magnetic, mechanical, chemical, and electrochemical systems.

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

1. Describe the suitable motor for electric drives and their various industrial applications (L3).
2. Apply the concepts of illumination to Calculate the illumination levels required for various lighting schemes (L3).
3. Explain the appropriate heating and welding techniques for different applications (L2).
4. Apply the concepts of D.C, A.C traction systems, speed-time curves and the energy consumption of different services under various operating conditions (L3).
5. Analyze different energy storage systems and their suitability for specific energy applications based on performance and efficiency. (L3).

UNIT-I

Selection of Motors: Types of Electric drives, mechanical features of drives- various types of enclosures, name plate details of motor- duty cycle, types of bearings, drive-end non-drive end, load equalization, temperature rise, Applications of electric drives.

UNIT-II

Illumination: Definitions of various illumination terminologies, laws of illumination, polar curves, various types of lamps: incandescent lamp, sodium vapour lamp, fluorescent lamp, CFL and LED, various lightning schemes-Domestic and industrial lamp fitting, design and calculation of illumination, electronic ballast, numerical problems.

UNIT-III

Electric Heating & Electric Welding: Electrical heating: advantages, methods of electric heating ñ resistance, arc, induction and dielectric heating, methods of temperature control, design of heating element, applications of electric heating. Electric welding: types, resistance, electric arc, gas welding, ultrasonic, advantages & disadvantages of electric welding, applications of electric welding**.**

UNIT–IV

Electric Traction: Introduction, systems of electric traction, special features of traction motors, the locomotive, characteristics and control of locomotives, track electrification, DC

Equipment, AC Equipment, Electric Braking with DC Motors and AC Motors, Overhead Equipment, Speed-Time Curves of Different Services, Trapezoidal and Quadrilateral Speed-Time Curves, Mechanics of Train Movement, Calculations of Tractive Effort, Power, Specific Energy Consumption, Numerical Problems.

UNIT-V

Energy Storage Systems: Thermal Energy storage-sensible and latent heat, phase change materials, Energy and energy analysis of thermal energy storage, Electrical Energy storage-super-capacitors, Magnetic Energy storage Superconducting systems, Mechanical-Pumped hydro, flywheels and pressurized air energy storage, Chemical-Hydrogen production and storage, Principle of direct energy conversion using fuel cells, Types of fuel cells, Fuel cell performance, Electrochemical Energy Storage Battery, primary, secondary and flow batteries.

Textbooks:

1. E. Openshaw Taylor, Utilization of Electric Energy, Universities Press, Penram International Publishers, 2010
2. N.V. Suryanarayana, Utilization of Electrical power including Electric drives and Electric Traction, New Age Publishers, 2017.
3. Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer.

Reference Books:

1. H. Partab, Art & Science of Utilization of Electric Energy, Dhanpat Rai & Sons, 1998.
2. J. B Gupta, Utilization of Electric Power & Electric Traction S.K. Kataria & Sons, Reprint 2020, 10th Edition.
3. Generation, distribution and utilization of electrical energy, C.L Wadhwa, Wiley Eastern Limited.
4. Thermal energy storage: Systems and Applications by Dincer I. and Rosen M. A., Wileypub.
5. Fuel cell Fundamentals by R. O' Hayre, S. Cha, W. Colella and F. B. Prinz, Wiley Pub.

Web Links:

1 https://onlinecourses.nptel.ac.in/noc22_ee94/preview
2 https://archive.nptel.ac.in/courses/108/105/108105060/
3 https://archive.nptel.ac.in/courses/112/103/112103263/
4 https://archive.nptel.ac.in/courses/112/107/112107090/
5 https://onlinecourses.nptel.ac.in/noc23_ag06/preview

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	3	2	-	2	1	-	2	-	-	2	2	1
CO2	3	3	2	2	-	2	1	-	2	-	-	2	2	2
CO3	2	2	2	1	-	2	1	-	2	-	-	1	1	2
CO4	3	2	1	1	-	1	1	-	2	-	-	2	1	1
CO5	3	3	2	2	-	2	1	-	2	-	-	2	2	2
CO*	3	2	2	2	-	2	1	-	2	-	-	2	2	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3101.4	Special Electrical Machines	3:0:0	3

Course objectives:

- To describe the operation and characteristics of permanent magnet dc motor.
- To analyze the performance and control of stepper motors, and their applications.
- To explain theory of operation and control of switched reluctance motor.
- To explain operation and Torque Speed characteristics of different BLDC and PMSM Motors**.**
- To understand the theory of travelling magnetic field and applications of linear motors.

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

1. Develop electronically commutated dc motors and PMDC Motors (L3).
2. Analyze the performance and control of stepper motors, and their applications. (L2).
3. Explain the working and control strategies of switched reluctance motor (L2).
4. Explain the principle of operation of PMBLDC and PMSM motors (L2)
5. Understand the significance of LIM for traction drives and applications of Hysteresis motor (L2).

UNIT –I

Permanent magnet materials and PMDC motors:

Introduction-classification of permanent magnet materials used in electrical machines-minor Hysteresis loop and recoil line-Stator frames of conventional dc machines-Development of Electronically commutated dc motor from conventional dc motor-Permanent magnet materials and characteristics-B-H loop -PMDC motor construction-Principle of operation-torque equation-Equivalent circuit- Application of permanent magnets in motors-Torque Speed Characteristics of PMDC Motor

UNIT – II

Stepper Motors: Principle of operation of Stepper Motor – Constructional details - Classification of stepper motors-single stack and multi stack configurations – Different configuration for switching the phase windings - Control circuits for stepper motors – Open loop and closed loop control of two-phase hybrid stepping motor.

UNIT – III

Switched Reluctance Motors: Construction and Principle of operation of Switched Reluctance Motor – Comparison of conventional and switched reluctance motors – Design of stator and rotor pole arcs – Torque producing principle and torque expression – Drive and power circuits for SRM – Position sensing of rotor – Applications of SRM.

UNIT – IV

Permanent Magnet Brushless DC Motor: Principle of operation of BLDC motor - Types of constructions - Surface mounted and interior type permanent magnet DC Motors – Torque and EMF equations for square wave-construction-working of Sine wave PMBLDC Motor – Torque – Speed characteristics of square wave for PMBLDC Motor - Merits & demerits of square wave & Sine wave PMBLDC Motor – Applications.

UNIT –V

Other Special Electrical machines:

Construction– principle of operation–Double sided LIM from rotating type Induction Motor – Schematic of LIM drive for traction – Development of one sided LIM with back iron-Construction- principle of operation and characteristics of Hysteresis motor-Applications of Hysteresis motor

Textbooks:

1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller, 1989, Oxford.
2. Special Electrical Machines, K.Venkata Ratnam, University press, 2009, New Delhi.

Reference Books:

1. Special electrical machines, E.G. Janardhanan, PHI learning private limited, 2014,

Web links:

1. https://nptel.ac.in/courses/108102156

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	3	3	-	-	-	-	-	2	-	-	2	2	2
CO2	3	2	3	-	2	-	-	-	2	-	-	2	2	2
CO3	3	3	3	-	2	-	-	-	2	-	-	2	2	2
CO4	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO*	2	3	3	-	2	-	-	-	2	-	-	2	2	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PC3104	Power Electronics Lab	0:0:3	1.5

Course objectives:

- To study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- To analyze the performance of single–phase bridge converters with both resistive and inductive loads.
- To understand the operation of AC voltage regulator with resistive and inductive loads.
- To understand the working of Buck converter, Boost converter and inverters.
- To understand the operation of dual converter and cyclo-converter.

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

1. Discuss the characteristics of various power electronic devices (L2).
2. Analyze the performance of single–phase bridge converters, Dual Converters and Cyclo-converters (L4)
3. Understand the Buck converter and Boost converter (L2).
4. Design using MATLAB software tool, the three phase AC voltage regulator (L3).
5. Understand single–phase square wave inverter with PWM technique (L2)

Any 10 of the Following Experiments are to be conducted

1. Study of Characteristics of Power Thyristor, Power MOSFET & Power IGBT.
2. Design and Development of Thyristor Firing Circuits (R, RC, and UJT Triggering).
3. Single - Phase Half controlled converter with R and RL load.
4. Single -Phase fully controlled bridge converter with R and RL load.
6. Verification of voltages ripples in buck converter in CCM operation.
7. Analysis of DC-DC Boost converter in CCM operation.
8. Single -Phase AC Voltage Regulator with R and RL Load.
9. Three-phase AC Voltage Regulator with R Load
10. Single -Phase square wave bridge inverter with R and RL Load.
11. Single -phase PWM inverter with sine triangle PWM technique
12. Single Phase Dual Converter with R Load.
13. Single-Phase Cyclo-converter with R load.
14. Simulation of Buck-Boost Converter.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

SNO	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	2	-	2	2	2	3	2	1	2	3	2
CO2	3	3	2	2	-	2	2	2	3	2	1	2	3	2
CO3	3	3	2	2	-	2	2	2	3	2	1	2	3	2
CO4	3	3	2	2	-	2	2	2	3	2	1	2	3	2
CO5	3	3	2	2	-	2	2	2	3	2	1	2	3	2
CO*	3	3	2	2	-	2	2	2	3	2	1	2	3	2

***** *For Entire Course, PO & PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PC3105	Analog and Digital Circuits Lab	0:0:3	1.5

Course Objectives:

1. Demonstrate linear and non-linear wave-shaping circuits, including their response to square-wave inputs.
2. To provide hands-on experience in implementing data conversion circuits such as DACs using operational amplifiers.
3. To enable students to design and analyze basic combinational logic circuits including code converters, arithmetic units, and data selectors.
4. To develop an understanding of sequential logic components such as flip-flops, counters, and shift registers for digital system design.
5. To familiarize students with hardware description languages for implementing digital circuits using VHDL.

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

1. Sketch the response of linear and non-linear wave shaping circuits (L2)
2. Implement a 4-bit DAC using a 741 Op-Amp to understand digital-to-analog signal conversion (L3)
3. Design code conversion circuits, adders, subtractors, multiplexers, encoders, and decoders using logic gates (L4)
4. Design flip-flops, shift registers, ripple counters, and synchronous up/down counters (L4)
5. Implement digital circuits such as half adder, full adder, and 4:1 multiplexer using VHDL (L4)

List of Experiments

1. Non-Linear Wave Shaping Clippers
2. Non-Linear Wave Shaping Clampers
3. Active Filter Applications – LPF, HPF (first order)
4. Implement 4-bit DAC using 741 Op-Amp
5. Design and realization of Code conversion circuits- BCD to Excess-3 and vice-versa.
6. Design and verify the logic circuit of Half adder and subtractor using logic gates.
7. Design and verify the logic circuit of Full adder/ subtractor using two half adders.
8. Design and implementation of encoder and decoder designs.
9. Design and realization of 8x1 mux using two 4x1 mux.
10. Design and verification of 4-bit ripple counter and mod 10/mod 12 ripple counter.
11. Design and implementation of 3-bit synchronous up/down counter.

Additional Experiments:

12. VHDL implementation of half adder, full adder
13. VHDL implementation of 4:1 Multiplexer

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, Digital Design, 4th Edition, Pearson Education, 2013.
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education (India Private Limited), 4th edition, 2012.

REFERENCE BOOKS:

1. Wakerly J.F. "Digital Design: Principles and Practices," Pearson India, 2008, 4th Edition.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.
3. John. M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	-	-	-	2	2	-	1	3	1
CO2	3	3	2	2	2	-	-	-	2	2	-	2	3	1
CO3	3	3	2	2	2	-	-	-	2	2	-	2	3	1
CO4	3	3	2	2	2	-	-	-	2	2	-	2	3	1
CO5	3	2	2	2	2	-	-	-	2	2	-	2	3	1
CO*	3	3	2	2	2	-	-	-	2	2	-	2	3	1

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE-ES3101	Tinkering Lab	0:0:2	1

Course Objectives:

- To create the skill that is required to develop simple hobby projects using electronic components
- Students are exposed to the real-time learning experience which helps students to better understand programming languages.
- To design and develop applications using Arduino
- To develop applications using ESP32
- To develop skills to design prototype for any engineering application

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

1. Construct simple models and hobby circuits by soldering techniques.
2. Apply soldering skill to dismantle/rework simple electronic circuits.
3. Develop simple interfacing applications using Arduino
4. Develop simple interfacing applications using ESP32.
5. Develop skills of using hand tools to construct a prototype of an engineering design.

List of Experiments

1. Identify tools and consumables used for soldering and de-soldering of "through hole" PCBs – soldering iron of different wattage.
2. Apply soldering skills to join single and multi-strand wires. (use proper tinning and HS sleeve for insulation)
3. Construct hobby circuits using general purpose PCB (dot board). (Assemble any one simple hobby electronic circuit)
4. Design a wheeled robot kit (containing two geared DC motors, caster wheel, Arduino uno, motor driver shield, 9V battery and line sensor) to make line follower robot.
5. Develop a blue tooth module (HC 05 or HC 06) to switch relay connected to port using smart phone.
6. Design a project based on Soil Irrigation System
7. Design wheeled robot kit and blue tooth module to control robot using smart phone.
8. Design LCD shield and display your name and class number.
9. Implement suitable Do it Yourself (DIY) project from internet and implement using Arduino and compatibles. (Open ended experiment)
10. Implement suitable DIY project from internet using ESP32 (Open ended experiment)

TEXT BOOK:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.
2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015.

Web Resources:

1. https://www.arduino.cc
2. https://www.adafruit.com/
3. https://github.com/

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	-	-	-	2	2	-	1	3	1
CO2	3	3	2	2	2	-	-	-	2	2	-	2	3	1
CO3	3	3	2	2	2	-	-	-	2	2	-	2	3	1
CO4	3	3	2	2	2	-	-	-	2	2	-	2	3	1
CO5	3	2	2	2	2	-	-	-	2	2	-	2	3	1
CO*	3	3	2	2	2	-	-	-	2	2	-	2	3	1

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course code	Course Title	L	T	P	Credits
R23BSH-SC3101	English and Soft Skills for Job Seekers (Skill Oriented Course)	0	1	2	2

Course Objectives: Upon completion of this course, students will be able to:

- To develop proficiency in spoken and written English by effectively using a wide range of grammatical structures and vocabulary, and by mastering skills such as paraphrasing, report and résumé writing, and formal correspondence.
- Communicate fluently and confidently in English through active participation in informal group discussions and formal presentations, leveraging audio-visual aids.
- Understand and apply best practices for successful performance in job interviews, including visume (video resume) preparation.
- Develop essential self-learning, communication, and soft skills that enhance employability through group discussions, teamwork, and case-based tasks.
- To prepare students for international education by building competence in the admission process, application writing, interview skills, and awareness of visa, cultural, and financial aspects.

Course Outcomes:

1. Understand the grammatical forms of English and the use of these forms in specific communicative and professional writing.
2. Improve their speaking ability in English, both in terms of fluency and comprehensibility by participating in Group discussions and oral assignments CO3: master interview skills for effective preparation and confident performance in diversejob scenarios.
3. Demonstrate confidence and professionalism in job interviews and workplace interactions by effectively applying practiced soft skills.
4. Demonstrate readiness for Higher education by effectively navigating its admission process.

UnitI:

Grammar for Professional Writing: Initial Assessment Readiness Articles—Usage, context, and error correction, Prepositions—Functions and contextual use Tenses—Forms, purposes, and corrections, Subject-Verb Agreement (Concord)—Identification and Correction Voice—active and passive usage, conversions, Paraphrasing and Summarizing Techniques of paraphrasing,summarizingkeyideas,ReportWriting—Elementsofformalreports,format and organization, Clarity and coherence in expression, Resume and Visume Creation,

Types of resumes: Chronological, Functional, hybrid Customizing resumes for job applications, Planning and scripting visumes, Recording and reviewing visumes, LOR (Letterof Recommendation)- Purpose, structure, tone, and content, SOP (Statement of Purpose)- Academic/professional goal alignment, personal background, clarity, coherence,

Proof reading and Editing: Common writing errors, strategies for self-editing, peer editing, and collaborative revision.

Learning Outcomes : At the end of the module, the learners will be able to

- Apply appropriate grammar structures—including articles, prepositions, tenses, voice, and subject – verb agreement—in a variety of professional and

academic writing contexts.

- Paraphrase and summarise complex texts using accurate language and coherent structures.
- Prepare tailored resumes and visumes suited to specific job roles and presentation styles.
- Draft effective LORs and SOPs, and apply proofreading techniques and editing strategies to identify and correct common writing errors through self-assessment and peer feedback.

UnitII:

Preparing for Oral Assessment:

Group Discussions: Techniques, etiquette, turn-taking, activelistening,

Expressing Opinions: Polite agreement /disagreement, clarity in communication,

Oral Presentations: Structure (introduction, body, conclusion), use of transitions, logical flow,

Vocabulary Use: Selecting formal/ semi-formal expressions fo rinterviews, academic and professional discussions,

Clarity & Confidence: Voice modulation, articulation, managing speaking pace, reducing fillers,

Public Speaking: Planning and delivering one –minute speeches, engaging openings and impactful conclusions.

Learning Outcomes: By the end of this unit, learners will be able to:

- Demonstrate effective group discussion skills, including appropriate techniques, turn- taking, active listening, and polite expression of opinions.
- Express agreement and disagreement politely informal and semi-formal settings while maintaining clarity and professionalism in communication.
- Organise and deliver structured oral presentations using clear introductions, well- developed content, logical transitions, and strong conclusions.
- Select and use appropriate vocabulary suitable for academic discussions, professional interviews, and workplace communication.
- Plan and deliver short public speeches (e.g.,one-minutetalks) with engaging openings and impactful closing statements tailored to the audience.

UnitIII:

Mastering Interview Skills

Purpose of Interviews: Understand recruiter expectations, align personal goals, skills, and achievements.

Interview Preparation: Pre-interview research, behavior , and presentation. FAQs: Framing answers about self, family, strengths, and weaknesses.

Interview Dynamics: Understanding assessment areas and developing effective responses. **Types of Interviews:** Awareness of formats: one-on-one,panel, telephonic, video/virtual, group discussions, and walk-in interviews; differences between HR and technical interviews. **Mock Interviews and Role Plays:** Practising real-time interview scenarios, peer feed back, video recording for self- review, identifying areas of improvement in verbal and non-verbal communication.

Learning Outcomes : At the end of the module, the learners will be able to:

- Understand recruiter expectations and the interview process.
- Prepare and behave appropriately during interviews.
- Respond confidently to common personal and career- related questions.
- Improve interview skills through mock interviews and feedback.

UnitIV:

Employability through Soft Skills

Teamwork and Collaboration: Importance of teamwork in the workplace, Role-based team challenges and problem-solving tasks, Reflective journaling on team dynamics, Workplace Etiquette and Professionalism, Basics of workplace behavior and grooming, Punctuality, discipline, and digital etiquette,

Decision-Making and Conflict Resolution: Decision- making models and techniques, Conflict styles and resolution strategies,

Emotional Intelligence and Motivation: Self-awareness and empathy in the workplace, Identifying emotional triggers and responses, Time Management and Goal Setting: Prioritizing tasks using the Eisenhower Matrix, SMART goals (Specific, Measurable, Achievable, Relevant, Time-bound),

Adaptability and Flexibility: Managing change in the work place Developing resilience and growth mindset, networking, and building professional relationships.

Learning Outcomes: At the end of the module, the learners will be able to:

- Demonstrate effective teamwork and collaboration in professional settings.
- Exhibit professional behaviour, work place etiquette, and digital discipline.
- Apply decision-making techniques and resolve conflicts constructively.
- Build emotional intelligence, self-awareness, and motivation to perform in diverse work environments.
- Manage time effectively, set achievable goals, and adapt to change with resilience.

UnitV:

English for Abroad Education

Introduction to Studying Abroad: Overview of global education systems and Admission Process, Research and University Selection: How to research courses and universities, Creating an application calendar, Understanding course credits, intakes, andrankings,

Application Documents: SOP (Statement of Purpose): Structure, language, and sample writing ,LOR (Letters of Recommendation): Types, tone, and formatting, Admission and Visa Interview Skills Types of admission interviews (in-person,video), FAQs and model responses, Justifying candidature and demonstrating motivation,

Visa Process: Documentation, interview preparation,

English Proficiency and Entrance Tests: Overview of TOEFL, IELTS, GRE,GMAT,SAT, ACT, Preparation strategies and practice samples.

Learning Outcomes: By the end of the module, learners will be able to:

- Understand and plan the international university admission process.
- Research and shortlist suitable universities by evaluating courses, intakes, credits, and global rankings
- Prepare essential application documents such as SOPs ,LORs, and admission essays using appropriate academic language
- Demonstrate effective communication in admission and visa interviews by confidently responding to FAQs and justifying candidature
- Gain awareness of visa procedures, cultural expectations, financial planning, and student safety for successful transition to higher education.

III-Year, II-Semester Syllabus

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PC3201	Electrical Measurements and Instrumentation	3:0:0	3

Course Objectives:

- To study the principle of operation and working of different types of instruments, Measurement of voltage and current.
- To study the working principle of different types of instruments for measurement of power, energy.
- To understand the principle of operation and working of DC and AC Potentiometers
- To understand the principle of operation and working of various types of bridges for measurement of parameters –Resistance, Inductance and Capacitance.
- To learn various Transducers and Display devices.

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

1. Choose the right type of instrument for measurement of voltage and current for AC and DC (L1)
2. Explain the principle of operation and working of different types of instruments (L2)
3. Utilize the potentiometer for Calibrating ammeter, voltmeter, and wattmeter (L3)
4. Select suitable bridge for measurement of electrical parameters (L3)
5. Demonstrate the concepts of various transducers and measurement of electrical quantities using Digital meters (L2)

UNIT-I

Measuring Instruments: Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – classification of torques –deflection, controlling, damping torques – Moving coil (MC), Moving iron (MI), Electrodynamometer and Electrostatic – ammeter, voltmeter.

UNIT-II

Measurement of Electrical and Magnetic Quantities: Principle and operation – Single and three phase watt meters and energy meters – Ballistic galvanometer – Equation of motion – Flux meter – Determination of B-H curve and measurements of iron loss by using bridge method- Instrument transformers.

UNIT-III

Potentiometers

DC Potentiometers: Principle and operation of D.C. Crompton's potentiometer – Standardization– Measurement of unknown resistance, current and voltage- applications.

AC Potentiometers: Types of AC potentiometers –standardization – applications.

UNIT–IV

AC and DC Bridges

DC bridges: Sensitivity of Wheat stone's bridge – Carey Foster's bridge– Kelvin's double bridge for measuring low resistance- measurement of high resistance – Megger.

AC bridges: Measurement of inductance – Quality Factor – Maxwell's bridge–Hay's bridge – Anderson's bridge- Measurement of capacitance and loss angle – Desauty bridge –Schering bridge, numerical problems

UNIT-V

Transducers and Digital Meters: Concept and Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers.

Digital Meters: Digital Voltmeter–Successive approximation, ramp and integrating type - Digital frequency meter –Digital multimeter –Digital Tachometer. Measurement of phase difference – Frequency – Hysteresis loop using lissajious patterns in CRO.

Textbooks:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation' DhanpatRai and Co 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi, 2003.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007
4. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 200

Reference Books:

1. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.
2. A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.A.Nagoor kani, "Control Systems", RBA Publications, 2nd Edition, 2006.
3. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.Control systems – K.Alice mary, P.Ramana.
4. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

Web Links:

1. https://nptel.ac.in/courses/108101037
2. https://www.electrical4u.com/electrical-engineering-articles/measurement

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	2	2	-	2	-	-	2	-	-	2	2	3
CO2	3	3	2	2	-	2	-	-	2	-	-	2	2	3
CO3	3	3	2	2	-	1	-	-	1	-	-	2	3	2
CO4	3	3	2	2	-	2	-	-	2	-	-	1	2	3
CO5	3	2	1	1	-	1	-	-	1	-	-	2	2	3
CO*	3	3	2	2	-	2	-	-	2	-	-	2	2	3

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PC3202	Microprocessors and Microcontrollers	3:0:0	3

Course Objectives:
- To introduce fundamental architectural concepts of microprocessors and microcontrollers.
- To impart knowledge on addressing modes and instruction set of 8085 & 8086.
- To introduce assembly language programming concepts.
- To impart knowledge on addressing modes and instruction set of 8051
- To explain applications of microcontrollers.

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

1. Distinguish between microprocessors & microcontrollers (L4)
2. Develop assembly language programming Using assembler directives (L3)
3. Develop programming and interfacing of various peripheral devices to 8086 with support of ICs 8255, 8259, 8257 and 8251. (L3)
4. Utilize the architecture functions of 8051 with understanding of memory, parallel ports, serial ports, timers and interrupts for simple application programs. (L3)
5. Analyse the applications of microcontrollers in real-time systems by interfacing with peripheral devices. (L3)

Unit I

Introduction to 8085 Microprocessor: Basic microprocessor system-working, 8085 Microprocessor Architecture, register organization, Pin Diagram, Flag Register, Machine cycles and T states – Fetch and execute cycles- Timing diagram for instruction and data flow.

Unit II

8085 Microprocessor programming: Interrupts of 8085, instructions set of 8085 and addressing modes, Assembly language programmes (ALP) in 8085 microprocessor- Data handling/Data transfer, Arithmetic operations, Code conversion- BCD to Binary - Binary to BCD, Sorting - Ascending and descending including bubble sorting.

Unit III

8086 Microprocessors: Register Organization of 8086, Architecture, Pin Diagram, Memory segmentation, Minimum and Maximum modes of 8086, Addressing Modes, Instruction Set of 8086, Assembler Directives, Procedures and Macros, Programmable Peripheral Interface 8255, Programmable Interrupt Controller 8259, DMA Controller 8257, Programming.

Unit IV

Intel 8051 Microcontroller: 8051 Microcontroller Architecture, Comparison between microprocessor and microcontroller, Pin diagram, Memory organization, Addressing Modes, Instruction set, Programming and Applications of Timers, Interrupts.

Unit V

Applications of Microcontrollers: 7-Segment LED Display, LCD and Keyboard Interfacing, ADC, DAC interfacing, relay, Stepper Motor Interfacing, DC motor control, different Sensors and relevant application programs.

Text Books:

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Penram International Publishing, 2013
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition, McGraw Hill Education, 2017.
3. Microcontrollers and application, Ajay.V.Deshmukh, TMGH, 2005

Reference Books:

1. Microcontrollers and application, Ajay. V. Deshmukh, TMGH,2005.
2. D.V.Hall, Microprocessors and Interfacing, TMGH, 2nd Edition.

Web Links:

1 https://nptel.ac.in/courses/106/108/106108100/ - Microprocessors and Microcontrollers by Prof Krishna Kumar-IISc Bangalore - NPTEL

2 http://nptel.ac.in/courses/108107029/ -Microprocessors by Dr Pramod Agarwal – IIT Roorkee - NPTEL

3 https://nptel.ac.in/courses/108/103/108103157/ - Microprocessors and Interfacing by Prof Shaik Rafi ahamed- IIT Guwahati - NPTEL

4 https://nptel.ac.in/courses/108/105/108105102/ - Microprocessors and Microcontrollers by Prof Santanu Chattopadhyay – IIT Kharagpur - NPTEL

5 http://www.microdigitaled.com/index.htm - learning microprocessors and various book materials.

6 https://www.tutorialspoint.com/microprocessor/index.htm - general information on microprocessors.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	3	2	-	-	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	2	2	-	2	2	2
CO3	3	3	2	-	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	3	3	-	2	2	2
CO5	3	2	3	3	3	-	-	-	3	3	-	2	3	2
CO*	3	2	3	2	2	-	-	-	2	2	-	2	2	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PC3203	Power System Analysis	3:0:0	3

Course Objectives:

- To develop the impedance diagram (p.u) and formation of Y_{bus}
- To study the different load flow methods
- To study the concept of the Z_{bus} building algorithm
- To study the effects of symmetrical and unsymmetrical faults
- To study the rotor angle stability of power systems

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

1. Apply mathematical knowledge of per-unit quantities and Y-bus matrix formation to power system components (L3)
2. Analyze Gauss seidel method, Newton Raphson method, Decoupled and Fast decoupled methods to solve power problems in Power Systems (L4)
3. Apply Z_{bus} formulation for symmetrical fault analysis in power systems (L3)
4. Analyze the power system under different unsymmetrical fault conditions (L4)
5. Interpret stability concepts and various methods to enhance the stability of a power system (L2)

UNIT –I

Per Unit Representation & Topology: Per Unit Quantities–Single line diagram– Impedance diagram of a power system–Graph theory definition – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of Y–bus matrix by singular transformation and direct inspection methods.

UNIT – II

Power flow studies: Necessity of power flow studies – Derivation of static power flow equations – Power flow Solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar Coordinates form) –Decoupled and Fast Decoupled methods – Algorithmic approach –Problems on 3–bus system only.

UNIT – III

Z–Bus formulation & Symmetrical Fault analysis

Formation of Z–Bus**:** Partial network– Algorithm for the Modification of Z bus Matrix for the addition of branch and addition of link (Derivations and Numerical Problems)–Modification of Z–Bus for the changes in network (Problems).

Transients on a Transmission line-short circuit of synchronous machine (on no-load) - 3–Phase short circuit currents and reactance's of synchronous machine–Short circuit MVA Calculations -Series reactors – selection of reactors.

UNIT – IV

Un-Symmetrical Fault analysis: Definition of symmetrical components - symmetrical components of unbalanced three phase Systems – Power in symmetrical components – Sequence impedances – Synchronous Generator – Transmission line and transformers – Sequence networks –Various types of faults LG– LL– LLG and LLL on unloaded alternator–unsymmetrical faults on power system.

UNIT –V

Power System Stability Analysis: Elementary concepts of Steady state, Dynamic and Transient Stabilities– Description of Steady State Stability Power Limit–Transfer Reactance–Synchronizing Power Coefficient –Power Angle Curve and Determination of Steady State Stability –Derivation of Swing Equation–Determination of Transient Stability by Equal Area Criterion–Applications of Equal Area Criterion–Methods to improve steady state and transient stability.

Textbooks:

1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Modern Power system Analysis – by I.J.Nagrath & D.P.Kothari: Tata McGraw–Hill Publishing Company, 3rd edition.

Reference Books:

1. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc.
2. Power System Analysis by Hadi Saadat – TMH Edition.
3. Power System Analysis by B.R.Gupta, Wheeler Publications.
4. Power System Analysis and Design by J.Duncan Glover, M.S.Sarma, T.J.Overbye-Cengage Learning publications.

Weblinks:

1. https://nptel.ac.in/courses/108/105/108105067/
2. https://nptel.ac.in/courses/108/104/108104051/

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	2	1	1	-	-	2	-	-	1	1	2
CO2	3	3	3	3	1	2	-	-	2	-	-	2	2	2
CO3	3	3	2	3	1	2	-	-	2	-	-	1	2	2
CO4	3	3	3	3	1	2	-	-	2	-	-	2	2	2
CO5	3	3	2	3	1	2	-	-	2	-	-	2	2	2
CO*	3	3	3	3	1	2	-	-	2	-	-	2	2	2

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3201.1	Discrete Time Signal Processing	3:0:0	3

Course Objectives:

- To describe discrete time signals and systems.
- To teach importance of FFT algorithm for computation of Discrete Fourier Transform.
- To learn the basic design and structure of FIR Filters
- To familiarize the design procedure of IIR filters with desired frequency responses
- To outline need of Multi-rate Processing.

Course Outcomes:

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

1. Illustrate difference equations for the given discrete time systems (L2).
2. Apply FFT algorithms for determining the DFT of a given signal (L3).
3. Design a digital IIR filter for the given specifications (L3).
4. Design digital FIR filter from the given specifications (L3).
5. Understand the trade-off between normal and multi rate DSP techniques (L2).

UNIT-I

Discrete Time Signals, Systems and Discrete Fourier series:

Discrete time signals & sequences, Classification of Discrete time systems, stability of LTI systems, LTI system Properties. Discrete time systems described by difference equations, Convolution of Discrete Time Signals and sequences.

Discrete Fourier series: DFS Representation of periodic sequences and Properties of Discrete Fourier Series.

UNIT-II

Transforms:

Discrete Fourier Transform (DFT):

Definition and Properties of Discrete Fourier Transforms, Convolution of sequences using DFT.

Fast Fourier Transforms (FFT): Definition, Radix-2 decimation in time and decimation in frequency FFT Algorithms and Inverse FFT.

UNIT-III

IIR Digital Filters:

Structures of IIR –Discrete time IIR filter from analog filter using Butter worth and Chebyshev approximations. IIR filter design by Impulse Invariance and Bilinear transformation

Basic structures of IIR systems, Transposed forms.

UNIT-IV

FIR Digital Filters:

Characteristics of FIR Digital Filters, Frequency Response, Design of Linear phase FIR Digital Filters using Fourier series and Window Techniques, Comparison of IIR & FIR filters, Realization of FIR filters.

UNIT-V

Multi rate Digital Signal Processing: Introduction, down sampling, Decimation, up sampling, Interpolation, Sampling Rate Conversion, Applications of Multi Rate Signal Processing.

Text Books

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education, 2007.
2. A.V.Oppenheim and R.W. Schaffer, Discrete Time Signal Processing ,PHI.

References

1. Andreas Antoniou, Digital Signal Processing, TATA McGraw Hill, 2006
2. Robert J. Schilling, Sandra L. Harris, Fundamentals of Digital Signal Processing using Matlab, Thomson, 2007.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

COS	**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	3	2	-	-	-	-	-	-	-	-	1	2	2
CO 2	3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO 3	3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO 4	3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO 5	3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO *	**3**	**3**	**2**	**2**	-	-	-	-	-	-	-	**1**	**2**	**2**

***** *For Entire Course, PO & PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3201.2	Advanced Control Systems	3:0:0	3

Course Objectives:

- To explain the concept of controllability, observability and design of plant controller by using pole placement technique.
- To apply describing function and phase-plane methods to assess the behavior of nonlinear control systems.
- To analyze the stability of a system using Lyapunov's method.
- To formulate the optimal control problems including minimum time, energy, and fuel cases, and design continuous-time state regulators.
- To Compare the advanced control strategies such as adaptive control, fuzzy logic control, and neural network-based control for nonlinear systems.

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

1. Apply the concepts of Controllability, Observability and pole placement technique to design the various control systems (L3)
2. Analyze nonlinear systems using the describing function technique and phase plane analysis (L4)
3. Examine the stability of nonlinear systems using Lyapunov's method (L4).
4. Apply optimal control techniques to solve problems involving minimum time, energy, fuel, and design continuous-time regulators. (L3).
5. Apply the concepts of Fuzzy Logic control and Neural Networks to various nonlinear Systems (L3).

UNIT – I

Controllability, Observability and design of pole placement: Tests for controllability and observability for continuous time systems – Principle of duality – Effect of state feedback on controllability and observability – Design of state feedback control through pole placement.

UNIT – II

Describing function analysis

Introduction to nonlinear systems, Types of nonlinearities – Saturation, Friction, Backlash, Dead-Zone, Describing functions – Dead-zone and Saturation, Relay with Dead-zone and Hysteresis, Introduction to phase–plane analysis.

UNIT – III

Stability analysis

Lyapunov's stability and Lyapunov's instability theorems. Direct method of Lyapunov for the linear time invariant Systems, methods of constructing Lyapunov's functions for nonlinear systems.

UNIT–IV

Optimal control:

Formulation of optimal control problem. Minimum time, Minimum energy, minimum fuel problems. State regulator problem. Output regulator problem. Tracking problem, Continuous-Time Linear Regulators.

UNIT – V

Advances in control systems:

Overview of nonlinear controllers: Adaptive control, Fuzzy Logic control and Neural Network Controllers.

Textbooks:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996
2. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998

Reference Books:

1. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication.
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw– Hill Companies, 1997.
4. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.

Web Links:

1. https://nptel.ac.in/courses/108/107/108107115/
2. https://nptel.ac.in/courses/108/105/108105019
3. https://infinite.mit.edu/video/james-k--roberge--6-302-lecture-15
4. https://digimat.in/nptel/courses/video/108106164/L09.html
5. https://archive.nptel.ac.in/courses/115/108/115108104/

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

S.NO	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	2	1	1	1	-	2	-	-	1	2	3
CO2	3	3	2	2	1	2	2	-	2	-	-	2	2	2
CO3	3	3	2	2	1	1	1	-	2	-	-	1	2	1
CO4	3	3	2	2	1	2	2	-	2	-	-	2	2	2
CO5	3	3	2	2	2	2	2	-	2	-	-	2	2	-
CO*	3	3	2	2	1	2	2	-	2	-	-	2	2	2

** For Entire Course, PO & PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3201.3	HVDC & FACTS	3:0:0	3

Course Objectives:

- To study the HVDC Transmission system
- To analyze the control aspects of HVDC Systems
- To understand the fundamentals of FACTS Controllers
- To know the effect of static shunt and series compensators
- To explain the operation of Combined Controllers

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

1. Explain the significance of HVDC transmission systems (L2)
2. Examine the various control strategies adopted for HVDC systems (L4)
3. Explain the fundamental principles of FACTS, including their importance in modern power systems. (L2)
4. Analyze the operational principles and performance characteristics of static shunt compensators and series compensators(L4)
5. Analyze the principles and functionalities of combined compensators(L4)

UNIT – I

HVDC transmission: HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DC links, Layout of HVDC Converter station and various equipment's. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit representation of rectifier and inverter configurations

UNIT – II

Control of HVDC system: Principles of control, desired features of control, converter control characteristics, power reversal, Ignition angle control, current and extinction angle control. Harmonics introduction, generation, ac filters and dc filters. Reactive Power Requirements in steady state, sources of reactive power– shunt capacitors-synchronous condensers.

UNIT – III

Introduction to FACTS: Power flow in an AC System – Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high-power devices – Voltage and current rating – Losses and speed of switching – Parameter trade–off devices.

UNIT – IV

Static shunt and series compensators: Shunt compensation – objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators – SVC, STATCOM, SVC and STATCOM comparison. Series compensation – objectives of series compensation, thyristor switched series capacitors(TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes.

UNIT – V

Combined compensators: Unified power flow controller (UPFC) – Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC) - basic Operating Principles and Characteristics.

Text Books:

1. K.R.Padiyar, 'HVDC Power Transmission Systems: Technology and System Interactions' New Age International Publishers.
2. Hingorani, L.Gyugyi, 'Understanding FACTS', IEEE Press New York, 2000 ISBN – 078033 4588.
3. E.W. Kimbark, Direct current transmission, Vol. I, Wiley Interscience, New York, 1971.

Reference Books:

1. Jos Arrillaga, 'High voltage Direct Current Transmission' IET Power and Energy Series 29
2. S.Kamakshaiah and V.Kamaraju 'HVDC Transmission' Tata McGraw-Hill
3. Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London, 1999.
4. Mohan Mathur R. and Rajiv K.Varma , 'Thyristor – based FACTS controllers for Electrical Transmission systems', IEEE press, Wiley Inter science , 2002.

Web Links:

1. https://archive.nptel.ac.in/courses/108/107/108107114/
2. https://nptel.ac.in/courses/108104013

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	-	-	-	-	2	-	-	2	3	2
CO2	3	3	3	2	-	-	-	-	2	-	-	2	3	2
CO3	3	2	2	1	-	-	-	-	2	-	-	2	3	2
CO4	3	3	3	2	-	-	-	-	2	-	-	2	3	2
CO5	3	3	3	2	-	-	-	-	2	-	-	2	3	2
CO*	3	3	3	2	-	-	-	-	2	-	-	2	3	2

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3201.4	Electric Drives	3:0:0	3

Course Objectives:

- To analyze the characteristics of DC motors.
- To understand the process for speed control of DC motors by controlled converters.
- To analyze the process for speed control of DC motors in four quadrants.
- To analyze the Speed control of Induction Motor on stator side.
- To understand the speed control of Induction Motor on rotor side.

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

1. Analyze the performance characteristics of DC motors under diverse operating conditions to enhance their practical applications. (L3)
2. Classify the approaches for regulating the speed of DC motors using controlled converter systems. (L2)
3. Examine the process for speed control of DC motors in four quadrants.(L3)
4. Analyze the mechanisms for speed control of induction motors through stator-side techniques.(L3)
5. Analyze the mechanisms for speed control of induction motors through rotor-side techniques.(L3)

UNIT-I

Electric Drives:

Electric drive, Block diagram of electric drive, torque equations of DC machine, -Dynamic Torque equation and Load torque equation, torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, armature voltage control for varying motor speed, – Four quadrant operation of drive (hoist control) – Braking methods**:** Dynamic – Plugging – Regenerative methods.

UNIT-II

Controlled Converter Fed DC Motor Drives

1-phase half and fully controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics — Principle of operation of dual converters and dual converter fed DC motor drives -Numerical problems.

UNIT-III

DC–DC Converters Fed DC Motor Drives

Single quadrant – Two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous current operation– Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics –Four quadrant operation – Closed loop operation (qualitative treatment only).

UNIT-IV

Stator side control of 3-phase Induction motor Drive

Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop v/f control of induction motor drives (qualitative treatment only).

UNIT-V

Rotor side control of 3-phase Induction motor Drive

Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications. Introduction to control of synchronous motor drives: Closed Loop control operation of synchronous motor drives (qualitative treatment only)

Textbooks:

1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall,1989.
2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control" , PrenticeHall, 2001.

References Books:

1. G. K. Dubey, "Fundamentals of Electrical Drives", CRC Press,2002.
2. W. Leonhard,"ControlofElectricDrives",SpringerScience&BusinessMedia,2001.

Web Links:

1. http://sdeuoc.ac.in/sites/default/files/sde_videos/Electrical%20Drives%20and%20Controls_0.pdf
2. https://nptel.ac.in/courses/108/108/108108077/

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

S. No.	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	1	2	2	-	2	-	-	3	1	3
CO2	3	3	2	1	1	2	2	-	2	-	-	3	2	3
CO3	3	3	2	1	1	2	2	-	2	-	-	3	2	3
CO4	3	3	2	1	1	2	2	-	2	-	-	3	2	3
CO5	3	1	2	1	1	2	2	-	2	-	-	3	2	3
CO*	3	3	2	1	1	2	2	-	2	-	-	3	2	3

** For Entire Course, PO & PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3202.1	Digital IC Applications	3:0:0	3

Course Objectives:

- To be able to use computer – aided design tools for development of complex digital logic circuits
- To be able to model, simulate, verify, analyze , and synthesize with hardware description languages
- To be able to design and prototype with standard cell technology and programmable logic
- To be able to design tests for digital logic circuits, and design for testability

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

1. Understand the principles and methodologies of digital integrated circuits design.
2. Apply computer-aided design (CAD) tools for the development of complex digital logic circuits.
3. Model, simulate, verify, analyze, and synthesize digital systems using hardware description languages (HDLs).
4. Design and prototype digital systems using standard cell technology and programmable logic devices.
5. Interpret and evaluate digital system performance and functionality through practical implementation and testing

UNIT-I

CMOS Logic & Bipolar Logic And Interfacing:

CMOSLogic: Introduction to logic families, CMOS logic, CMOS steady state electrical behavior, CMOS dynamic electrical behavior, CMOS logic families.

Bipolar Logic And Interfacing: Bipolar logic, Transistor logic, TTL families, CMOS/TTL interfacing, low voltage CMOS logic and interfacing, Emitter coupled logic, Comparison of logic families, Familiarity with standard 74XX and CMOS 40XX series ICs – Specifications.

UNIT-II

VHDL Hardware Description Language: Design flow, program structure, types and constants, functions and procedures, libraries and packages.

The VHDL design elements: Structural design elements, behavioral design elements, time dimension and simulation synthesis.

UNIT-III

Combinational Logic Design : Decoders, encoders, three-state devices, multiplexers and demultiplexers**,** Code Converters, EX-OR gates and parity circuits**,** Comparators, adders & subtractors, ALUs, Combinational multipliers**,** VHDL models for the above ICs.

UNIT-IV

Design Examples (using VHDL): Barrel shifter, comparators, floating-point encoder, and dual parity encoder.

Sequential Logic Design: Latches & flip-flops, PLDs, counters, shift register and their VHDL models,Design process of FSM: Moore and Mealy machines and their VHDL models, Synchronous design methodology and its impediments.

UNIT-V

ROMs: Internal Structure, 2D–decoding commercial types, timing and applications.
Static RAMs: Internal Structure, timing and standard SRAMs, Synchronous SRAMs.
Dynamic RAMs: Internal Structure, timing and standard DRAMs, Synchronous DRAMs.

Textbooks:

1. John F. Wakerly, "Digital Design Principles & Practices" 3rd edition, PHI/ Pearson Education Asia, 2005.
2. J.Bhasker, "AVHDL Primer," 3rd Edition, Pearson Education/PHI

Reference Books:

1. Charles H. Roth Jr., "Digital System Design using VHDL," 2nd Edition, PWS Publications, 2008.
2. Stephen Borwn and Zvonko Vramesic, "Fundamentals of Digital Logic with VHDL Design," 2nd Edition, McGraw Hill, 2005.

Web Links:

1 https://onlinecourses.nptel.ac.in/noc25_ee44/preview
2 https://onlinecourses.nptel.ac.in/noc25_ee21/preview

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	-	-	3	3
CO2	2	2	3	2	3	-	-	-	-	1	-	1	3	3
CO3	2	3	3	2	3	-	-	-	-	1	-	1	3	3
CO4	2	1	3	2	3	-	-	-	-	1	-	1	3	3
CO5	2	2	3	3	2	-	-	-	-	1	-	-	3	3
CO*	2	2	3	2	3	-	-	-	-	1	-	1	3	3

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3202.2	Programmable Logic Controller	3:0:0	3

Course Objectives:

- Understand the fundamentals of PLC I/O modules and ladder diagrams for industrial control systems.
- Understand the function of PLC registers and programming instructions for industrial control system applications.
- Apply PLC functions in practical scenarios to address automation and control requirements in industry.
- Utilize data handling functions in PLC systems to solve practical problems in industrial automation.
- Apply analog operations and PID control modules to address industrial automation control and optimization tasks.

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

1. Explain the I/O modules of PLC systems and ladder diagrams used in control applications. (L2)
2. Explain various types of registers and programming instructions used in PLC systems. (L2)
3. Apply various types of PLC functions to solve industrial control and automation problems. (L3)
4. Implement different data handling functions and utilize them in industrial automation applications. (L3)
5. Apply analog operations and PID modules to solve control problems in industrial automation systems. (L3)

UNIT-I

Introduction to PLC systems: I/O modules and interfacing - CPU processor - programming Equipment - programming formats - construction of PLC ladder diagrams - Devices connected to I/O Modules. Digital logic gates - programming in the Boolean algebra system - conversion examples Ladder Diagrams for process control: Ladder diagrams & sequence listings - ladder diagram construction and flowchart for spray process system.

UNIT -II

PLC Programming: Input instructions - outputs - operational procedures - programming examples using contacts and coils. Drill press operation. PLC Registers: Characteristics of Registers - module addressing - holding registers - Input Registers - Output Registers.

UNIT-III

PLC Functions: Timer functions & Industrial applications - counters - counter function industrial applications - Arithmetic functions - Number comparison functions - number conversion functions.

UNIT-IV

Data Handling functions: SKIP - Master control Relay - Jump - Move - FIFO - FAL - ONS - CLR & Sweep functions and their applications. Bit Pattern and changing a bit shift register - sequence functions and applications - controlling of two-axis & three axis Robots with PLC - Matrix functions.

UNIT – V

Analog PLC operation: Analog modules & systems - Analog signal processing - Multi bit Data Processing - Analog output Application Examples - PID principles - position indicator with PID control - PID Modules - PID tuning - PID functions.

Textbooks:

1. Programmable logic controller by Frank D. Petrusella, Tata McGraw-Hill publication
2. Programmable Logic Controllers: Principles and Applications by John W. Webb and Ronald A. Reis, Prentice – Hall India publication, 5th edition

Reference Books:

1. Introduction to programmable logic controller by Gary dunning, Thomson Asia Pte Ltd. Publication, Singapore
2. Programmable Controller by T. A. Huges, ISA publication, 2nd edition
3. Programmable Logic Controllers by W. Bolton, Elsevier Newnes publication, 4th edition.

Web Links:

1. http://coep.vlab.co.in/?sub=33&brch=97
2. http://www.plcdev.com/book/export/html/9
3. http://www.plcmanual.com/
4. http://literature.rockwellautomation.com
5. http://www.automation.siemens.com
6. http://nptel.ac.in/video.php

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	-	2	-	-	1	2	3
CO2	3	3	2	2	-	-	2	-	2	-	-	2	2	3
CO3	3	3	2	3	-	-	2	-	2	-	-	2	2	3
CO4	3	3	3	3	-	-	2	-	2	-	-	2	3	3
CO5	3	3	3	3	-	-	2	-	2	-	-	2	3	3
CO*	3	3	2	3	-	-	2	-	2	-	-	2	3	3

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3202.3	Power Quality	3:0:0	3

Course Objectives:

- To understand the different Power quality issues and its standards.
- To understand the sources of sags, swells and interruptions and devices for voltage regulation
- To explain Categories and Characteristics of Electromagnetic Phenomena in Power Systems and principles of voltage regulation.
- To understand the sources of harmonics, harmonic indices and Devices for controlling harmonic distortion.
- To discuss Power quality monitoring considerations and its standards.

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

1. Identify the sources and effects of power quality problems. (L2)
2. Apply the concept of compensation for sags ,swells using Voltage regulating devices(L3)
3. Explain the principle of voltage regulation and power factor improvement methods. (L2)
4. Analyse voltage distortion, current distortion and their indices(L4)
5. Explain power quality measurement data according to standards. (L2)

UNIT I

Introduction

Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations - CBEMA and ITI Curves.

UNIT II

Voltage Imperfections in Power Systems

Power quality terms – Voltage sags – Voltage swells and interruptions – Sources of voltage sag, swell and interruptions – Nonlinear loads – IEEE and IEC standards. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.

UNIT III

Voltage Regulation and Power Factor Improvement

Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor improvement.

UNIT IV

Harmonic Distortion and Solutions

Voltage distortion vs. Current distortion – Harmonics vs. Transients – Harmonic indices – Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Numerical problems.

UNIT-V

Power Quality Enhancement: Harmonic filters: passive, Active and hybrid filters - Custom power devices: Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC -control strategies: P-Q theory, Synchronous detection method.

Text Books:

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.WayneBeaty, McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2012.
2. Power quality, C. Sankaran, CRC Press, 2001.

Reference Books:

1. Understanding Power quality problems – Voltage Sags and Interruptions, Math H. J. Bollen IEEE Press Series on Power Engineering, WILEY, 2007.
2. Power quality – VAR Compensation in Power Systems, R. SastryVedam, Mulukutla S. Sarma, CRC Press, 2009, First Indian Reprint 2013.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2012.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO. No.	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	1	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	2
CO4	3	3	-	2	2	-	-	-	-	-	-	-	2	2
CO5	3	1	-	2	3	2	-		-	-	-	1	1	1
CO*	3	2	-	2	2	2	-	-	-	-	-	1	1	1

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE3202.4	Switched Mode Power Conversion	3:0:0	3

Course Objectives:

- To impart foundational knowledge on the principles, classifications, and operating modes of DC-DC converters, emphasizing current and voltage mode control.
- To provide an in-depth understanding of resonant converters, their topologies, and associated control techniques for high-frequency power conversion.
- To develop analytical skills for modeling and deriving small-signal transfer functions of various DC-DC converter configurations.
- To enable students to design and analyze feedback control systems and implement suitable controllers for achieving desired performance in DC-DC converters.

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

1. Analyze the operation of DC-DC converters with current and voltage mode control (L3)
2. Analyze resonant converters and their control techniques (L3)
3. Demonstrate the transfer functions of various DC-DC converters (L2)
4. Design DC-DC converters and feedback loops (L3)
5. Design the controllers of DC-DC converters (L3)

UNIT-I

DC/DC Converters and Current Mode control:

Basic topologies of buck, boost converters, buck-boost converters and cuk converter, isolated DC/DC converter topologies: forward, and fly-back converters, half and full bridge topologies, modeling of switching converters. Voltage mode and current mode control of converters, peak and average current mode control, its advantages and limitations, voltage and current fed converters.

UNIT-II

Resonant Converters:

Need for resonant converters, types of resonant converters, methods of control, phase-modulation technique with ZVS in full-bridge topology, series resonant converter and resonant transition converter

UNIT-III

Converter Transfer Functions

Application of state-space averaging to switching converters, derivation of converter transfer functions for buck, boost and fly-back topologies.

UNIT-IV

Power Converter Design

Design of filter inductor & capacitor, and power transformer, Ratings for switching devices, current transformer for current sensing, design of drive circuits for switching devices, considerations for PCB layout.

UNIT-V

Controller Design

Introduction, mechanisms of loop stabilization, shaping E/A gain vs. frequency characteristic, conditional stability in feedback loops, stabilizing a continuous mode forward converter and discontinuous mode fly-back converter, feed-back loop stabilization with current mode control, the right-half plane zero.

Text Books:

1. Ned Mohan Tore M. Undeland: Power Electronics: Converters, Applications, and Design, John Wiley & Sons, 2007, 3rd Edition
2. Abraham I. Pressman, "Switching Power Supply Design", McGraw Hill International, 2009, 3rd Edition.

Reference Books:

1. P. C. Sen: Modern Power Electronics, S.Chand - 2005.
2. Krishna K Gupta and and Pallavee Bhatnagar, Multilevel Inverters: Conventional and Emerging Topologies and their Control, Elsevier Science, 5 December 2017.
3. Keng C. Wu, Switch-Mode Power Converters: Design and Analysis by,Elsevier Science, December 2005.

Weblinks:

1. https://www.youtube.com/watch?v=P0MK7sWfs9k&list=PLbMVogVj5nJRY--U9E7dvmqgB9RhGuymk
2. https://www.youtube.com/watch?v=kyQCOzC1CbY&list=PLbRMhDVUMngciqfzPF7bflm1rLcz4Kx3A
3. https://www.youtube.com/watch?v=KczK_vJ2Sa4&list=PLbRMhDVUMngdY3ABQsP29Ib0VLWkU4pgN
4. https://archive.nptel.ac.in/courses/108/108/108108036/
5. https://archive.nptel.ac.in/courses/108/105/108105180/

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO. No.	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	1	-	-	-	-	-	-	1	2	-
CO2	3	2	2	1	2	-	-	-	-	-	-	1	2	-
CO3	3	2	2	1	-	-	-	-	-	-	-	1	2	-
CO4	3	2	3	2	2	-	-	-	-	-	1	1	2	-
CO5	3	2	3	2	2	-	-	-	-	-	1	1	3	-
CO*	3	2	3	2	2	-	-	-	-	-	1	2	2	-

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PC3204	Electrical Measurements and Instrumentation Lab	0:0:3	1.5

Course Objectives:

- To determine the unknown inductance, resistance, capacitance using DC and AC Bridges.
- To analyze the calibration of various instruments.
- To understand the measurement of frequency and phase difference by using CRO
- To understand the measurement of various non-electrical parameters using transducers.
- To learn the testing of dielectric strength of transformer oil.

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

1. Apply suitable method for measuring R, L and C parameters in an electric network (L3).
2. Analyze the calibration of various instruments (L4)
3. Demonstrate the measurement of frequency and phase difference by using CRO (L2)
4. Analyze the measurement of various electrical and non-electrical parameters using appropriate measuring instruments (L4).
5. Analyze the testing of transformer oil (L4)

List of Experiments:

1. Measurement of Inductance using Anderson bridge.
2. Measurement of Capacitance using a Schering bridge.
3. Measurement of Low Resistance using Kelvin's double bridge.
4. Measurement of High resistance and Insulation resistance using Megger.
5. Calibration and testing of single-phase Energy meter.
6. Calibration of dynamometer wattmeter using phantom loading.
7. Calibration of Voltmeter and Ammeter by using DC Potentiometer.
8. Measurement of frequency and phase difference by using CRO.
9. Measurement of displacement with the help of LVDT.
10. Resistance strain gauge – strain measurement and Calibration

Additional experiments:

1. Measurement of pressure and weight using piezoelectric transducer
2. Dielectric oil testing using H.T test kit.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	1	2	-	2	2	2	3	2	1	2	3	-
CO2	3	3	2	2	-	2	2	2	3	2	1	2	3	-
CO3	3	3	2	2	-	2	2	2	3	2	1	2	3	-
CO4	3	3	2	2	-	2	2	2	3	2	1	2	3	-
CO5	3	3	1	2	-	1	2	2	2	2	1	2	3	-
CO*	3	3	2	2	-	2	2	2	3	2	1	2	3	-

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PC3205	Microprocessors & Microcontrollers Lab	0:0:3	1.5

Course Objectives:

- To impart the basic instructions of 8086 microprocessor for implementation of arithmetic, logical, BCD and ASCII operations.
- To demonstrate various instructions of 8086 for implementing different array-based operations.
- To explain the mechanism of DOS based interrupt handling services with demonstrated examples.
- To explain the process of interfacing 8086 microprocessor with peripheral control ICs like 8255 and 8259.
- To explain the procedure of interfacing 8051 microcontroller with timers, parallel and serial communication ports.
- To demonstrate the usage of 8051 as embedded controller with real world applications like calculator, LCD and hex keypad etc.

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

1. Utilize the knowledge of Assembly language and assembler directives for programming in 8086 and 8051 with focus towards their limited arithmetic operations. (L3)
2. Experiment with the knowledge of 8086 string operations towards different data structures operations. (L3)
3. Make use of DOS/BIOS services and Peripheral Control ICs to utilize different input and output functions of a 8086 based microcomputer system. (L3)
4. Utilize the 8051 features to produce Delay and Interrupt functions needed for embedded system design. (L3)
5. Model real world applications with peripherals interfacing 8051 microcontrollers. (L3)

List of Experiments:

1. Simple arithmetic operations using Trainer board ESA 86/88E.
2. Ascending and Descending Order using MASM software
3. Code Conversion (Eg. ASCII to Packed BCD and Packed BCD to ASCII form).
4. Addition of an array of N-BCD numbers stored in packed form using MASM software.
5. Finding the reverse of a string using MASM software.
6. Addition of two 3x3 Matrices using MASM software.
7. Read a string of characters from keyboard with Echo using MASM software.
8. BCD to Seven segment conversion using MASM software.
9. Interface a stepper motor to 8086 through 8255-ESA 86/88E Board.
10. Interfacing ESA Traffic light model to 8051 through 8255 using ESA 51E board-keil C51 Programming.
11. Develop an embedded C program to display the given string on LCD.

12. 8051 serial communication interfaces with PC.

Text Books:

1. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition, McGraw Hill Education, 2017.
2. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd edition, Pearson, 2012.

References:

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Penram International Publishing, 2013. 2. Kenneth J. Ayala, The 8051 Microcontroller, 3rd edition, Cengage Learning, 2004.
3. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide: Designing and Optimizing System Software, Elsevier, 2004.
4. John H. Davies, Newnes, MSP 430 Microcontroller Basics, Elsevier Pulications,2008.
5. Barry B.Brey, "The Intel Microprocessors: Architecture, Programming and Interfacing", PHI, 6th Edition.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO. No.	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	1	2	-	-	-	1	1	-	1	1	1
CO2	3	2	2	2	2	-	-	-	1	1	-	1	1	1
CO3	3	2	2	2	2	3	-	3	2	2	2	2	2	1
CO4	3	2	2	3	3	3	-	3	2	2	-	2	2	2
CO5	3	3	3	3	3	2	-	2	2	2	2	2	2	2
CO*	3	2	2	2	2	2	-	2	3	2	1	2	3	2

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–SC3201	IoT Applications of Electrical Engineering (Skill Oriented Course)	0:1:2	2

Course Objectives:

- To impart practical knowledge on IoT using microcontrollers like Arduino and Raspberry Pi.
- To develop skills in interfacing various sensors and actuators with microcontrollers for real-time applications.
- To enable students to design and implement IoT-based systems integrating hardware and software.
- To familiarize students with wireless communication technologies such as Bluetooth and Wi-Fi.
- To encourage innovation through open-ended projects in smart systems, automation, and healthcare applications.

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

1. Demonstrate the ability to set up and configure Arduino/Raspberry Pi and perform basic programming tasks.
2. Implement sensors (temperature, IR, LDR) and actuators (LED, buzzer, displays) with microcontrollers and write control programs.
3. Implement wireless communication between embedded systems and mobile devices using Bluetooth and Wi-Fi modules.
4. Develop real-time IoT applications such as smart irrigation and patient health monitoring using platforms like ESP32 and Blynk.
5. Design and prototype complete IoT-enabled systems in domains such as home automation, solar power and smart grids with open-ended problem-solving skills.

List of Experiments:

Any TEN of the following Experiments are to be conducted

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface temperature sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To Interface 7 Segment Display With Arduino/Raspberry Pi
6. To interface Organic Light Emitting Diode (OLED) with Arduino/Raspberry Pi
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when ‘1’/’0’ is received from smartphone using Bluetooth.
8. Arduino based smart irrigation system using ESP32 and Blynk App.
9. IoT-Enabled Smart Grid (DIY Project Open ended experiment)
10. IoT based Patient Health Monitoring System (DIY Project Open ended experiment)
11. IoT based Home Automation System (DIY Project Open ended experiment)
12. IoT-based Solar Power Monitoring System (DIY Project Open ended experiment)

TEXT BOOK:

1. Internet of Things By Rajkamal, Tata McGraw Hill publication
2. Internet of things(A-Hand-on-Approach) By Vijay Madisetti and ArshdeepBahga1st Edition, Universal Press
3. The Internet of Things: Connecting Objects By Hakima Chaouchi Wiley publication
4. The Internet of Things – Key applications and Protocols By Olivier Hersent, David Boswarthick, Omar Elloumi,, Wiley, 2012

Web Resources:

1. https://nptel.ac.in/courses/106105166
2. https://www.udemy.com/internet-of-things-iot-for-beginners-getting-started/
3. http://playground.arduino.cc/Projects/Ideas
4. http://www.megunolink.com/articles/arduino-garage-door-opener
5. http://www.willward1.com/arduino-wifi-tutorial
6. http://www.toptechboy.com/arduino-lessons
7. https://www.eprolabs.com
8. http://www.makeuseof.com/tag/pi-overdose-heres-5-raspberry-pi-alternatives

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	3	2	-	3	3	1
CO2	3	3	3	2	2	2	2	2	2	2	-	2	3	1
CO3	3	3	3	2	2	2	2	2	2	2	-	2	3	1
CO4	3	3	3	2	2	2	2	2	2	2	-	2	3	1
CO5	3	3	3	2	2	2	2	2	2	2	-	2	3	1
CO*	3	3	3	2	2	2	2	2	2	2	-	2	3	1

***** *For Entire Course, CO vs. PO-PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23EEE-MC3201	Entrepreneurship And Incubation (Mandatory Course)	2	0	0	0

Course Objectives:

- Outline an environment to inculcate entrepreneurial skills.(L2)
- Develop innovative products, services, processes and techniques.(L3)
- Plan to prepare financial proposals and start-ups.(L3)
- Analyse the ideas to collaborate entrepreneur skills in establishment of start-ups.(L4)
- Explain the financial resources existing in government and private sectors.(L2)

Course Outcomes:

1. Explain the knowledge of Entrepreneurial behavior and skill development.(L2)
2. Identify business ideas that have value in the end-market.(L2)
3. Develop the validity of idea and its unique selling proportion.(L3)
4. Comprehend opportunity and challenges of-start up (L3)
5. Analyze various Government and non-Government financial resources.(L2)

Unit I: Fundamentals of Entrepreneurship: Entrepreneurship-Concept, Importance, Characteristics –Myths and Traits of Entrepreneurship -Entrepreneurial Ecosystem– Manager Vs Entrepreneur-SocialandEthicalPerspectivesofEntrepreneurship-Women Entrepreneurship.

Application: Case lets: Business cases of young entrepreneurs.

Learning Outcomes: At the end of this unit students will be able to:

- Interpret the concepts of entrepreneurship and the characteristics of an entrepreneur.(L2)
- Explain the significance of entrepreneurship in the economic development of anation.(L2)

Unit II: Ideation and Evaluation of Business Ideas

Opportunity identification – Ideation process - Sources of business ideas – Role of creativity –Sources of Innovation –Technological Innovation and Entrepreneurship - Product/ Service design–Design Thinking-Entrepreneurs Eco-system-Networking

Caselets: Business cases of OYO.

Activity: Collection of novel business ideas.

Learning Outcomes: At the end of this unit students will be able to

- Choose the right business ideas.(L2)
- Evaluate the business idea. (L3)

Unit III: Feasibility Analysis and Business plan

Thrust areas of entrepreneurship- Techno-economic feasibility assessment-Financial feasibility

Market feasibility– Legal Feasibility, Environmental analysis and regulations.

Preparation of Business plan – Lean Startup Methodologies-Business canvas & Lean canvas.

Activity:

- Preparation of business plan (draft)
- Analysis on TEDx program Talks

Learning Outcomes: At the end of this unit students will be able to:

- Evaluate technical feasibility.(L3)
- Develop Business and Lean canvas. (L2)

Unit IV: Business Incubation and startups

Fundamentals of business incubation – Services of incubators - Start-ups-meaning, significance-startup strategy – Present scenario of startups. Role of startups in Indian economy-MSME- Idea Registration process-Pitching

Activity:

- Evaluating new start-ups in India
- Analysis on Shark Tank India program

Learning Outcomes: At the end of this unit students will be able to

- Describe the process of business incubation/incubators(L2)
- Select a suitable incubator and build a feasible business model.(L3)

Unit V: Financial resources

Sources of finance–Bootstrapping-Government Support– MSMEs-Crowd Funding– Venture Capitalists &Angel Investors - Schemes for women entrepreneurs

Activity: Identify different financial sources available for Funding

Learning Outcomes:

At the end of this unit students will be able to:

- Knowledge about various sources of finance for entrepreneurship. (L2)
- Analyze the opportunities Seed capital /Angel financiers and understand operation.(L2)

Text Books:

1. T.VRao, Donald F.Kuratko, Entrepreneurship, ASouth-AsianPerspective,CengageLearning,2012
2. DatsyDavies, IndianStartups,AmazonAsia-PacificHoldingsPrivateLimited,2016

Reference Books:

1. P.N.Rath, Sarjue Pandita, Entrepreneurship: Startup India & StandupIndia, Lexicon Publishing House, 2018
2. Madhurima Lall, Shikha Sahai, Entrepreneurship, Excel Books(P)Ltd.2008
3. RajeevRoy, Entrepreneurship, Oxford Higher Education.2011
4. H.Nandan, Fundamentals of Entrepreneurship, PHI Learning(P)Ltd,2013

Web Resources:

1. https://www.startupindia.gov.in
2. https://strategyzer.com/canvas/business-model-canvashttps://canvanizer.com/new/lean-canvashttps://msme.gov.in/
3. https://t-hub.co/http://www.apinnovationsociety.com/index.phphttps://aim.gov.in/atal-incubation-centres.phphttps://nptel.ac.in/courses/110/106/110106141/

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3;MEDIUM:2;LOW:1):

S NO	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	-	-	-	-	-	2	2	1	2	1	1	2	-	1
CO 2	-	-	-	-	-	1	1	1	1	1	1	2	-	1
CO 3	-	-	-	-	-	2	2	2	1	2	-	1	-	1
CO 4	-	-	-	-	-	1	1	2	1	1	2	1		1
CO 5	-	-	-	-	-	1	1	2	1	1	2	1	-	1
CO *	-	-	-	-	-	2	1	2	1	2	2	2	-	1

R23_EEE (Honors)

Track- I							
S. No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23EEE-HN2201	Electric Vehicle Technology and Mobility	3	0	0	3
2	III-I	R23EEE-HN3101	Modelling and Analysis of Electrical Machines	3	0	0	3
3	III-II	R23EEE-HN3201	Modeling and Analysis of Power Semiconductor Devices and Converters	3	0	0	3
4	IV-I	R23EEE-HN4101	Grid Interface of Electric Vehicles	3	0	0	3
5	II Year to IV Year	R23EEE-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23EEE-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track II (Networks)							
S. No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23EEE-HN2202	Embedded System Design	3	0	0	3
2	III-I	R23EEE-HN3102	VLSI Design Technology	3	0	0	3
3	III-II	R23EEE-HN3202	Industrial Electronics	3	0	0	3
4	IV-I	R23EEE-HN4102	Advanced Microcontroller based Systems	3	0	0	3
5	II Year to IV Year	R23EEE-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23EEE-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track-III							
S. No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23EEE-HN2203	Renewable Energy Systems & Sources	3	0	0	3
2	III-I	R23EEE-HN3103	Flexible AC Transmission Systems	3	0	0	3
3	III-II	R23EEE-HN3203	Advanced Power System Protection	3	0	0	3
4	IV-I	R23EEE-HN4103	Distributed Generation and Micro Grid	3	0	0	3
5	II Year to IV Year	R23EEE-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23EEE-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Honors Track offered by EEE

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–HN3101	Modelling and Analysis of Electrical Machines	3:0:0	3

Course Objectives:

- To establish unified theory of rotating machines.
- To understand the concept of phase transformation.
- To analyze different electrical machines for improved performance through modification of their characteristics.
- To develop concepts on mathematical modelling of electrical machines.
- To analyze the mathematical modelling of BLDC machine and switched reluctance machine

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

1. Understand the basics of Machine modelling (L2)
2. Analyze the mathematical modelling of DC machine (L4)
3. Apply mathematical modelling concepts to 3-phase Induction Machines (L3)
4. Develop the 3-phase Synchronous Machine modelling (L3)
5. Analyze the mathematical modelling of BLDC Machine and Switched Reluctance Machine (L4)

UNIT – I

Principles for electrical machine analysis and magnetically coupled circuits

Review of basic concepts, magnetizing inductance, Modelling linear and non-linear magnetic circuits, Inductance matrices of induction and synchronous machines.

UNIT – II

Modelling & Analysis of D.C Machine

Mathematical model of separately excited D.C motor – Steady State Analysis-Transient State Analysis, Transfer function of separately excited D.C Motor, Mathematical model of D.C Series motor, Shunt motor.

UNIT- III

Modelling & Analysis of Induction Machine

Linear transformation-Phase transformation - three phase to two phase transformation (abc to dq0) and two phase to three phase transformation (dq0 to abc), Mathematical modelling single phase induction machines. Stator reference frame model-Rotor reference frame model.

UNIT –IV

Modelling of Synchronous Machine

Synchronous machine inductances–voltage equations in the rotor's dq0 reference frame electromagnetic torque- current in terms of flux linkages.

UNIT –V

Modelling of Special Machines

Modelling of PM Synchronous motor, modelling of BLDC motor, modelling of Switched Reluctance motor.

Text Books:

1. Generalized theory of Electrical Machinery –P.S.Bimbra- Khanna Publishers.
2. Electric Motor Drives - Modelling, Analysis& control -R.Krishnan- Pearson Publications- 1st edition -2002.

Reference Books:

1. Analysis of Electrical Machinery and Drive systems – P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff – Second Edition-IEEE Press.
2. Dynamic simulation of Electric machinery using Matlab / Simulink –CheeMunOng- PHl.
3. Modern Power Electronics and AC Drives-B.K. Bose – PHI

Web Links:

1. https://archive.nptel.ac.in/courses/108/106/108106023/
2. https://archive.nptel.ac.in/courses/108/105/108105131/

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	3	-	-	-	-	2	-	-	2	3	3
CO2	3	3	3	3	2	-	-	-	2	-	-	2	3	3
CO3	3	3	3	3	2	-	-	-	2	-	-	2	3	3
CO4	3	3	3	3	2	-	-	-	2	-	-	2	3	3
CO5	3	3	3	3	2	-	-	-	2	-	-	2	3	3
CO*	3	3	3	3	2	-	-	-	2	-	-	2	3	3

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–HN3201	Modeling and Analysis of Power Semiconductor Devices and Converters	3:0:0	3

Course Objectives:

- To introduce the structure, characteristics, and switching behavior of power semiconductor devices.
- To model power semiconductor devices for simulation and analysis.
- To analyze the performance of various power electronic converters under steady-state and dynamic conditions.
- To design and evaluate converter topologies for specific power processing applications.

Course Outcomes:

1. Explain the physical structure, operating principles, and switching characteristics of power semiconductor devices. (L2)
2. Develop mathematical and simulation models for power semiconductor devices. (L3)
3. Analyze the operation and performance of various AC-DC, DC-DC, and DC-AC converters. (L3)
4. Evaluate the steady-state and dynamic behavior of converters using analytical and simulation tools. (L4)
5. Design converter circuits to meet application-specific requirements. (L3)

UNIT-I: Power Semiconductor Devices

Overview of modern power semiconductor devices, Characteristics and switching behavior of Power Diodes, BJTs, Power MOSFETs, IGBTs, and SCRs, Device ratings and protection, Switching losses and thermal modeling

UNIT-II: Modeling of Power Semiconductor Devices

Device modeling for circuit simulation (Piecewise linear, behavioral, and physics-based models), Modeling of conduction and switching losses, SPICE-based and MATLAB/Simulink modeling techniques

UNIT-III: Analysis of DC-DC Converters

Classification and principle of operation, Steady-state and dynamic analysis of Buck, Boost, Buck-Boost, and Cuk converters, Small signal modeling and transfer functions,
Continuous and discontinuous conduction modes.

UNIT-IV: Analysis of AC-DC and DC-AC Converters

Controlled rectifiers: single-phase and three-phase, Inverters: voltage source and current source, Sinusoidal PWM, space vector modulation, Harmonic analysis and filter design.

UNIT-V: Converter Modeling and Control

Averaged modeling and state-space representation of converters, Feedback control design for converters, Stability analysis and compensator design, Case studies using simulation tools.

Textbooks:

1. Mohan, Undeland, and Robbins, "Power Electronics: Converters, Applications, and Design," Wiley, Latest Edition.
2. Rashid M.H., "Power Electronics: Circuits, Devices, and Applications," Pearson Education, Latest Edition.
3. Bimal K. Bose, "Modern Power Electronics and AC Drives," Pearson Education.

Reference Books:

1. Ned Mohan, "Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB/Simulink," Wiley.
2. V.R. Moorthi, "Power Electronics: Devices, Circuits and Industrial Applications," Oxford University Press.
3. P.C. Sen, "Power Electronics," Tata McGraw Hill.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	1
CO2	2	3	2	-	2	-	-	-	-	-	-	1	2	-
CO3	3	3	3	2	2	-	-	-	-	-	-	1	2	1
CO4	3	3	3	3	2	-	-	-	-	-	-	1	2	-
CO5	2	3	3	2	3	-	-	-	-	-	-	1	2	-
CO*	3	3	3	2	2	-	-	-	-	-	-	1	2	1

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–HN3102	VLSI Design Technology	3:0:0	3

Course Objectives:

- To understand the Basic of VLSI, MOS and CMOS circuits and their process technology.
- To understand the Designing of MOS and BICMOS circuit design process.
- To learn the basic principle and concepts of dynamic CMOS circuits.
- To learn the concepts of Technology Scaling of MOS transistors.
- To understand the concepts of testing of combinational and sequential circuits and also the scan of design techniques.

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

1. Able to understand the fundamentals of CMOS VLSI and associated technologies.
2. Able to solve problems in the design of CMOS logic circuits, with particular reference to speed and power consumption. and
3. Implement to explain basic operation principles of Dynamic CMOS circuits.
4. Implement and design of scaling models and scaling function for device parameters
5. Analyze to design for testability and Testability

UNIT-I

Introduction to VLSI: VLSI design flow - Overview of VLSI design styles: Full custom, semi-custom, and programmable logic - Design hierarchy and abstraction levels-CMOS logic, basic MOS transistor theory - MOS as a switch, CMOS inverter characteristics - Moore's Law and scaling trends

UNIT-II

MOS and BICMOS circuit design process: CMOS logic circuits - MOS layers - stick diagrams - design rules to generate layout - 2 μm meter - 1.2 μm meter CMOS rules - Layout diagrams - Symbolic diagrams.

UNIT-III

Dynamic CMOS circuits: Basic Principles of pass transistor and transmission gate - CMOS Transmission-Gate and Pass-transistor logic circuits - Domino CMOS Logic - clocked CMOS - NOR CMOS Logic - Zipper CMOS circuits.

UNIT-IV

Scaling of MOS circuits: Scaling models-Scaling function for device parameters – Limitation of Scaling. Subsystem design process: Architectural issues – switch logic – examples of structural design (Combinational logic) design of ALU subsystem – commonly used storage elements – aspects of design rules.

UNIT-V

Test and Testability: Design for testability built in self test (BIST) – teaching combinational logic – testing sequential logic – practical design for test guide lines – scan design techniques.

Textbooks:

1. Basic VLSI design by Douglas A, Pucknell, Kamran Eshraghian, Prantice Hall, 1996 3rd edition.
2. Principles of CMOS vlsi design: A system Perspective..Neil H.E. weste and Kamran Eshraghian.
3. CMOS VLSI Design: A Circuits and Systems Perspective, 4e by Neil H.E. Weste and Harris.Automatic control system – B.C.Kuo , john wiley and son's 8th edition, 2003.

Reference Books:

1. Mead, C.A and Conway, L.A., Introduction to VLSI Systems, Wesley – Wesley.
2. Neil H.E. Weste and David Harris., CMOS VLSI Design: A Circuits and Systems Perspective.

Web Links:

1. https://nptel.ac.in/courses/117106092
2. https://onlinecourses.nptel.ac.in/noc21_ee09/preview
3. https://nptel.ac.in/domains/discipline/112?course=112_0

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	-	-	1	2	2
CO2	3	3	2	3	-	-	-	-	2	-	-	3	2	3
CO3	3	3	3	3	-	-	-	-	2	-	-	2	3	3
CO4	3	3	3	2	-	-	-	-	2	-	-	2	3	3
CO5	3	3	3	3	-	-	-	-	2	-	-	2	3	3
CO*	3	3	2	3	-	-	-	-	2	-	-	2	3	3

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–HN3202	Industrial Electronics	3:0:0	3

Course Objectives:

- To describe semi-conductor devices (such as PN junction diode & Transistor) and their switching characteristics.
- To equip students with a foundational understanding of the operational amplifier.
- To understand the characteristics of AC to DC converters.
- To enable students to comprehend the operation, characteristics, selection criteria, and integration of discrete and analog sensors in automation systems..
- To enable students to understand how different analog process control devices work.

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

1. Understand the semi-conductor devices and their switching characteristics. (L2)
2. Analyze basic operational amplifier circuits. (L4)
3. Analyze AC-to-DC power conversion, including various rectifier topologies and filtering circuits (L4)
4. Analyze appropriate electronic and non-contact sensors for specific automation tasks. (L4)
5. Analyze the working principles of process actuators and various analog sensors. (L4)

UNIT-I

Semiconductor Fundamentals and Basic Optoelectronic Devices: Scope of industrial Electronics, Semiconductors, Merits of semiconductors, crystalline structure, Intrinsic semiconductors, Extrinsic semiconductors, current flow in semiconductor, Open circuited p-n junction, Diode resistance, Zener diode, Photoconductors and junction photo diodes, Photo voltaic effect, Light emitting diodes(LED).

UNIT-II

Operational Amplifiers and Linear ICs: Introduction to the Op-Amp Parameters, Understanding Op-Amp Data Sheets, Inverting Amplifiers, Non-inverting amplifiers, Summing Amplifiers, Differential Amplifiers, Voltage –to-Current Converters, Integrators and Differentiators, Comparators and Detectors, Active Filter Circuits, Instrumentation Amplifiers

UNIT-III

Rectification, Filtering, and Voltage Regulation: AC to DC converters- Introduction, Classification of Rectifiers, Half wave Rectifiers, Full wave Rectifiers, Comparison of Half wave and full wave rectifiers, Bridge Rectifiers, Bridge Rectifier meter, Voltage multiplying Rectifier circuits, Capacitor filter, LC Filter, Metal Rectifiers, Regulated Power Supplies, Classification of Voltage Regulators, Accuracy of Voltage Regulator, Principle of automatic voltage Regulator, Simple D.C. Voltage stabilizer using Zener diode, D.C. Voltage Regulators, Series Voltage Regulators, Complete series voltage regulator circuit.

UNIT-IV

Discrete Automation Sensors and Devices: Introduction to Electronic Sensors, Non-contact Sensors, Sensor Output Interfaces, Analog Automation Sensors, Sensor Applications and Selection, Integrating Sensors into Power and Control Circuits.

UNIT-V

Analog Process Control Devices and Sensors: Process Actuators and Output Devices, Control Valves, Electrical Heating Elements, Control Sensors, Transmitters, and Transducers, Temperature Sensors, Pressure Sensors, Flow Sensors, Level Sensors, Position Sensors

TEXT BOOKS:

1. G. K. Mithal, .Industrial Electronics., Khanna Publishers, Delhi, 2000.
2. Industrial Automated Systems: Instrumentation and Motion Control by Terry L.M. Bartelt.
3. J.Gnanavadivel, R.Dhanasekaran, P.Maruthupandi, .Industrial Electronics.,Anuradha Publications, 2011.

REFERENCE BOOKS:

1. F. D. Petruzulla, .Industrial Electronics., McGraw Hill, Singapore, 1996.
2. M. H. Rashid, .power Electronics Circuits, Devices and Application., PHI, 3rdedition,2004.
3. G. M. Chute and R. D. Chute, Electronics in Industry, McGraw Hill Ltd,Tokyo, 1995.
4. Introduction to Instrumentation, Sensors and Process Control by William C. Dunn

Web Links:

1. https://www.geeksforgeeks.org/input-and-output-devices/
2. https://tii-tech.com/learning-systems/integrated-automation/analog-process-control-system/

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	3	2	1	2	-	-	1	-	2	2	1
CO2	3	3	3	3	3	1	1	-	-	2	-	2	2	1
CO3	3	3	3	3	3	2	3	-	-	2	-	3	2	1
CO4	3	3	3	3	2	2	2	-	-	2	3	3	2	1
CO5	3	3	2	3	2	2	2	-	-	2	1	3	2	1
CO*	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**2**	**1**	**3**	**2**	**1**

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–HN3103	Flexible AC Transmission Systems	3:0:0	3

Course Objectives:

- To understand the fundamentals of FACTS Controllers
- To understand the operation of voltage source converter and Current source converter
- To know the effect of static shunt compensators
- To know the effect of static series compensators
- To explain the operation of Combined Controllers

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

1. Explain the fundamental principles of FACTS, including their importance in modern power systems. (L2)
2. Explain the concept of voltage source converter and Current source converter (L2)
3. Analyze the operational principles and performance characteristics of shunt compensators (L4)
4. Analyze the operational principles and performance characteristics of series compensators(L4)
5. Analyze the principles and functionalities of combined compensators (L4)

UNIT – I

Introduction to FACTS: Power flow in an AC System – Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high power devices – Voltage and current rating – Losses and speed of switching – Parameter trade–off devices.

UNIT–II

Voltage source and Current source converters: Concept of voltage source converter(VSC) – Single phase bridge converter – Square–wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter– Three–phase current source converter – Comparison of current source converter with voltage source converter.

UNIT – III

Shunt Compensators: Objectives of shunt compensation – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping. Static VAR compensator (SVC) and Static Compensator(STATCOM)**:** The regulation and slope transfer function and dynamic performance – Transient stability enhancement and power oscillation damping– Operating point control.

UNIT – IV

Series Compensators: Static series compensators**:** Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements. GTO thyristor controlled Series Capacitor (GSC) – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC).

UNIT – V

Combined compensators: Unified power flow controller (UPFC) – Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC) - basic Operating Principles and Characteristics.

Text Books:

1. Hingorani, L.Gyugyi, 'Understanding FACTS', IEEE Press New York, 2000 ISBN – 078033 4588.
2. "Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London, 1999.

.

Reference Books:

1. "Flexible ac transmission system modeling and control" by Xiao-Ping Zhang,Christian Rehtanz,Bikash Pal, Springer.
2. Mohan Mathur R. and Rajiv K.Varma , 'Thyristor – based FACTS controllers for Electrical Transmission systems', IEEE press, Wiley Inter science , 2002.

Web Links:

1. https://archive.nptel.ac.in/courses/108/107/108107114/

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	3	2
CO2	3	3	3	-	-	-	-	-	2	-	-	2	3	2
CO3	3	2	2	-	-	-	-	-	2	-	-	2	3	2
CO4	3	3	3	-	-	-	-	-	2	-	-	2	3	2
CO5	3	3	3	-	-	-	-	-	2	-	-	2	3	2
CO*	3	3	3	-	-	-	-	-	2	-	-	2	3	2

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–HN3203	Advanced Power System Protection	3:0:0	3

Course Objectives:

- To know construction of static relays
- To understand the operation of amplitude and phase comparators
- To comprehend the concepts of Static over current, static differential and static distance relays.
- To understand multi-input comparators and concept of power swings on the distance relays.
- To know the operation of microprocessor based protective relays

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

1. Describe the construction of static relay and identify the advantages of static relay over electromagnetic relay
2. Analyse the importance of reliability in various fields.
3. Explore the operation of rectifier bridge comparators, instantaneous comparators, phase comparators, multi input comparators, static differential and distance relays
4. Describe instantaneous, definite time and inverse definite minimum time over current relays.
5. Analyze the concept of power swings on distance relays and to identify the microprocessor based protective relays and their operation

UNIT- I

STATIC RELAYS & COMPARATORS: Static relays - Basic construction of Static relays – Level detectors – Replica Impedance-Mixing circuits-General equation for two input phase and Amplitude Comparators – their types – Duality between Amplitude and Phase Comparator –Conic section characteristics–Three input Amplitude Comparator – Hybrid comparator – Switched distance schemes – Polyphase distance schemes-Phase faults scheme –Three phase scheme–Combined and Ground fault scheme.

Unit -II

TYPES OF STATIC RELAYS: Instantaneous over current relay – Time over current relays - Basic principles - Definite time and Inverse definite time over current relays, directional over current relays - Static Differential Relays-Analysis of static differential relays–Static relay schemes-Dual bias transformer differential protection – Harmonic restraint relay.

UNIT- III

NUMERICAL RELAYS: Advantages of Numerical Relays – Numerical network-Digital Signal processing–Estimation of Phasors – Full Cycle Fourier Algorithm – Half Cycle Fourier Algorithm- practical considerations for selection of Algorithm–Discrete Fourier Transform

Unit – IV

DISTANCE RELAYS AND POWER SWINGS: Static Distance Relays - Static Impedance - reactance - MHO and Angle Impedance relay sampling comparator – Realization of reactance and MHO relay using a sampling comparator.

Effect of power swings on the performance of Distance relays- Power swing analysis -

Principle of out of step tripping and blocking relays - Effect of line length and source impedance on distance relays.

UNIT-V

MICROPROCESSOR BASED PROTECTIVE RELAYS: Over current relays – Impedance relays – Directional relay – Reactance relay (Block diagram and flowchart approach only). Generalized mathematical expression for distance relays-Measurement of resistance and reactance – MHO and offset MHO relays – Realization of MHO characteristics – Realization of Offset MHO characteristics (Block diagram and flow chart approach only) - Basic principle of Digital computer relaying.

Textbooks:

1. T.S. Madhava Rao, Power system Protection static relay, Tata McGrawHill Publishing Company limited, 2nd Edition, 2004.
2. Badri Ram and D.N. Vishwakarma, Power system Protection and Switchgear, Tata McGraw Hill Publication Company limited, 2nd Edition, 2013.

References:

1. Bhavesh Bhalja, R. P. Maheshwari, N. G. Chothani, Protection and Switchgear, Oxford University Press, 2nd Edition, New Delhi, India, 2018.
2. Oza, B. A., N. C. Nair, R. P. Mehta, et al., Power System Protection & Switchgear, Tata McGraw Hill, New Delhi, 1st Edition, 2011.

Web Resources:

1. https://ieeexplore.ieee.org/book/5264125
2. https://onlinecourses.nptel.ac.in/noc21_ee110/preview

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH: 3; MEDIUM:2; LOW:1):

CO No.	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	-	-	1	2	3
CO2	3	3	3	3	-	-	-	-	2	-	-	2	3	3
CO3	3	3	3	3	-	-	-	-	2	-	-	2	3	3
CO4	3	3	2	2	-	-	-	-	2	-	-	2	2	3
CO5	3	3	2	2	-	-	-	-	2	-	-	2	2	3
CO*	3	3	2	2	-	-	-	-	2	-	-	2	2	3

***** *For Entire Course, CO vs. PO-PSO Mapping*

R23_Minors Degree offered by EEE

S. No	Year & Semester	Course Code	Subject Name	L:T:P	Credits
1	II-II	R23EEEMT-2201	Fundamentals of Special Electrical Machines	3:0:0	3
2	**III-I**	**R23EEE-MT3101**	**Fundamentals of Power Systems**	**3:0:0**	**3**
3	**III-II**	**R23EEE-MT-3201**	**Fundamentals of Electrical Measurements and Instrumentation**	**3:0:0**	**3**
4	**III-II**	**R23EEE-ML3202**	**Fundamentals of Electrical Measurements and Instrumentation Lab**	**0:0:3**	**1.5**
5	IV-I	R23EEE-MT4101	Fundamentals of Power Electronics	3:0:0	3
6	IV-I	R23EEE-ML4102	Fundamentals of Power Electronics Lab	0:0:3	1.5
7	II year to IV year	R23EEE-MM0001	Minors MOOCS-1	0:0:0	3
Total Credits					**18**

Minors Track offered by EEE

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–MT2201	Fundamentals of Special Electrical Machines	3:0:0	3

Course objectives:

- To describe the operation and characteristics of permanent magnet dc motor.
- To analyze the performance and control of stepper motors, and their applications.
- To explain theory of operation and control of switched reluctance motor.
- To explain operation and Torque Speed characteristics of different BLDC and PMSM Motors.
- To understand the significance of LIM and applications of linear motors.

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

1. Explain the principle and operation of PMDC Motors (L2).
2. Analyze the performance and control of stepper motors, and their applications. (L4).
3. Explain the working and power converters of switched reluctance motor (L2).
4. Analyze Torque Speed characteristics of different BLDC and PMSM Motors. (L4).
5. Understand the significance of LIM for traction drives and applications of Hysteresis motor (L2).

UNIT –I

Permanent magnet materials and PMDC motors:

Introduction-classification of permanent magnet materials used in electrical machines-minor Hysteresis loop and recoil line -B-H loop -PMDC motor construction-Principle of operation-torque equation-Equivalent circuit- Application of permanent magnets in motors-Torque Speed Characteristics of PMDC Motor

UNIT – II

Stepper Motors: Principle of operation of Stepper Motor – Constructional details - Classification of stepper motors-single stack and multi stack configurations - Control circuits for stepper motors – Open loop and closed loop control of two-phase hybrid stepping motor, Numerical Problems

UNIT – III

Switched Reluctance Motors: Construction and Principle of operation of Switched Reluctance Motor – Comparison of conventional and switched reluctance motors – Torque producing principle and torque expression – Drive and power circuits for SRM – Position sensing of rotor – Applications of SRM.

UNIT – IV

Permanent Magnet Brushless DC Motor: Principle of operation of BLDC motor - Types of constructions - Surface mounted and interior type permanent magnet DC Motors – Torque and EMF equations for square wave-construction-working of Sine wave PMBLDC Motor – Torque – Speed characteristics of square wave for PMBLDC Motor - Merits & demerits of

square wave & Sine wave PMBLDC Motor – Applications.

UNIT –V

Other Special Electrical machines:

Construction– principle of operation–Double sided LIM from rotating type Induction Motor – Schematic of LIM drive for traction - principle of operation and characteristics of Hysteresis motor-Applications of Hysteresis motor

Textbooks:

1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller, 1989, Oxford.
2. Special Electrical Machines, K.Venkata Ratnam, University press, 2009, New Delhi.

Reference Books:

1. Special electrical machines, E.G. Janardhanan, PHI learning private limited, 2014,

Web links:

1. https://nptel.ac.in/courses/108102156

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	3	3	-	-	-	-	-	2	-	-	2	2	2
CO2	3	2	3	-	2	-	-	-	2	-	-	2	2	2
CO3	3	3	3	-	2	-	-	-	2	-	-	2	2	2
CO4	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO*	2	3	3	-	2	-	-	-	2	-	-	2	2	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–MT3101	Fundamentals of Power Systems	3:0:0	3

Course Objectives:

- To study the principle and operation of conventional power generating stations
- To study the principle and operation of non-conventional power generating stations
- To introduce Mechanical design calculations of transmission lines and discuss the concepts of neutral grounding
- To classify distribution systems
- To study different types of load curves and tariffs applicable to consumers

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

1. Describe the operation of conventional power stations. (L2)
2. Describe the operation of non-conventional power stations. (L2)
3. Calculate sag of transmission line on equal and unequal heights of towers. (L3)
4. Analyze the various factors associated with power distribution. (L4)
5. Analyse different economic factors of power generation and tariffs. (L4)

UNIT-I

Generating Power Stations: Conventional Power Generating Stations: Block diagram of thermal power station (TPS), brief description of TPS components. Block diagram of hydro power station, Selection of site, description of main components, Nuclear fission and chain reaction, principle of operation of nuclear reactor, description of components.

UNIT-II

Non- Conventional Power Generating Stations: Principles of solar radiation, solar energy collectors. Role and potential of wind energy options, horizontal and vertical axis turbines-applications.

UNIT-III

Mechanical Design of Transmission lines: Sag and Tension Calculations with equal and unequal heights of towers, Effect of Wind and Ice on weight of Conductor - Stringing chart and sag template and its applications-Numerical Problems.

Neutral Grounding: Effectively grounded system, ungrounded system, Resonant Grounding, methods of neutral grounding, Generator neutral breaker, grounding Practice

UNIT-IV

General Aspects of Distribution Systems: Classification of distribution systems, design features of distribution systems, radial distribution, ring main distribution -AC distributors fed at one end and at both ends, comparison of DC and AC distribution -Kelvin's law-Limitations of Kelvin's law- Choice of scheme-Size of feeders, load modeling and characteristics-Numerical Problems-Applications.

UNIT-V

Economic Aspects & Tariff:

Economic Aspects – load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity factor and plant use factor, base and peak load plants.

Tariff Methods– Costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a tariff method, tariff methods: simple rate, flat rate, blockrate, two-part, three–part, and power factor tariff methods.

Textbooks:

1. Raja, A. K., Amit Prakash Srivastava, and Manish Dwivedi. Power plant engineering. New Age International, 2006.
2. Rajput, R. K. "Non-conventional Energy Sources and Utilization." S. K. Kataria & Sons, 2012.
3. Wadhwa, C. L. Electrical power systems. New Age International, 2006.
4. Mehta, V. K., and Rohit Mehta. Principles of Power System. S. Chand Publishing, 2005.

Reference Books:

1. Kothari, Dwarkadas Pralhaddas, and I. J. Nagrath. Power system engineering. New Delhi, India: Tata McGraw-Hill, 2008.
2. Grigsby, Leonard L. Electric power generation, transmission, and distribution. CRC press, 2007.
3. Singh, Sri N. Electric power generation: transmission and distribution. PHI Learning Pvt. Ltd., 2008.
4. Bansal, N. K. Non-conventional energy resources. Vikas Publishing House, 2014.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	1	-	-	2	-	1	-	-
CO2	3	1	-	-	-	1	2	-	-	2	-	2	-	-
CO3	3	2	1	-	1	1	1	-	-	1	-	1	-	1
CO4	3	3	2	1	2	2	2	1	1	2	2	2	1	1
CO5	2	3	2	2	2	2	2	1	1	2	3	2	-	1
CO*	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**1**

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–MT3201	Fundamentals of Electrical Measurements and Instrumentation	3:0:0	3

Course Objectives:

- To study the principle of operation and working of different types of instruments, Measurement of voltage and current.
- To study the working principle of different types of instruments for measurement of power, energy.
- To understand the principle of operation and working of DC and AC Potentiometers
- To understand the principle of operation and working of various types of bridges for measurement of parameters –Resistance, Inductance and Capacitance.
- To learn various Transducers and Display devices.

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

1. Choose the right type of instrument for measurement of voltage and current for AC and DC (L1)
2. Explain the principle of operation and working of different types of instruments (L2)
3. Utilize the potentiometer for Calibrating ammeter, voltmeter, and wattmeter (L3)
4. Select suitable bridge for measurement of electrical parameters (L3)
5. Demonstrate the concepts of various transducers and measurement of electrical quantities using Digital meters (L2)

UNIT-I

Measuring Instruments: Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – classification of torques –deflection, controlling, damping torques , Electrodynamometer and Electrostatic – ammeter, voltmeter.

UNIT-II

Measurement of Electrical and Magnetic Quantities: Principle and operation – Single and three phase watt meters and energy meters – Ballistic galvanometer – Equation of motion — Determination of B-H curve and measurements of iron loss by using bridge method.

UNIT-III

Potentiometers

DC Potentiometers: Principle and operation of D.C. Crompton's potentiometer – Standardization– Measurement of unknown resistance, current and voltage- applications.

AC Potentiometers: Types of AC potentiometers –standardization – applications.

UNIT–IV

AC and DC Bridges

DC bridges: Sensitivity of Wheat stone's bridge – Carey Foster's bridge– Kelvin's double bridge for measuring low resistance- measurement of high resistance – Megger.

AC bridges: Measurement of inductance – Quality Factor – Maxwell's bridge–Hay's bridge – Anderson's bridge- Measurement of capacitance and loss angle – Desauty bridge –Schering bridge, numerical problems

UNIT-V

Transducers and Digital Meters Transducers: Concept and Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers, LVDT – Piezoelectric Transuders

Digital Meters: Digital Voltmeter–Successive approximation, ramp and integrating type - Digital frequency meter–Digital multimeter–Digital Tachometer..

Textbooks:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation' DhanpatRai and Co 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi, 2003.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007
4. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 200

Reference Books:

1. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.
2. A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.A.Nagoor kani, "Control Systems", RBA Publications, 2nd Edition, 2006.
3. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.Control systems – K.Alice mary, P.Ramana.
4. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

Web Links:

1. https://nptel.ac.in/courses/108101037
2. https://www.electrical4u.com/electrical-engineering-articles/measurement

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	2	2	-	2	-	-	2	-	-	2	2	3
CO2	3	3	2	2	-	2	-	-	2	-	-	2	2	3
CO3	3	3	2	2	-	1	-	-	1	-	-	2	3	2
CO4	3	3	2	2	-	2	-	-	2	-	-	1	2	3
CO5	3	2	1	1	-	1	-	-	1	-	-	2	2	3
CO*	3	3	2	2	-	2	-	-	2	-	-	2	2	3

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–ML3202	Fundamentals of Electrical Measurements and Instrumentation Lab	0:0:3	1.5

Course Objectives:

- To determine the unknown inductance, resistance, capacitance using DC and AC Bridges
- To analyze the calibration of various instruments.
- To understand the measurement of frequency and phase difference by using CRO
- To understand the measurement of various non-electrical parameters using appropriate measuring instruments
- To understand the measurement of pressure and Weight using Transducers

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

1. Apply suitable method for measuring R, L and C parameters in an electric network(L3)
2. Analyze the calibration of various instruments (L4)
3. Demonstrate the measurement of frequency and phase difference by using CRO (L2)
4. Analyze the measurement of various electrical and non-electrical parameters using appropriate measuring instruments (L4)
5. Analyze the measurement of pressure and Weight using Transdusers (L4)

List of Experiments

1. Measurement of L using a bridge technique.
2. Measurement of C using a bridge technique.
3. Measurement of Low Resistance using Kelvin's double bridge.
4. Measurement of High resistance and Insulation resistance using Megger.
5. Calibration and testing of single-phase Energy meter.
6. Calibration of dynamometer wattmeter using phantom loading.
7. Calibration of Voltmeter and Ammeter by using DC Potentiometer.
8. Measurement of frequency and phase difference by using CRO.
9. Measurement of displacement with the help of LVDT.
10. Measurement of pressure and weight using piezoelectric transducer

Additional experiments:

1. Resistance strain gauge – strain measurement and Calibration

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	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	1	2	-	2	2	2	3	2	1	2	3	-
CO2	3	3	2	2	-	2	2	2	3	2	1	2	3	-
CO3	3	3	2	2	-	2	2	2	3	2	1	2	3	-
CO4	3	3	2	2	-	2	2	2	3	2	1	2	3	-
CO5	3	3	1	2	-	1	2	2	2	2	1	2	3	-
CO*	3	3	2	2	-	2	2	2	3	2	1	2	3	-

***** *For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–MT4101	Fundamentals of Power Electronics	3:0:0	3

Course Objectives:

- To understand the principles of power semiconductor devices and their switching characteristics.
- To analyze and design various power converters including rectifiers, choppers, and inverters.
- To study control techniques and modulation strategies in power electronics.
- To explore applications of power electronics in renewable energy systems and motor drives.

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

1. Explain the operation, characteristics, and protection methods of various power semiconductor devices.
2. Analyze and design controlled and uncontrolled rectifiers for different load types.
3. Design and evaluate the performance of DC-DC converters for practical applications.
4. Analyze inverter circuits and apply suitable modulation techniques for harmonic control.
5. Describe the role of power electronics in renewable energy integration and advanced applications like EVs and smart grids.

UNIT I: Power Semiconductor Devices

Overview of Power Electronics and Applications, Characteristics and Ratings of Power Devices: Diode, SCR, MOSFET, IGBT, Static and Dynamic characteristics of power devices

UNIT II: AC-DC Converters

Single-phase and Three-phase Uncontrolled Rectifiers with R load, Single-phase and Three-phase Controlled Rectifiers (half and full converters) with R load.

UNIT III: DC-DC Converters

Classification: Buck, Boost, Buck-Boost converters, Operation in Continuous conduction Modes, Control strategies

UNIT IV: DC-AC Converters

Single-phase half bridge and Full bridge Voltage Source Inverter (VSI) and Three-phase Voltage Source Inverter (VSI), Pulse width Modulation Techniques

UNIT V: AC-AC Converters

Single-phase half wave and full wave-controlled AC voltage controllers, Single phase step-up and step-down cyclo converters

Text Books:

1. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
2. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
3. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.

Reference Books:

1. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
2. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited,India, 2009

Web Resources:

1 https://nptel.ac.in/courses/108/105/108105066/

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

S. NO.	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	3	3	1	2	-	-	2	-	-	1	3	2
CO2	3	3	3	3	1	2	-	-	2	-	-	1	3	2
CO3	3	3	3	3	1	2	-	-	2	-	-	1	3	2
CO4	3	3	3	3	1	2	-	-	2	-	-	1	3	2
CO5	3	2	2	3	1	2	-	-	2	-	-	1	3	2
CO*	3	3	3	3	1	2	-	-	2	-	-	1	3	2

** For Entire Course vs. PO & PSO Mapping*

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–ML4102	Fundamentals of Power Electronics Lab	0:0:3	1.5

Course Objectives:

- To study the characteristics of various power electronic devices.
- To analyze the performance of single–phase bridge converters with both resistive and inductive loads.
- To understand the operation of AC voltage regulator with resistive loads.
- To understand the working of Buck and Boost converters.
- To understand the operation of Single phase voltage source inverters.

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

1. Discuss the characteristics of various power electronic devices (L2).
2. Analyse the performance of single–phase bridge converters (L3).
3. Analyse the output characteristics of Buck and Boost converters (L2).
4. Design the single-phase AC voltage regulator with Resistive loads (L3).
5. Understand single–phase square wave inverter with PWM technique (L2)

Any 10 of the Following Experiments are to be conducted

1. Study of Characteristics of Thyristor.
3. Study of Characteristics of Power MOSFET.
4. Study of Characteristics of Power IGBT.
5. Study of Single -Phase Half wave-controlled rectifier with R load.
6. Study of Single -Phase fully controlled bridge converter with R load.
7. Analysis of DC-DC Buck converters in CCM operation.
8. Analysis of DC-DC Boost converters in CCM operation.
9. Single-Phase Half Bridge VSI with R-load.
10. Single-Phase Full Bridge VSI with R load.
11. Single-Phase AC-AC voltage regulator with R-load.
12. Single -phase PWM inverter with sine triangle PWM technique.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

S. NO.	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	1	2	2	-	-	-	2	-	-	2	2	3
CO2	3	3	2	2	1	-	-	-	2	-	-	2	2	2
CO3	3	3	2	2	2	-	-	-	2	-	-	2	2	2
CO4	3	3	2	2	2	-	-	-	2	-	-	2	2	2
CO5	3	3	1	2	2	-	-	-	2	-	-	2	2	2
CO*	3	3	2	2	2	-	-	-	2	-	-	2	2	2

** For Entire Course vs. PO & PSO Mapping*

R23_Open Electives Courses for EEE

Offering Department: Electronics and Communications Engineering						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23ECE-OE0001	Basics of Communication Systems	3	0	0	3
2	R23ECE-OE0002	Micro Processors and Interfacing	3	0	0	3
3	R23ECE-OE0003	Digital System Design using Verilog	3	0	0	3
4	R23ECE-OE0004	Fundamentals of Digital Image Processing	3	0	0	3
5	R23ECE-OE0005	Introduction to Internet of Things	3	0	0	3
6	R23ECE-OE0006	Wireless Sensor Networks	3	0	0	3
7	R23ECE-OE0007	Satellite Communication	3	0	0	3
8	R23ECE-OE0008	Fundamentals of Embedded Systems	3	0	0	3

Offering Department: Mechanical Engineering						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23MEC-OE0001	Operations Research	3	0	0	3
2	R23MEC-OE0002	3D Printing Technology	3	0	0	3
3	R23MEC-OE0003	Statistical quality control	3	0	0	3
4	R23MEC-OE0004	Hybrid Vehicle Technologies	3	0	0	3
5	R23MEC-OE0005	Industrial Robotics	3	0	0	3
6	R23MEC-OE0006	Nano Materials	3	0	0	3
7	R23MEC-OE0007	AI and ML In Manufacturing	3	0	0	3
8	R23MEC-OE0008	Automation in Manufacturing	3	0	0	3

Offering Department: Computer Science and Engineering & Allied Branches						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23CSE-OE0001	Python Programming	3	0	0	3
2	R23CSE-OE0002	Data Structures Using C	3	0	0	3
3	R23CSE-OE0003	Operating System Concepts	3	0	0	3
4	R23CSE-OE0004	Introduction to Java Programming	3	0	0	3
5	R23CSE-OE0005	Database Management Systems Concepts	3	0	0	3
6	R23CSE-OE0006	Unix & Shell Programming	3	0	0	3
7	R23CSE-OE0007	Software Engineering	3	0	0	3
8	R23CSE-OE0008	Introduction to Data mining	3	0	0	3
9	R23CSE-OE0009	Fundamentals of Web Technologies	3	0	0	3
10	R23CSE-OE0010	Fundamentals of Computer Networks	3	0	0	3
11	R23CSE-OE0011	Basics of Cloud Computing	3	0	0	3
12	R23CSE-OE0012	Introduction to Machine Learning	3	0	0	3
13	R23CSE-OE0013	Essentials of Cyber Security	3	0	0	3
14	R23CSE-OE0014	Introduction to React JS	3	0	0	3
15	R23CSE-OE0015	Deep Learning	3	0	0	3
16	R23CSE-OE0016	DevOps	3	0	0	3
17	R23CSE-OE0017	Mobile Computing	3	0	0	3
18	R23CSE-OE0018	Java Full Stack Development	3	0	0	3
19	R23CSE-OE0019	Human Computer Interface	3	0	0	3
20	R23CSE-OE0020	Cryptography and Network Security	3	0	0	3
21	R23CSE-OE0021	Quantum Computing	3	0	0	3
22	R23CSE-OE0022	Big data Analytics	3	0	0	3
23	R23CSE-OE0023	Block Chain Technology	3	0	0	3
24	R23CSE-OE0024	Multimedia Application Development	3	0	0	3
25	R23CSE-OE0025	Mobile Adhoc Networks	3	0	0	3
26	R23CSS-OE0001	Operating Systems	3	0	0	3
27	R23CSS-OE0002	Redhat Linux	3	0	0	3
28	R23CSS-OE0003	Cloud Computing	3	0	0	3
29	R23CSS-OE0004	Distributed Operating System	3	0	0	3
30	R23CIT-OE0001	Basics of Computer Networks	3	0	0	3
31	R23CIT-OE0002	Cryptography and Network Security	3	0	0	3
32	R23CIT-OE0003	Mobile Computing	3	0	0	3
33	R23CIT-OE0004	Wireless sensor networks	3	0	0	3
34	R23CSM-OE0001	An Introduction to Artificial Intelligence	3	0	0	3
35	R23CSM-OE0002	Introduction to Machine Learning with Python	3	0	0	3
36	R23CSM-OE0003	Foundation of Deep Learning for Engineering Applications	3	0	0	3
37	R23CSM-OE0004	Natural Language Processing- Frontiers Approach	3	0	0	3

OPEN ELECTIVES

Course code	Course Title	L	T	P	Credits
R23ECE-OE0001	Basics of Communication Systems **(Open Elective)**	3	0	0	3

Course Objectives:

- Introduce the fundamental principles of analog and digital communication systems.
- Understand the representation and transmission of signals.
- Learn the basics of amplitude, frequency, and phase modulation techniques.
- Study noise performance in communication systems.
- Introduce multiplexing and multiple access techniques.

Course Outcomes:

1. Understand the fundamental elements of communication systems. (L2)
2. Explain various analog and digital modulation techniques. (L2)
3. Analyze the effect of noise on communication signals. (L4)
4. Understand bandwidth and power requirements in modulation schemes. (L2)
5. Describe basic multiplexing techniques and system applications. (L2)

UNIT – I

Introduction to Communication Systems: Basic block diagram of a communication system, types of communication (analog and digital), electromagnetic spectrum, frequency bands, and applications in daily life.

UNIT – II

Amplitude Modulation: Principles of amplitude modulation (AM), modulation index, power and bandwidth of AM, generation and detection of AM signals, DSB-SC and SSB modulation.

UNIT – III

Angle Modulation: Frequency modulation (FM) and phase modulation (PM), modulation index, bandwidth of FM (Carson's Rule), generation and demodulation techniques of FM signals.

UNIT – IV

Noise and Performance Analysis: Types of noise, noise figure, signal-to-noise ratio (SNR), effect of noise on AM and FM systems, pre-emphasis and de-emphasis.

UNIT – V

Multiplexing and Digital Communication Basics: Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), basic digital communication concepts (PCM, ASK, FSK, PSK), comparison of analog and digital systems.

Textbooks

1. Simon Haykin, Communication Systems, Wiley.
2. B.P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press.
3. Sanjay Sharma, Communication Systems, S.K. Kataria & Sons. (Indian Author)

Course code	Course Title	L	T	P	Credits
R23ECE-OE0002	Micro Processors and Interfacing **(Open Elective)**	3	0	0	3

Course Objectives: students are provided with

- 8085 8-bit architecture and register organization.
- 8086 architecture, memory segmentation & organization and features of minimum and maximum mode operations.
- Programming of 8086 in assembly language and tools.
- Interfacing memory and various peripheral control devices with 8086.

Course Outcomes: Student is able to

1. Outline the architecture and working diagram of 8085 microprocessors. **(L2)**
2. Interpret the 8086 functioning in minimum mode and maximum mode with its architecture, memory segmentation and organization. **(L2)**
3. Construct Assembly language program for 8086 using assembler directives, addressing modes and instruction set. **(L3)**
4. Develop Interface circuits with various peripheral control ICs for 8086 system. **(L3)**
5. Desing various memory interfacing Circuits with 8086 system.**(L3)**

UNIT 1

Introduction to 8085 Microprocessor: Basic microprocessor system-working, 8085 Microprocessor Architecture, register organization, Pin Diagram, Flag Register, Instruction Cycle, Timing Diagram, Interrupts of 8085.

UNIT 2

8086 Microprocessor: Evolution of Microprocessors, Register Organization of 8086, Architecture, Pin Diagram, Memory segmentation and organization, Stack implementation, Interrupt structure of 8086. minimum and maximum mode microprocessor system, Timing diagram and General Bus operation.

UNIT 3

8086 Programming: Addressing Modes, Instruction Set of 8086, Assembly Language Programming: Assembler Directives, Simple programs, Procedures and Macros Program.

UNIT 4

Data Transfer Schemes and Principle Interfacing: IO Interfacing: Programmable Peripheral Interface 8255 and its applications, Programmable Interrupt Controller 8259 with examples, Programmable Communication Interface 8251 USART, DMA Controller 8257, Programmable Keyboard and Display Interface 8279.

UNIT-5

Memory and IO Interfacing 8086: Address decoding techniques, Interfacing Static RAM and ROM chips, ADC and DAC Interfacing.

Text Books:

1. Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Ramesh S Gaonkar, Penram International Publishing, 2013
2. Advanced Microprocessors and Peripherals, 3e, K M Bhurchandi, A K Ray, McGraw Hill Education, 2017.

References:

1. The Intel Microprocessors: Architecture, Programming and Interfacing, Barry B.Brey, PHI, 6th Edition.
2. Microprocessors and Interfacing, 2e, Douglas.V.Hall, Tata McGrawhill.

Course code	Course Title	L	T	P	Credits
R23ECE-OE0003	Digital System Design using Verilog **(Open Elective)**	3	0	0	3

Course Objectives:

- To introduce the basics and programming fundamentals of Verilog HDL
- To describe the primitive instances of gates and explain the various modeling constructs of Verilog.
- To familiarize various behavioral modeling constructs of Verilog essential for designing digital circuits.
- To Design and implement various combinational logic circuits in Verilog HDL
- To Design and implement various sequential logic circuits in Verilog HDL.

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Understand the fundamentals of Digital System Design flow using Verilog HDL. (L2)
2. Construct logic circuits with the concept of Gate Level and Dataflow modelling (L3)
3. Construct logic circuits with the concept of Behavioral modelling. (L3)
4. Make use of Verilog programming to design Combinational digital circuits. (L3)
5. Develop synthesizable Verilog codes for sequential digital circuits. (L3)

UNIT-I

Introduction to Verilog HDL: Introduction, Verilog as HDL, Basic elements: Keywords, Identifiers, Comments, Tasks and functions, Numbers, Strings, Logic Values, Data Types, Scalars and Vectors, Parameters, Operands and Operators. Simulation and Synthesis Tools.

UNIT-II

Gate Level Modeling: Introduction, Module Structure, Different Gate Primitives, Array of Instances of Primitives, Illustrative Examples,

Data Flow Modeling: Introduction, Continuous Assignment Structure, Delays, and Assignment to Vectors, Operators and different Examples.

UNIT-III

Behavioral Modeling: Blocking and Non-Blocking Assignments, Simulation Flow : if and if-else constructs, case statement, Assign-De-Assign construct, different loop constructs, Examples

UNIT IV

Design of combinational circuits Elements using HDL models: Logic gates, Half Adders, Full Adders, Subtractors, Decoders, Encoders, Multiplexers, and De-multiplexers & Comparators,

UNIT-V

Design of Sequential circuits Elements using HDL models: RS, D, T, JK Latches & Flip Flops, Registers and Counters.

Text Books

1. T.R Padmanabhan, B.Bala Tripura Sundari Design through Verilog HDL, Wiley India Publications, 2009
2. J.Bhaskar, A Verilog HDL Primer, BS Publications, 3rd Edition.

Reference Books

1. Verilog HDL – Samir Palnitkar, 2nd Edition, Pearson Education, 2009
2. John F.Wakerly , Digital Design, Pearson, 4th Edition.
3. Zainalabdien Navabi, Verilog Digital System Design, TMH, 2nd Edition.

Course code	Course Title	L	T	P	Credits
R23ECE-OE0004	Fundamentals of Digital Image Processing **(Open Elective)**	3	0	0	3

Course Objectives:

- Introduce the basic concepts and techniques of digital image processing.
- Understand image acquisition, sampling, and quantization processes.
- Study image enhancement and filtering techniques in spatial and frequency domains.
- Explore image segmentation and representation techniques.
- Learn the basics of morphological processing and image compression.

Course Outcomes:

1. Understand image formation, sampling, and quantization techniques. (L2)
2. Apply spatial and frequency domain enhancement methods. (L3)
3. Analyze filtering and edge detection techniques. (L4)
4. Understand image segmentation and morphological operations. (L2)
5. Identify compression techniques and their applications. (L2)

UNIT – I

Introduction and Image Fundamentals: Definition of digital image, image sensing and acquisition, image sampling and quantization, basic relationships between pixels, color image fundamentals, and image file formats.

UNIT – II

Image Enhancement in Spatial Domain: Intensity transformations, histogram processing, spatial filtering, smoothing and sharpening filters, and contrast enhancement techniques.

UNIT – III

Image Enhancement in Frequency Domain: Fourier Transform, frequency domain filtering, low-pass and high-pass filters, homomorphic filtering, and enhancement using Discrete Cosine Transform (DCT).

UNIT – IV

Image Segmentation and Morphology: Edge detection using gradient operators, thresholding techniques, region-based segmentation, morphological operations like dilation, erosion, opening, and closing.

UNIT – V

Image Compression and Representation: Lossless and lossy compression techniques, run-length coding, Huffman coding, JPEG, wavelet-based compression, and basics of image representation and description.

Textbooks:

1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, Pearson.
2. Anil K. Jain, Fundamentals of Digital Image Processing, PHI Learning. (Indian Author)
3. S. Jayaraman, S. Esakkirajan, and T. Veerakumar, Digital Image Processing, McGraw-Hill. (Indian Author)

Course code	Course Title	L	T	P	Credits
R23ECE-OE0005	Introduction to Internet of Things **(Open Elective)**	3	0	0	3

Course Objectives:

- To Understand the Architectural Overview of IoT and layers involved in Architecture.
- To Understand Real World Design Constraints of IOT and Various Protocols.
- To familiarize the students to the basics of Internet of things and protocols.
- To expose the students to some of the hardware and Software applications areas where Internet of Things can be applied.

Course Outcomes:

The students should be able to:

1. Understand the architecture of IoT systems, including the components and their roles.(L2)
2. Interface various electronic components, including LEDs, push buttons, buzzers, and LCD displays, with the Arduino board.(L3).
3. Establish remote access to the Raspberry Pi for control and management.(L3)
4. Apply knowledge to develop basic IoT applications using the ESP8266.(L3)

Understand the fundamentals of virtualization and cloud computing architecture.(L2)

UNIT - I

Introduction to IOT: Understanding IoT fundamentals, IOT Architecture and protocols, Various Platforms for IoT, Real time Examples of IoT , Overview of IoT components and IoT Communication Technologies ,Challenges in IOT.

UNIT - II

Arduino Simulation Environment: Arduino Uno Architecture, Setup the IDE, Writing Arduino Software, Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED, push button and buzzer with Arduino, Interfacing Arduino with LCD. Sensor & Actuators with Arduino

UNIT - III

Raspberry Pi Programming: Installing and Configuring the Raspberry Pi, Getting Started with the Raspberry Pi,Using the Pi as a Media Centre, Productivity Machine and Web Server, Remote access to the Raspberry Pi. Preparing Raspberry Pi for IoT Projects.

UNIT - IV

Basic Networking with ESP8266 WiFi module : Basics of Wireless Networking, Introduction to ESP8266 Wi-Fi Module ,Various Wi-Fi library , Web serverintroduction, installation, configuration ,Posting sensor(s) data to web server .IoT Protocols ,M2M vs. IOT Communication Protocols.

UNIT - V

Cloud Platforms for IOT : Virtualization concepts and Cloud Architecture , Cloud computing, benefits ,Cloud services -- SaaS, PaaS, IaaS , Cloud providers & offerings ,Study of IOT Cloud platforms , ThingSpeak API and MQTT , interfacing ESP8266 with Web services

Text Books:

1. Simon Monk, Programming Arduino: Getting Started with Sketches, Second Edition McGraw- Hill Education
2. Peter Waher,Learning Internet of Things,Packt publishing.
3. OvidiuVermesan,PeterFriess, IoT-From Research and Innovation to Market deployment, River Publishers

Reference Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2. Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM – MUMBAI
3. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer.

Course code	Course Title	L	T	P	Credits
R23ECE-OE0006	Wireless Sensor Networks **(Open Elective)**	3	0	0	3

Course Objectives:

- Emphasize the basic WSN technology and sensor node architecture with its unique constraints and challenges in design of WSN for different applications.
- Summarize the transceiver design and network technologies used in wireless sensor and networks.
- Explains various key MAC protocols for sensor networks with their merits and demerits.
- Provide knowledge of different routing protocols with their advantages.
- Create awareness on transport layer protocols, security considerations, sensor network platforms and tools with a brief study of different WSN applications.

Course Outcomes:

1. Illustrate the wireless sensor node architectures.
2. Outline the physical layer design.
3. Inspect MAC protocols of wireless sensor and networks.
4. Inference various network layer routing protocols of wireless sensors.
5. Summarize the network security requirements.

UNIT-I

Overview of Wireless Sensor Networks: Key definitions of sensor networks, advantages of sensor networks, unique constraints and challenges, driving application, enabling technologies for wireless sensor networks.

Architectures:

Single-node architecture - hardware components, energy consumption of sensor nodes, operating system and execution environments, network architecture- sensor network scenarios, optimization goals and figures of merit, gateway concepts.

UNIT - II

Networking Technologies: Physical layer and transceiver design consideration, personal area networks (PANs), hidden node and exposed node problem, topologies of PANs, MANETs, and WANETs.

UNIT - III

MAC Protocols for Wireless Sensor Networks: issues in designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention -Based Protocols, contention - based protocols with reservation mechanism, contention - based MAC protocols with scheduling Mechanisms, MAC protocols that use directional antennas, others MAC protocols.

UNIT - IV

Routing Protocols: introduction, issues in designing a routing protocols for Ad Hoc Wireless Networks, classification of routing protocols, table- driven routing protocols, On-Demand routing protocols, Hybrid routing protocols, routing protocols with efficient flooding mechanisms, hierarchical routing protocols, power- aware routing protocols, proactive routing.

UNIT-V

Transport Layer and Security Protocols: Introduction, issues in designing a transport layer protocol for Ad Hoc wireless networks, design goals of a transport layer protocol for Ad Hoc wireless networks, Security in Ad Hoc wireless networks, network security requirements, issues and challenges in security provisioning, network security attacks, key management, secure routing in Ad Hoc wireless Networks.

Sensor Network Platforms and Tools:

Sensor node hardware - Berkeley motes, programming challenges, node- level software platforms, node-level simulators, state - centric programming.

Textbooks

1. Ad Hoc wireless networks: Architectures and protocols - C.Siva Ram Murthy and B.S.Manoj, 2004, PHI.
2. Wireless Ad - Hoc and Sensor Networks: Protocols, Performance and Control - Jagannathan Sarangapani, CRC Press.
3. Holger Karl & Andreas Willig, Protocol and Architectures for Wireless Sensor Networks, John Wiley, 2005.

References

1. Kazem Sohraby, Daniel Minoli, & Taieb Zanti, "Wireless Sensor Networks - Technology, Protocols and Applications", John Wiley, 2007.
2. Feng Zhao & Leonidas J.Guibas, “Wireless Sensor Networks - An Information Processing Approach", Elsevier, 2007.
3. Ad Hoc Mobile Wireless Networks: Protocols & Systems, C.K.Toh, 1ed, Pearson Education.
4. Wireless Sensor Networks - C.S.Raghavendra, Krishna M.Sivalingam, 2004, Springer.
5. Wireless Sensor Networks - S Anandamurugan, Lakshmi Publications

Course code	Course Title	L	T	P	Credits
R23ECE-OE0007	Satellite Communication **(Open Elective)**	3	0	0	3

Course Objectives:

- Introduce the basic concepts and architecture of satellite communication systems.
- Understand satellite orbits, launch methods, and positioning techniques.
- Study satellite subsystems including transponders and antennas.
- Learn about satellite link design and signal propagation.
- Explore multiple access techniques and satellite applications.

Course Outcomes:

1. Understand satellite system architecture and functions. (L2)
2. Analyze orbital mechanics and satellite positioning. (L4)
3. Understand the design and working of satellite subsystems. (L2)
4. Analyze satellite link budgets and signal propagation. (L4)
5. Understand access techniques and applications in communication systems. (L2)

UNIT – I

Overview of Satellite Communications: Introduction to satellite communication, advantages and limitations, types of satellites, satellite applications in communication, broadcasting, navigation, and remote sensing.

UNIT – II

Orbital Mechanics and Launchin: Kepler's laws, orbital elements, types of satellite orbits (LEO, MEO, GEO), look angle determination, eclipse effects, and satellite launching methods.

UNIT – III

Satellite Subsystems: Space segment and ground segment, transponders, antenna systems, telemetry, tracking and command (TT&C), and power systems.

UNIT – IV

Satellite Link Design and Propagation: Link power budget, system noise temperature, C/N ratio, G/T ratio, propagation effects such as rain attenuation, free-space loss, and ionospheric effects.

UNIT – V

Access Techniques and Applications: FDMA, TDMA, CDMA in satellite communication, VSAT systems, satellite mobile communication, GPS, and DTH systems.

Textbooks:

1. Dennis Roddy, Satellite Communications, McGraw-Hill.
2. Timothy Pratt et al., Satellite Communications, Wiley India.
3. T. K. Bandopadhyay, Satellite Communication, PHI Learning. (Indian Author)

Course code	Course Title	L	T	P	Credits
R23ECE-OE0008	Fundamentals of Embedded Systems **(Open Elective)**	3	0	0	3

Course Objectives

- Basic fundamentals and components of a typical embedded system.
- Embedded system development as a hardware design and firmware design methodologies, tools and integration.
- Understand the need and development of hardware software codesign.
- Aware of the interrupt service mechanism and device driver programming.
- Understand the working of real time operating systems.

Course Outcomes

1. Illustrate the working of various components of a typical embedded system. (L2)
2. Develop hardware and firmware design methodologies, tools and integration for a embedded system. (L3)
3. Discuss the importance and development using hardware software codesign. (L2)
4. Summarize the interrupt service mechanism and device driver programming. (L2)
5. Outline the real time operating system functions and study of a deployed RTOS. (L2)

UNIT-I

Introduction to Embedded System: Embedded System, Embedded System Vs General Computing System, History of Embedded Systems, Classification of Embedded System, major Application Areas, Purpose of Embedded system, Core of Embedded System, Memory, Sensors and Actuators, Communication Interface, other System components, PCB and passive components, Characteristics of Embedded System, Quality Attributes of Embedded System, application and domain specific embedded systems.

UNIT-II

Embedded system Development: Analog and Digital Electronic components, VLSI and IC Design, EDA tools, PCB Fabrication, Embedded Firmware Design approaches, embedded firmware development languages, Integration of Hardware and Firmware, Board Bring up, Embedded System Development Environment – IDE, Types of File Generated on Cross Compilation- Disassembler/ Decompiler, Simulator, Emulator and Debugging, Target hardware Debugging, Boundary Scan,

UNIT-III

Hardware Software Co-design and program modelling: Fundamental Issues in Hardware and Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modelling Language (UML), hardware Software Trade-offs, embedded product development life cycle- objectives, different phases, approaches of EDLC.

UNIT-IV

Device Drivers and Interrupt service mechanism: Programmed I/o, busy-wait approach without interrupt service mechanism, ISR concepts, interrupt sources, interrupt service handling mechanism, multiple interrupts, context and periods for context switching, interrupt latency and deadline. Classification of processors interrupt service mechanism from context saving, direct memory access, device driver programming.

UNIT-V

Real time operating system: operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling, threads, processes and scheduling, task communication, task synchronization, how to choose an RTOS, case study of ucos-II and vxworks.

Textbooks:

1. Introduction to Embedded System, Shibu K.V, Tata McGraw-Hill, 2014.

References:

1. Embedded Systems- Architecture, programming and Design, 2e, Raj kamal, McGraw Hill Education (India) Private Limited.
2. Embedded System Design- Frank vahid, Tony Givargis, Wiley publications, 2002.

Course code	Course Title	L	T	P	Credits
R23MEC-OE0001	Operations Research **(Open Elective)**	3	0	0	3

Course Objectives:

The objectives of the course are to

- Explore advanced methodologies in Operations Research to model and optimize decision-making processes in complex systems.
- Comprehend the theoretical foundations and practical applications of Linear Programming to address challenges in industrial and operational domains.
- Develop effective solutions for Transportation and Assignment Problems by applying optimization techniques to enhance productivity in manufacturing and efficiency in logistics.
- Impart knowledge of strategic tools in Game Theory and Network Analysis to evaluate and improve competitive scenarios and project management systems.
- Evaluate Queuing models and Simulation models to address uncertainty and improve the system performance.

Course Outcomes

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

1. ***construct*** mathematical models for allocation problems to find the optimal solutions. **(L3)**
2. ***determine*** optimal solutions for transportation and assignment problems and ***test*** for optimality to obtain the optimal solutions. **(L4)**
3. ***design*** simulation models for discrete systems under uncertainties to obtain the solutions for decision making. **(L4)**
4. ***apply*** the concepts of PERT and CPM for scheduling the projects. **(L3)**
5. ***determine*** strategic solutions for competitive scenarios in two-person zero-sum games **(L4)**

UNIT I

Introduction to Operations Research (OR): OR definition - Classification of Models,
Linear Programming (LP): Problem Formulation, Graphical Method, Special Cases of LP-Degeneracy, Infeasibility and Multiple Optimal Solutions; Simplex Method, Big- M simplex Method, application of L.P.P. in manufacturing firms. Software solutions
Applications: Determination of Production quantities of different products in manufacturing industries

UNIT II

Transportation and Assignment Problems: Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution –North West Corner Rule, Least Cost Method, Vogel's Approximation Method; Optimality Method – Modified Distribution (MODI) Method; Special Cases – Unbalanced Transportation Problem, Degenerate Problem. Assignment Problem – Formulation, Hungarian Method for Solving Assignment Problems, Traveling Salesman problem. application of Transportation and Assignment Problems in manufacturing firms. Software solutions.
Applications: Optimizing transportation costs in distribution of goods

UNIT III

Queuing Theory: Introduction – Basic queuing process, basic structure of queuing models terminology: arrival Pattern, service channel, population, departure pattern, queue discipline, Kendall's notation.
Single Channel model with poisson arrivals, exponential service times with infinite queue length
Simulation: Basic concept of simulation, discrete event simulation, applications of simulation, merits and demerits of simulation, Monte Carlo simulation, simulation of Inventory system, simulation of Queuing system. Simulation languages
Applications: Decision making in uncertainty situations

UNIT IV

Network Analysis: Network Representation, rules for drawing network, Fulkerson's Rule, Determination of Earlier Starting Time and Earliest Finishing Time in the Forward Pass – Latest Starting Time and Latest Finishing Time in Backward Pass, determination of critical path, total float calculation, Time estimates in PERT, Probability of completing the project, project cost, project crashing, Optimum project duration, Project management.

Applications: Project planning control in manufacturing and maintenance

UNIT V

Game Theory: Optimal solution of two-person zero sum games, the max min and min max principle. Games without saddle points, mixed strategies. algebraic method, Reduction by principles of dominance, graphical method for [2x n] and [mx2] game problems, Linear programming model

Applications: Determination of optimal strategies in competition between industries

Text books:

1. Sharma S.D., Operations Research: Theory, Methods and Applications, Kedar Nath Ram Nath.
2. Prem kumar Gupta and Hira, Operations Research, S Chand Company Ltd., New Delhi.

Reference books:

1. Hiller F.S., and Liberman G.J., Introduction to Operations Research, Tata McGraw Hill.
2. Sharma J.K., Operations Research: Theory and Applications, Laxmi Publications.
3. Taha H.A., Operations Research, Prentice Hall of India, New Delhi.
4. Pannerselvam R., Operations Research, Pentice Hall of India, New Delhi.
5. Sundaresan.V, and Ganapathy Subramanian.K.S, Resource Management Techniques: Operations Research, A.R Publications.

Web Source References:

1. https://onlinecourses.nptel.ac.in/noc22_mg15
2. https://onlinecourses.nptel.ac.in/noc22_ma48
3. https://onlinecourses.nptel.ac.in/noc24_mg30
4. https://www.britannica.com/topic/operations-research
5. https://www.theorsociety.com/about-or

Course code	Course Title	L	T	P	Credits
R23MEC-OE0002	3D Printing Technology **(Open Elective)**	3	0	0	3

Course Objectives:

The objectives of the course are

- To exploit technology used in 3D printing.
- To understand importance of 3D printing in advance manufacturing process.
- To acquire knowledge, techniques and skills to select relevant 3D Printing process.
- To explore the potential of 3D Printing in different industrial sectors.

Course Outcomes

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

1. **Know** the importance of 3D printing in Manufacturing (L1)
2. **Understand** the liquid-based 3D printing system(L2)
3. **Illustrate** the solid-based 3D printing system (L2)
4. **Explain** the powder-based 3D printing system (L2)
5. **Elucidate** the application 3D printing in medical field (L2)

UNIT-I

Introduction: 3D Printing, Generic 3D Printing Process, Benefits of 3D Printing, Distinction Between 3D Printing and CNC Machining, Classification of 3D Printing Processes, Metal Systems, Hybrid Systems, Milestones in 3D Printing Development, 3D Printing around the World.

UNIT-II

LIQUID-BASED 3D PRINTING SYSTEM: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages.

UNIT-III

SOLID-BASED 3D PRINTING SYSTEMS: Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT-IV

POWDER BASED 3D PRINTING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages, disadvantages and case studies.

UNIT-V

MEDICAL APPLICATIONS & FUTURE DIRECTION FOR 3D PRINTING - Use of 3D Printing to Support Medical Applications, Limitations of 3D Printing for Medical Applications, Further Development of Medical 3D Printing Applications. Use of Multiple Materials in 3D Printing - Discrete Multiple Material Processes, Blended Multiple Material Processes, Commercial Applications Using Multiple Materials, Business Opportunities and Future Directions

Text Books

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer.
2. 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, LeongKah Fai, World Scientific.

References

1. Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venuvinod and Weiyin Ma,Springer.
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and RapidTooling, D.T. Pham, S.S. Dimov, Springer.
3. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley &Sons.

4. Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC PressTaylor & Francis Group.
5. Additive Manufacturing: Principles, Technologies and Applications, C.P Paul, A.N Junoop, McGraw Hill.

Web resources

1. https://www.nist.gov/additive-manufacturing
2. https://www.metal-am.com/
3. http://additivemanufacturing.com/basics/
4. https://www.3dprintingindustry.com/
5. https://www.thingiverse.com/
6. https://reprap.org/wiki/RepRap

Course code	Course Title	L	T	P	Credits
R23MEC-OE0003	Statistical quality control **(Open Elective)**	3	0	0	3

Course Objectives:

The Objectives of this course are to

- Explore the techniques for identifying customer needs, gathering customer feedback, and using that information to drive quality improvements.
- develop skills in analyzing quality control data and making data-driven decisions to maintain or improve product quality
- Design and apply TQM tools and techniques such as control charts, process capability analysis, and Kaizen for continuous process improvement.
- Comprehend Six Sigma methodologies and acceptance sampling plans for quality excellence and reduce operational costs.
- foster a culture of quality and support quality management initiatives to ensure compliance, sustainability, and competitive advantage.

Course outcomes:

Upon completion of this course students will be able to

1. ***apply*** the concept of Quality function deployment to meet the customer quality requirements in product development **(L3)**
2. ***apply*** tools and techniques of Quality Management to identify the assignable causes for process variations to control the manufacturing process **(L3)**
3. ***construct*** control charts for variables and attributes for controlling manufacturing process **(L3)**
4. ***develop*** acceptance sampling plan to minimize producer risk and consumer risk. **(L4)**
5. ***comprehend*** Six Sigma methodologies and ISO quality systems to achieve quality excellence **(L2)**

UNIT –I

Introduction: Introduction to quality – Definition of Quality, Dimensions of Quality, Quality Planning, Total quality management – history – stages of evolution– objectives –Inspection and quality control, Quality Management versus TQM, Reliability engineering –reliability as a parameter of quality for sustainability -bathtub curve, MTBF, System reliability calculations, Quality Loss Function, Quality function deployment (QFD). applications, real life examples

Application:

Quality control concepts used to meet customer requirements in manufacturing industries

UNIT II

Tools and Techniques of TQM: Process capability, Natural Tolerance limits, Process capability index. Check Sheets, Histograms, Scatter Diagrams, Cause and Effect Diagrams, Pareto Chart, control charts, TPM, Kaizen, JIT, Quality Circles, Seven wastes elimination in manufacturing industries for sustainable development, Five S principle

Application: Perform Process capability studies in machine tool industries

UNIT III

Statistical Process Control: Control charts: Statistical basis of the Control Charts-principles, Control limits for X and R-Charts, analysis of pattern on control charts, Type I and Type II errors, p chart, c chart construction. Simple Numerical Problems, revised control limits

Application:

Identify the assignable causes Quality control in manufacturing to control the processes

UNIT- IV

ACCEPTANCE SAMPLING: Fundamental concept in acceptance sampling, Need of acceptance sampling, operating characteristics curve. Producer risk and consumer risk in sampling plans. Acceptance plans, single sampling plan, double sampling plan –exercises.

Application: Selection of sampling plan to minimize risk in purchasing parts, components from the suppliers

UNIT- V

Quality Systems: The Concept of Six Sigma, Objectives of Six Sigma, The Frame-Work of Six Sigma Programme, Six Sigma Problem Solving Approach, The DMAIC Model: Cost of Poor Quality, Benefits and Costs of Six Sigma.

Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

Case Studies of TQM projects and Six Sigma projects.

Application: Systems followed in manufacturing units for quality excellence

Text books:

1. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd.
2. Statistical Quality Control, M.Mahajan, Dhanpat Rai Publishing Co Pvt Ltd

Reference Books:

1. Introduction to statistical quality control: By D.C. Montgomery, John Wiley &Sons Inc.
2. Forrest W. Breyfogle, Implementing Six Sigma, John Wiley & Sons, Inc.
3. Statistical Quality Control – R.C. Gupta– Khanna Publishers, Delhi
4. Grant,E,L.and LavenWorth,R.S.: Statistical Quality Control, McGraw Hill.
5. Evans, J R and W M Lindsay, An Introduction to Six Sigma and Process Improvement, Cengage Learning.

Web Source References:

1. https://nptel.ac.in/courses/112/107/112107259/- Inspection and Quality controlmanufacturing.
2. https://nptel.ac.in/courses/110105039
3. https://www.youtube.com/watch?v=qb3mvJ1gb9g
4. https://nptel.ac.in/courses/110104085
5. https://onlinecourses.nptel.ac.in/noc20_mg19

Course code	Course Title	L	T	P	Credits
R23MEC-OE0004	Hybrid Vehicle Technologies **(Open Elective)**	3	0	0	3

Course Objectives:

The course is intended to

- Familiarize the fundamentals of conventional and hybrid electric vehicle components.
- Understand the configurations and working of hybrid and electric drive-trains.
- Understand the architecture, operation and energy management of PHEVs
- Study and understand different power converters used in hybrid and electrical vehicles.
- Familiarize with different batteries and other energy storage systems.

Course outcomes:

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

1. *Understand* the fundamentals of conventional and hybrid electric vehicle components.
2. *Describe* hybridization of power sources in hybrid electric vehicles.
3. *Apply* the principles of power management and fuel economy to optimize the PHEV performance
4. *Explain* the working principle of power electronics in hybrid vehicles.
5. *Describe* the different battery technologies and other energy storage systems.

UNIT–I:

Introduction: Fundamentals of vehicle, components of conventional vehicle and propulsion load, drive cycles and drive terrain; concept of electric vehicle and hybrid electric vehicle; history of hybrid vehicles, advantages and applications of electric and hybrid electric vehicles, different motors suitable for of electric and hybrid electric vehicles.

UNIT–II:

Architectures of Hybrid, Plug-in Hybrid, Fuel Cell and Electric Vehicles

Hybrid Electric Drive-trains: Architectures of HEVs, Series and parallel HEVs complex HEVs. Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV- Fuel Cell vehicles and its constituents.

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

UNIT–III:

Plug-in Hybrid Electric Vehicle: PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology(V2G), PHEV battery charging.

Applications:

- Optimizing fuel economy by managing the switch between electric and combustion power in PHEVs.
- Using PHEV batteries to support the grid during peak demand through Vehicle-to-Grid (V2G) technology.

UNIT–IV:

Power Electronics in HEVs: Rectifiers used in HEVs, voltage ripples, Buck converter used in HEVs, non- isolated bidirectional DC-DC converter, voltage source inverter, current source inverter, isolated bidirectional DC-DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT–V:

Battery and Storage Systems: Energy storage parameters; lead acid, li-ion and Ni-MH batteries, ultracapacitors, flywheels- superconducting magnetic storage system; pumped hydroelectric energy storage; compressed Air energy storage-storage heat; energy storage as an economic resource.

Applications:

- Battery selection in EVs: Selecting Li-ion or Ni-MH batteries for EVs based on battery cost and performance.

- Supporting the power grid with pumped hydro or compressed air energy storage systems.

Text Books:

1. Ali Emadi, Advanced Electric Drive Vehicles, 1st Edition, CRC Press.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2nd Edition, CRC Press, 2010.

Reference Books:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2009.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H.Partab: Modern Electric Traction-DhanpatRai &Co,2007.

Web link:

1. https://archive.nptel.ac.in/courses/108/103/108103009/

Course code	Course Title	L	T	P	Credits
R23MEC-OE0005	Industrial Robotics **(Open Elective)**	3	0	0	3

Course Objectives:

The objectives of the course are

- To understand the Geometrical Configuration and Components of Industrial Robots (Anatomy)
- To analyze the factors influencing gripper selection and design.
- To grasp the concept of rotation matrices and their significance in robotics.
- To understand forward and inverse kinematics of robot manipulator
- To familiarize the students with the fundamentals of sensors and various drive systems.
- To develop Program Robot for applications in various fields.

Course Outcomes:

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

1. Understand the anatomy of robots including the components and structure. (L2)
2. Design the grippers considering grasping force, Engelberger-g-factors, and actuation mechanisms (L2)
3. Apply basic transformation and rotation matrices in robot kinematics (L3)
4. Explain the function of feedback components such as position sensors (potentiometers, resolvers, encoders) and velocity sensors. (L2)
5. Understand the use of robots in manufacturing, inspection and quality control applications. (L2)

Unit- I

Robotics: Introduction, classification with respect to geometrical configuration (Anatomy), Controlled system & chain type, Serial manipulator & Parallel Manipulator. Components of Industrial robotics, precession of movement, resolution, accuracy & repeatability,

Dynamic characteristics: speed of motion, load carrying capacity & speed of response, Sensors, Internal sensors: Position sensors, & Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, & Force and Torque sensors.

Unit-II

Grippers & End effectors: Mechanical Gripper, Grasping force, Engelberger-g-factors, mechanisms for actuation, Magnetic gripper, vacuum cup gripper, considerations in gripper selection & design, specifications. Selection of gripper based on Application.

Applications:

1. Wall climbing robot
2. Vacuum cups

Unit- III

Motion Analysis:

Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation.

Manipulator Kinematics- Assignment of frames, D-H Transformation Matrix, joint coordinates and world Coordinates, Forward and inverse kinematics.

Applications:

1. Robot trajectory generation by forward kinematics.
2. Welding robots by inverse kinematics by root multiplicity.

Unit-IV

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors, potentiometers, resolvers, encoders, Velocity sensors, Tactile and Range sensors, Force and Torque sensors, End Effectors and Tools.

Applications:

1. Automated Assembly Lines in Automotive Manufacturing
2. Surgical Robotics (e.g., Da Vinci System)

Unit-V

Robot Programming & Applications: Material Transfer - Material handling, loading and unloading- Processing spot and continuous arc welding & spray-painting Assembly and Inspection. Robotic Programming Methods - Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

Applications:

1. Automated Car Body Assembly
2. Electronics Manufacturing (e.g., PCB Assembly)

Text Books

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Robotics / John j.Craig / Pearson

References

1. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson
2. Robot Dynamics and controls / Spony and Vidyasagar / John Wiley

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc23_me143/preview
2. https://www.youtube.com/results?search_query=1.%09Robotics+Programming+in+Just+30+Days!+%7C+Industrial+Robotics+Programming+in+Bangalore+%7C+RVM+CAD
3. https://www.youtube.com/watch?v=QiFbrmJTib4&t=11s
4. https://www.youtube.com/watch?v=hL_GKapQd1k

Course code	Course Title	L	T	P	Credits
R23MEC-OE0006	Nano Materials **(Open Elective)**	3	0	0	3

Course objectives:

The objectives of the course are

- To understand the nano-structured materials and their applications.
- To learn about the nano-crystalline materials, their properties and defects.
- To understand various techniques of nanofabrication.
- To identify the tools to characterize nano materials.
- To analyze the applications of nano materials.

Course Outcomes:

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

1. ***Explain*** nano-structured materials and their applications **(L2)**
2. ***Apply*** knowledge about the nano-crystalline materials, their properties and defects **(L3)**
3. ***Demonstrate*** various techniques of nanofabrication **(L2)**
4. ***Apply*** the tools to characterize nano materials **(L3)**
5. ***Analyze*** the applications of nano materials **(L4)**

UNIT–I

Introduction to Nanomaterials: History and Scope, Classification of Nano structured Materials, Distinction between nanomaterials and bulk materials, Classification of nanomaterials: 0D, 1D, 2D, 3D, Fascinating Nanostructures, and applications of nanomaterials, challenges and future prospects.

Learning outcomes:

At the end of this unit students will be able to:

1. ***Understand*** the fundamental concepts of nanomaterials and how they differ from bulk materials **(L2)**
2. ***Identify*** and describe various nanostructures (0D, 1D, 2D, 3D) and their unique properties at the nanoscale **(L2)**

Application:

Semiconductors , Nano sensors, Memory storage devices, Hydrogen fuel cells.

UNIT–II

Properties Of Nano Materials: Microstructure and Defects in Nano crystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and declinations. Effect of Nano-dimensions on Materials Behaviour: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility. Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

Application: high-density data storage and magnetic sensors

UNIT–III

Manufacturing Methods: Bottom-up approaches: Physical Vapour Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapour Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly. Top-down approaches: Mechanical alloying, Nano-lithography. Consolidation of Nano powders: Shock wave consolidation, Hot isostatic pressing, Cold isostatic pressing, Spark plasma sintering.

Application:

Bulk nanostructured alloys for aerospace and automotive applications

UNIT-IV

Characterization of Nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe, Nano indentation.

Application:

Measures the hardness and elastic modulus of individual nanoparticles

UNIT-V

Applications of Nano Materials: Nano-electronics, Micro- and Nano electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

Application:

Solar cells, Batteries and water purification systems

Textbooks

1. Charles. P. Poole Jr& Frank J. Owens, Introduction to Nanotechnology, Wiley-Inter science.
2. A.K. Bandyopadhyay, Nano Materials, New Age International Pvt Ltd Publishers.
3. T. Pradeep , Nano: The Essentials, McGraw Hill Education.

References

1. S.O. Pillai, Solid State Physics, New Age International Private Limited.
2. Charles Kittel, Introduction to solid state physics, Wiley & Sons (Asia) Pvt Ltd.

Web Sources References:

1. https://www.youtube.com/watch?v=oN1I09LpygE&list=PLMlC7Vx5awsenMs5y02xcW6i5NmdEIRGx&index=2
2. https://www.youtube.com/watch?v=jryDvx7VNxw&list=PLyqSpQzTE6M8682dGkNTN8936vSY4CbqZ&index=15
3. https://www.youtube.com/watch?v=mva_njonj2Y&list=PLbMVogVj5nJTdeiLvuGSB_AE8hloTAHWJ&index=3
4. https://www.youtube.com/watch?v=JffF6AqWCHE

Course code	Course Title	L	T	P	Credits
R23MEC-OE0007	AI and ML In Manufacturing **(Open Elective)**	3	0	0	3

Course Objectives:

The main objectives of this course are to:

- Introduce the fundamentals of Artificial Intelligence (AI) and its relevance to modern manufacturing systems.
- Enable students to understand and apply AI techniques like Machine Learning, Expert Systems, and Fuzzy Logic in industrial scenarios.
- Familiarize students with AI applications in predictive maintenance, quality control, process optimization, and robotics.
- Develop the ability to analyze manufacturing data using AI-based decision-making tools.
- Encourage innovation in smart manufacturing by integrating AI with Industry 4.0 technologies.

Course Outcomes:

After completing this course, the students will be able to:

1. Explain the role and benefits of Artificial Intelligence in modern manufacturing and Industry 4.0. (L2)
2. Apply machine learning algorithms to real-world problems like fault detection and predictive maintenance in manufacturing. (L3)
3. Develop expert systems to support manufacturing decision-making and diagnostics. (L6)
4. Analyze and implement fuzzy logic and neural network models for manufacturing process control. (L4)
5. Evaluate advanced AI applications in smart robotics, digital twins, and AI-driven production systems. (L5)

UNIT I:

Introduction to AI in Manufacturing: Definition and scope of AI in engineering, Evolution of AI and its relationship with automation, Traditional automation vs. AI-based decision-making, Role of AI in Industry 4.0 and Smart Factories, Cyber-Physical Systems (CPS) and AI, Benefits and limitations of AI in manufacturing, Case studies: AI in production lines, real-time process control

UNIT II:

Machine Learning for Manufacturing Systems: Overview of ML algorithms and relevance to manufacturing, Supervised, unsupervised, and reinforcement learning, Classification (SVM, Decision Trees, k-NN) and Regression models, Clustering techniques (K-means, Hierarchical) for pattern detection, Feature engineering and preprocessing of sensor data, Predictive maintenance using historical data, Intro to deep learning: CNN and RNN applications in fault detection, Tools: Python, Scikit-learn, TensorFlow, MATLAB

UNIT III:

Expert Systems and Knowledge Representation: Components of an expert system: knowledge base, inference engine, user interface, Rule-based reasoning and IF-THEN rule chaining, Certainty factors and decision trees, Knowledge acquisition methods: interviews, machine learning, simulations, Semantic networks, ontologies, and frames, AI-based troubleshooting and fault diagnostic systems, Case study: Expert systems in CNC, PLCs, and maintenance management

UNIT IV:

Fuzzy Logic and Neural Networks in Manufacturing : Fundamentals of fuzzy logic and fuzzy inference systems, Designing fuzzy rule-based controllers, Integration of fuzzy logic with PLCs and SCADA, Neural networks: architecture, activation functions, training algorithms, Backpropagation and real-time adaptation, Process optimization using neural networks and fuzzy hybrid models, Applications: welding control, casting defect prediction, tool wear monitoring

UNIT V:

AI Applications in Smart Manufacturing: Intelligent robotics and AI-based path planning, Machine vision systems and defect detection, Digital twins and virtual commissioning, AI in production planning and real-time scheduling, Role of AI in quality assurance and adaptive control, AI in smart inventory management and logistics, Ethical implications and challenges in AI implementation, Case studies: AI in aerospace, automotive, and healthcare manufacturing

Textbooks:

1. **Russell, Stuart J., and Peter Norvig**, *Artificial Intelligence: A Modern Approach*, Pearson Education, 3rd Edition, 2019.
2. **Dan W. Patterson**, *Introduction to Artificial Intelligence and Expert Systems*, PHI Learning, 2009.
3. **M. Gopal**, *Applied Machine Learning*, McGraw-Hill Education, 2018.
4. **Ramesh Babu**, *Artificial Intelligence in Mechanical and Industrial Engineering*, SciTech Publications, 2022 *(Indian Author)*

Reference Books:

1. **V.S. Janakiraman, K. Sarukesi, P. Gopalakrishnan**, *Foundations of AI and Expert Systems*, Macmillan India, 2019 *(Indian Author)*
2. **David Forsyth**, *Applied Machine Learning*, Springer, 2019.
3. **Donald A. Waterman**, *A Guide to Expert Systems*, Pearson, 2018.
4. **S. N. Sivanandam**, *Principles of Soft Computing*, Wiley India, 2nd Edition, 2011 *(covers fuzzy logic and neural networks)*

Online Resources:

Coursera – AI for Everyone (by Andrew Ng)
https://www.coursera.org/learn/ai-for-everyone
edX – Artificial Intelligence in Manufacturing (by RWTH Aachen University)
https://www.edx.org
MIT OpenCourseWare – Artificial Intelligence
https://ocw.mit.edu
Google AI – Research and Tools
https://ai.google
YouTube – AI in Industry by Analytics Vidhya / Siemens
https://www.youtube.com

Course code	Course Title	L	T	P	Credits
R23MEC-OE0008	Automation in Manufacturing **(Open Elective)**	3	0	0	3

Course Objectives:

The main objectives of this course are to:

- Understand the concept of automation and process control systems.
- Classify the automated flow lines and analyze automated flow lines
- Able to balance the operations on assembly line.
- Design automated material handling systems.
- Understand the level of automation in continuous and discrete manufacturing systems.

Course Outcomes:

1. ***Understand*** the characteristics of Automated Systems. (L2)
2. ***Illustrate*** operational aspects of flow lines.(L2)
3. ***apply*** the methods to balance the assembly line(L3)
4. ***Compare*** conventional and automated material transport, storage system.(L2)
5. ***Explain*** the level of automation in continuous and discrete manufacturing industries.(L2)

Unit-I

Introduction To Automation: Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies, levels of automation, Basic elements of an automated system, Types of production, pneumatic and hydraulic components, circuits, automation in foundry industries, automation in machine tools, mechanical feeding and tool changing and machine tool control. Economical and technological factors for automation. Barriers of automation in manufacturing industries.

Applications:

- Automated Material Handling System in Manufacturing
- Automation in Machine Tools for Precision Manufacturing

Unit-II

Automated Flow Lines: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations. Analysis of automated flow lines - General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

Applications:

- Automated Conveyor Systems in Assembly Lines
- Buffer Storage in Automotive Manufacturing

Unit-III

Assembly Line Balancing: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

FMS: Types of FMS, components of FMS, Types of flexibility, types of FMS layouts, applications, scope for FMS in manufacturing today, group technology, hierarchy of computer control in FMS, economic justification of FMS planning, scheduling and control of FMS

Applications:

- Optimized Assembly Line Balancing in Electronics Manufacturing
- Flexible Manufacturing Systems (FMS) in Automotive Production

Unit-IV

Material Handling Systems: Introduction to Material Handling, Basic Principles, Material Transport equipment, analysis of material transport systems, Automated Guided Vehicle Systems, Generalized Theories Governing the Mechanical Design Parameters of Handling Systems storage systems–storage system performance and location strategies, Conventional storage methods and equipment, Automated Storage and Retrieval System (ASRS) and Its Types, Applications of ASRS,Engineering analysis of storage systems. ASRS and Industry 4.0

Automatic Identification Methods: Overview of Identification Methods, Barcode technology, Radio frequency identification, other AIDC technologies, benefits of AIDC.

Applications:

- Automated Storage and Retrieval System (ASRS) in Warehousing
- Radio Frequency Identification (RFID) in Supply Chain Management

Unit-V

Industrial Control Systems: Process industries Vs Discrete manufacturing industries, levels of automation in the two industries, variables and parameters in the two industries. Continuous Vs Discrete control –continuous control system, discrete control system.

Automated Inspection And Assembly: Fundamentals, inspection principles, types of inspection methods and equipment, Quality function deployment, Coordinate Measuring Machines, Machine Vision, Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems, Multi- Station Assembly Machines, Single Station Assembly Machines.

Applications:

- Industrial Control Systems in Chemical Processing Plants
- Machine Vision-Based Automated Inspection in Automotive Manufacturing

Text Books:

1. M.P. Groover, Automation, Production systems and Computer Integrated Manufacturing,3/e, PHI
2. Learning.
3. Geoffrey Boothroyd, Assembly Automation and Product design, Taylor and Francis Publishers.

Reference Books:

1. Krishna Kant, Computer based industrial control, Prentice Hall of India.
2. Tiess Chiu chang and A. W. Richard, An introduction to automated process planning systems, Tata Mc Graw Hill.
3. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel, Nicholas, G. Odrey, IndustrialRobotics, McGraw Hill.

Course Code	Subject Name	L	T	P	C
R23CSE-OE0001	**PYTHON PROGRAMMING**	3	0	0	3

Course Objectives:

- Understand the structure and data types of Python script.
- Implement iterations and functions in Python.
- Implement modules and understand packages.
- Implement data structures using mutable & immutable objects.
- Understand object-oriented concepts and Exception handling.

Course Outcomes:

- Implement Basic Python programming Fundamentals for Computation of Expression [L3]
- Apply Iterators and functions in data processing.[L3]
- Understand modules and packages to leverage powerful libraries for data science tasks.[L2]
- Implement sequences and data structures for data organization.[L3]
- Implement object-oriented principles in Python, handling run-time errors.[L3]

Unit I: **Hours:10**

Introduction: History of Python, Features of Python, Applications, Python Using the REPL (Shell), Running Python Scripts, Variables, Assignment forms, Keywords, Input-Output, Indentation.

Operators and Type Conversion: Data Types: Numeric, Booleans, Sequence, Strings, Type Conversions, Operators, Operator Precedence, Evaluation of Expressions.

Learning Outcomes: After completing this chapter, students will be able to

- Understand the environment of Python. (L2)
- Write and run simple scripts in Python. (L3)
- Implement Type conversion techniques. (L3)

Unit II: **Hours:10**

Control Flow: Conditional statements (if, else, elif), Looping structures (for, while, for-else, while-else)Transfer Control Statements**:** break, continue, pass.

Functions: Defining Functions, Calling Functions, Types of Arguments: Keyword Arguments, Default Arguments, Variable-length arguments, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables, Anonymous Functions, Lambda, map, reduce and filter.

Learning Outcomes: After completing this chapter, students will be able to

- Understand the iterations using looping structures.(L2)
- Implement Python functions.(L3)

Unit III: **Hours:9**

Modules: Creating modules, import statement, from import statement, namespace, built-in modules- OS, random, Math, JSON, request, date, RegEx, itertools

Packages: Introduction to PIP**,** Installing packages using PIP.

Exploring Data Science Libraries: NumPy, Pandas,Data visualization: Matplotlib

Learning Outcomes: After completing this chapter, student will be able to

- Understand modules (L2)
- Understand data science libraries.(L2)

Unit IV: **Hours:10**

Strings & Data Structures: String**,** String Formatting**,** List, String and List Slicing, Tuple, Sets, Frozen Sets, Dictionaries, Comprehensions, Built-in methods of all sequences, File Handling: Reading and writing files,File modes and file objects

Learning Outcomes: After completing this chapter, student will be able to

- Implement different data structures in Python.(L3)
- Understand different file handling Operations.(L2)

Unit V: **Hours:09**

Object Oriented Programming OOP in Python: Classes, 'self- variable', Methods, Constructor, Inheritance, Polymorphism, and Data Abstraction.

Errors and Exceptions: Syntax Errors, Exceptions, Exception Handlers, Raising Exceptions, User-defined Exceptions.

Learning Outcomes: After completing this chapter, student will be able to

- Understand Object oriented concepts with real world scenarios.(L2)
- Implement exceptions in Python.(L3)

TEXT BOOKS:

1. Let Us Python by Yashavant Kanetkar ,Aditya Kanetkar ,6th edition, BPB Publication
2. Python Programming: Using Problem Solving Approach by Reema Theraja, 2nd edition, Oxford publications.

REFERENCE BOOKS:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.
2. Learning Python, Mark Lutz, Orielly.
3. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO12	PSO1	PSO2	PSO3
	3	2	2	2	3				3			1	2	3	3
	3	3	2	2	3				3			1	2	3	3
	3	3	2	2	3				3			1	2	3	3
	3	3	3	2	3				3			1	2	3	3
	3	3	3	3	3				3			1	2	2	3
	3	3	3	2	3				3			1	2	3	3

** For Entire Course, PO & PSO Mapping*

Course Code	Subject Name	L	T	P	C
R23CSE-OE0002	**DATA STRUCTURES USING C**	3	0	0	3

Course Objectives:

1. To teach efficient storage mechanisms of data for an easy access.
2. To develop application using data structures.
3. To improve the logical ability

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

1. Compare the performances of various Searching and Sorting techniques in terms of time and space complexities.
2. Illustrate the applications of Stacks.
3. Implement various types of Queues and their efficient operations.
4. Demonstrate the advantages of dynamic memory allocation via linked lists.
5. Implement the basic operations, search and traversals on Trees.

UNIT-I

Time and space complexity, Data Structures – Introduction to Data Structures, abstract data types, Searching and Sorting – Sorting- selection sort, bubble sort, insertion sort, quick sort, merge sort, shell sort, radix sort, Searching-linear and binary search methods, comparison of sorting and searching methods.

UNIT –II

Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, circular linked list implementation, Double linked list implementation, insertion, deletion and searching operations. Applications of linked lists.

UNIT-III

Stacks-Operations, array and linked representations of stacks, stack applications -infix to postfix conversion, postfix expression evaluation, recursion implementation.

UNIT-IV

Queues-operations, array, and linked representations. Circular Queue operations, Dequeues, applications of queues.

UNIT-V

Trees – Definitions, tree representation, properties of trees, Binary tree, Binary tree representation, binary tree properties, binary tree traversals, binary tree implementation, applications of trees.

Text Books:

1. Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahniand Susan Anderson-Freed, Universities Press, 2008.
2. Data structures A Programming Approach with C, 2nd Edition D.S.Kushwaha and A.K.Misra, PHI, 2007.

References:

1. Data structures: A Pseudocode Approach with C, 2nd edition, R.F.GilbergAndB.A.Forouzan, CengageLearning.
2. Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
3. Data Structures using C& C ++,2nd Edition A.M.Tanenbaum,Y. Langsam, M.J.Augenstein, Pearson.
4. Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.TondoandB.Leung,Pearson

Course Code	Subject Name	L	T	P	C
R23CSE-OE0003	**OPERATING SYSTEM CONCEPTS**	3	0	0	3

Course Objectives

1. Provide knowledge about the services rendered by operating systems.
2. Present detail discussion on processes, threads and scheduling algorithms.
3. Discuss various file-system implementation issues and memory management techniques.

Course Outcomes:

1. Understand the importance of operating systems and different types of system calls.
2. Analyze the communication between processes and various process scheduling algorithms.
3. Understand the process synchronization, different ways for deadlocks handling.
4. Analyze various memory mapping techniques and different page replacement methods.
5. Evaluate various file allocation and disk scheduling algorithms.

UNIT-I: **Operating Systems Overview:**

Introduction: what is an operating system, Types of operating systems, operating systems concepts, operating systems services, Introduction to System call, System call types, Operating System Generation.

UNIT–II: Process Management:

Process concept: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication.

Multithreaded Programming: Overview, Multithreading models, Threading Issues.

Process scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT-III: Synchronization:

Process Synchronization: The Critical-Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples.

Principles of deadlock – System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

UNIT-IV: Memory Management:

Memory Management strategies: Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.

Virtual Memory Management: Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing.

UNIT-V: File system Interface- The concept of a file, Access Methods, Directory and Disk structure, File system mounting.

File System implementation: File system structure, allocation methods, free-space management.

Mass-storage structure: Overview of Mass-storage structure, Disk scheduling, Device drivers.

Text Books:

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 10 th edition, Wiley, 2013.
2. Tanenbaum A S, Modern Operating Systems, 4th edition, Pearson Education, 2008. (forInterprocess Communication and File systems).

References:

i. Tanenbaum A S, Woodhull A S, Operating Systems Design and Implementation, 3rd edition, PHI, 2006.

ii. Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw-Hill, 2012.

iii. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009.

iv. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004.

Course Code	Subject Name	L	T	P	C
R23CSE-OE0004	**INTRODUCTION TO JAVA PROGRAMMING**	3	0	0	3

Course Objectives

1. Understand the structure and environment of Java.
2. Implement the relationship between objects.
3. Understand the Strings and Organize data using different data
4. Implement text processes and error handling.
5. Understand to create multi threading applications and GUI applications.

Course Outcomes:

1. Understand the environment of JRE and Control Statements. (L2)
2. Implement real world objects using class Hierarchy (L3)
3. Implement generic data structures for iterating distinct objects (L3)
4. Implement error handling through exceptions and file handling through streams. (L3)
5. Design thread-safe GUI applications for data communication between objects (L4)

Unit I: Java Environment and Program Structure (10 Hours)

History of Java, Features, Applications, Java Installation - JDK and JRE, JVM Architecture, OOPS Principles, Class and Object, Naming Convention, Data Types, Type Casting, Type Conversion, Wrapper classes, Operators, instance of operator, Command Line Arguments, Decision making, Arrays, and Looping statements.

Learning Outcomes: Student will be able to

1. Understand architecture of Java Virtual Machine. (L2)
2. Understand the structure of java program and its environment. (L2)

Unit II: Class Hierarchy & Data Hiding (10 Hours)

Property, Method, Constructor, Inheritance (IS-A) , Aggregation and Composition (HAS-A), this and super, static and initialize blocks, Method overloading and overriding, static and final keywords, Types of Inheritance, Compile time and Runtime Polymorphism, Access Specifiers and scope, packages and access modifiers, Abstract class, Interface, Interface Inheritance, Achieving Multiple Inheritance, Class casting, Object Cloning, Inner Classes.

Learning Outcomes: Student will be able to

1. Understand the class hierarchy and their scope. (L2)
2. Implement relationship between objects. (L3)
3. Understand data hiding and nested classes. (L2)
4. Implement data type casting and cloning of objects. (L3)

Unit III: Strings and Collections (10 Hours)

String: Methods, StringBuffer and StringBuilder, StringTokenizer

Collections: Exploring java.util.*, Scanner, Iterable, Collection Hierarchy, Set, List, Queue and Map, Comparable and Comparator, Iterators: foreach, Enumeration, Iterator and ListIterator.

Learning Outcomes: Student will be able to

1. Understand the usage of String and its properties and methods.(L2)
2. Understand data structures and Iterators. (L2)
3. Create the data structures and implement different utility classes. (L3)

Unit IV: IO and Error Handling (10 Hours)

IO Streams: Exploring java.io.*, Character and Byte Streams, Reading and Writing, Serialization and De-serialization, Error Handling: Error vs Exception, Exception hierarchy, Types of Exception, Exception handlers, User defined exception, Exception propagation.

Learning Outcomes: Student will be able to

1. Understand character and byte streams. (L2)
2. Understand the hierarchy of errors and exceptions. (L2)
3. Implement data streams and exception handlers. (L3)

Unit V: Threads and GUI (8 Hours)

Multi-Threading: Process vs Thread, Thread Life Cycle, Thread class and Runnable Interface, Thread synchronization and communication.

GUI: Component, Container, Applet, Applet Life Cycle, Event delegation model, Layouts, Menu, MenuBar, MenuItem.

Learning Outcomes: Student will be able to

1. Understand the Thread Life Cycle and its scheduling.(L2)
2. Implement the synchronization of threads. (L2)

TEXT BOOKS:

1. The complete Reference Java, 8th edition, Herbert Schildt, TMH.
2. Programming in JAVA, Sachin Malhotra, SaurabhChoudary, Oxford.
3. Introduction to java programming, 7th edition by Y Daniel Liang, Pearson.
4. Java: How to Program, 9th Edition (Deitel) 9th Edition.
5. Core Java: An Integrated Approach, Java 8 by R. Nageswara Rao.

REFERENCE BOOKS:

1. Swing: Introduction, JFrame, JApplet, JPanel, Componets in Swings, Layout Managers
2. Swings, JList and JScrollPane, Split Pane, JTabbedPane, JTree, JTable, Dialog Box.

Weblinks:

1. https://www.javapoint.com/
2. https://www.sitesbay.com/java/index
3. https://www.tutorialspoint.com/java/index.htm
4. https://www.w3schools.com/java/
5. https://www.programiz.com/java-programming

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

SNO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2	1	2				1			1	3	1	2
CO2	3	3	2	2	2				2			1	3	1	2
CO3	3	3	2	1	2				2			1	3	1	2
CO4	3	3	2	1	2				2			1	3	1	2
CO5	3	3	2	1	2				2			1	3	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0005	**DATA BASE MANAGEMENT SYSTEMS CONCEPTS**	**3**	**0**	**0**	**3**

Course Objectives:

1. Train in the fundamental concepts of database management systems, database modeling and design, SQL, PL/SQL, and System implementation techniques.
2. Enable students to model ER diagram for any customized applications.
3. To learn the principles of systematically designing and using large scale Database Management Systems for various applications.

Course Outcomes:

1. Understand the usage of Key Constraints on Database.
2. Describe ER model and normalization for database design.
3. Create, maintain, and manipulate a relational database using SQL.
4. Understand efficient data storage and retrieval mechanism, recovery techniques.
5. Design and build database system for a given real world problem.

UNIT-I:

An Overview of Database Management: Introduction- Importance of Database System, Data Independence- Relation Systems and Others- Summary, Database system architecture, Introduction-The Three Levels of Architecture-The External Level- the Conceptual Level- the Internal Level-Mapping- the Database Administrator-The Database Management Systems- Client/Server Architecture.

UNIT-II:

The E/R Models: The Relational Model, Relational Calculus, Introduction to Database Design, Database Design and ER Diagrams-Entities Attributes, Entity Sets-Relationship and Relationship Sets-Conceptual Design with the ER Models.

The Relational Model: Integrity Constraints Over Relations- Key Constraints –Foreign Key Constraints-General Constraints, Relational Algebra and Calculus, Relational Algebra- Selection and Projection- Set Operation, Renaming – Joins- Division- More Examples of Queries, Relational Calculus - Tuple Relational Calculus, Domain Relational Calculus.

UNIT-III:

Queries, Constraints, Triggers: The Form of Basic SQL Query, Union, Intersect, and Except, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers and ActiveDatabase.

Schema Refinement (Normalization) : Purpose of Normalization or Schema Refinement, Concept of Functional Dependency, Normal Forms Based on Functional Dependency(1NF, 2NF and3 NF), Concept of Surrogate Key, Boyce-Codd Normal Form(BCNF), Lossless Join and Dependency Preserving Decomposition, Fourth NormalForm(4NF).

UNIT-IV:

Transaction Management and Concurrency Control:

Transaction, Properties of Transactions, Transaction Log, Transaction Management with SQL using Commit Rollback and Save Point, Concurrency Control for Lost Updates, Uncommitted Data, Inconsistent Retrievals, and the Scheduler.

Concurrency Control with Locking Methods: Lock Granularity, Lock Types, Two Phase Locking For Ensuring Serializability, Deadlocks, Concurrency Control with Time Stamp Ordering: Wait/Die and Wound/Wait Schemes, Database Recovery Management : Transaction Recovery.

UNIT-V:

Overview of Storages and Indexing: Data on External Storage- File Organization and Indexing – Clustered Indexing – Primary and Secondary Indexes, Index Data Structures, Hash-Based

Indexing – Tree- Based Indexing, Comparison of File Organization.

Text Books:

1. Introduction to Database Systems, 8th Edition CJ Date, Pearson, 2004.
2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATAMcGraw Hill 3rd Edition.

References Books:

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel13th Edition.
2. Fundamentals of Database Systems, 7 th Edition ElmasriNavrate Pearson Education.
3. Database Systems - The Complete Book, 2nd edition H G Molina, J D Ullman, J WidomPearson.
4. Data base System Concepts, 7thedition ,Silberschatz, Korth,Mcgraw Hill (TMH).

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0006	**UNIX and Shell Programming**	3	0	0	3

Course Objectives:

- To provide an overview of the history, development, and significance of UNIX/Linux in computing.
- To provide skills in diagnosing common problems, log analysis, and troubleshooting techniques in a UNIX/Linux environment.
- To provide an overview of system administration tasks such as user management, backup and restore, system monitoring, and software installation.
- To explain file systems, mounting, disk usage, file permissions (chmod), and file attributes (chown).

Course Outcomes:

- Understand the architecture and features of UNIX. (L2)
- Apply the commands for implementation of the File System. (L3)
- Understand the Streams, Pipes and Filters. (L2)
- Apply the pattern reorganization commands and scripting concepts. (L3)
- Implementation of system calls for file system. (L3)

Unit 1 (10 Hours)

Introduction to Unix:

Introduction to Unix-Brief History-What is Unix-Unix Components-Using Unix-Commands in Unix-Some Basic Commands-Command Substitution-Giving MultipleCommands.

Learning Outcomes: Student will be able to

- Understand the origins and development of Unix. (L2)
- Learn the key milestones in the evolution of Unix (L3)
- Learn how to use command substitution to streamline tasks. (L3)

Unit 2 (8 Hours)

Unix Utilities:

Introduction to Unix file system, vi editor, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, unlink, du, df, mount, unmount, find, unmask, ulimit, ps, w, finger, Arp, ftp, telnet, rlogin. Text processing utilities and backup utilities , detailed commands to be covered are tail, head , sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio

Learning Outcomes: Student will be able to

1. Learn the organization and layout of the Unix directory hierarchy. (L2)

2. File Attributes and Permissions: Understand the various file attributes and how permissions work. (L2)

Unit 3 (10 Hours)

Introduction to Shells:

Using the Shell-Command Line Structure-Met characters- Creating New Commands-Command Arguments and Parameters-Program Output as Arguments-Shell Variables- -More on I/O Redirection-Looping in Shell Programs.

Filters:

Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Files with Duplicate Lines, Count characters, Words or Lines, Comparing Files.

Learning Outcomes: Student will be able to

1. Understand the role and management of variables in the Unix shell. (L2)
2. Gain advanced knowledge of input/output redirection in Unix. (L3)
3. Learn how to implement loops in shell scripts. (L3)

Unit 4 (12 Hours)

Grep: Operation, grep Family, Searching for File Content.

Sed: Scripts, Operation, Addresses, commands, Applications, grep and sed.

Shell Programming:

Basic Script concepts, Expressions, Decisions: Making Selections, Repetition, special Parameters and Variables, changing Positional Parameters, Argument Validation, Debugging Scripts, Script Examples.

Learning Outcomes: Student will be able to

1. Understand the basics of awk for pattern scanning and text processing (L2)
2. Learn best practices for creating and using effective filters and well-structured files in Unix. (L3)

Unit 5 (8 Hours)

File Management:

File Structures, System Calls for File Management – create, open, close, read, write, lseek, link, symlink, unlink, stat, fstat, lstat, chmod, chown, Directory API – opendir, readdir, closedir, mkdir, rmdir, umask.

Learning Outcomes: Student will be able to

1. Learn how to change file ownership using the chown command.(L2)
2. Understand how to change the group ownership of a file using the chgrp command.(L2)

TEXT BOOKS:

1. Unix and shell Programming Behrouz A. Forouzan, Richard F. Gilberg.Thomson
2. Your Unix the ultimate guide, Sumitabha Das, TMH. 2nd Edition.

REFERENCE BOOKS:

- Unix for programmers and users, 3rd edition, Graham Glass, King Ables, Pearson Education.
- Unix programming environment, Kernighan and Pike, PHI. / Pearson Education.
- The CompleteReference Unix, Rosen, Host, Klee, Farber, Rosinski, Second Edition, TMH.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

Cos	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	2	1	3				1		1	1	2	3	3
CO2	3	2	2	1	3				1		1	1	2	3	3
CO3	3	3	3	2	3				1		1	2	3	3	3
CO4	3	3	3	2	3				2		1	2	3	3	3
CO5	2	2	2	2	2				2		1	1	2	2	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0007	**SOFTWARE ENGINEERING**	3	0	0	3

Course Objectives:
1. Explain the phases of Software Development.
2. Teach the customer requirement gathering techniques.
3. Teach Software Design techniques
4. Demonstrate coding standards
5. Apply the testing techniques on software

Course Outcomes:
Students will be able to:
1. Understand the need of Software Life Cycle Models (L1)
2. Demonstrate the Requirements of the Software Systems process (L2)
3. Summarize the system models of software engineering (L2)
4. Choose appropriate software architecture style for real-time software projects (L3)
5. Analyze various testing techniques, Risk management and Software quality of the software products(L4)

UNIT-1
Introduction: Introduction to Software Engineering, Evolving role of Software, Software Crisis,Changing Nature of Software, Software myths, Process Models for Software Development, Waterfall, prototyping Evolutionary models: Incremental model, Spiral model, Agile developmental process.
Learning Outcomes:
At the end of the module, students will be able to:
1. List the steps involved in software development. (L1)
2. Explain myths of software. (L2)
3. Apply various software process models (L3)

UNIT-2
Software Requirements Engineering: Functional & Non-functional requirements, Feasibility studies, Requirements Elicitation and Analysis, requirements validation, Software Requirements Specification, Process and System Models, context models, behavioural model, Data model.
Learning Outcomes:
At the end of the module, students will be able to:
1. Explain software development model (L2)
2. Define functional and non-functional requirements for software development (L1)
3. Analyse user requirementsfor a software(L4)

UNIT-3
Design Engineering: Design concepts, data design, software architecture, Architectural styles and patterns, User interface design - Golden rules, User interface analysis and design, Effective Modular Design.
Learning Outcomes:
At the end of the module, students will be able to:
1. List the software architecture style for the given problem. (L1)
2. BuildGoldenrulesfor the given problem (L3)
3. User Interface Analysis and Design (L5)

UNIT-4

Coding&Testing: Coding standards, code review and verification, Testing levels: Unit testing, integration testing, system testing . alpha and beta testing, black box and white box testing, debugging.

Learning Outcomes:

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

1. Implementation of coding standards(L6)
2. Apply different Testing concepts (L3)

UNIT-5

Risk Management: Risk types, strategies, Estimation and Planning. Software Quality .McCall Quality factors, Six Sigma for Software Quality, Quality Assurance and its techniques.

Applications: analyze the risks in any software project

Learning Outcomes:

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

1. Evaluate different Risk management techniques. (L5)

Text books:

1. Roger S. Pressman, Software Engineering, A practitioner.s Approach, 7thEdition, McGraw-Hill International Edition, 2009
2. Rajib Mal, Fundamentals of software Engineering, 3rdEdition, Eastern Economy Edition, 2009

Reference books:

1. Sommerville, Software Engineering, 7thEdition, Pearson education, 2004
2. K KAggarwal and Yogeshsingh, Software engineering,3rd Edition,New age International publication,2008

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0008	**Introduction to Data Mining**	3	0	0	3

COURSE OBJECTIVES:

- Students will be enabled to understand and implement classical models and algorithms in data warehousing and data mining.
- They will learn how to analyze the data, identify the problems, and choose the relevant models and algorithms to apply.
- They will further be able to assess the strengths and weaknesses of various methods and algorithms and to analyze their behavior.

COURSE OUTCOMES:

- Understand the process of knowledge discovery from data.
- Analyze the Data Pre-processing techniques.
- Apply classification techniques to various data sets.
- Apply the association rule mining to real time applications
- Apply the clustering algorithms to various data sets.

UNIT –I:

Introduction: Why Data Mining? What Is Data Mining? What Kinds of Data Can Be Mined? What Kinds of Patterns Can Be Mined? Which Technologies Are Used? Which Kinds of Applications Are Targeted? Major Issues in Data Mining. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity

Learning Outcomes: Student should be able to

1. Summarize the process of Data mining.(L2)
2. Classify various kinds of Data Mining techniques.(L2)
3. Memorize different visualization techniques.(L1)
4. Differentiate a data warehouse with data mining(L4)

UNIT –II:

Data Pre-processing: Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization

Learning Outcomes: Student should be able to

1. Recognize various steps in Data Preprocessing.(L1)
2. Identify the process of handling noisy data.(L1)

UNIT –III:

Classification: Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Working of Decision Tree, building a decision tree, methods for expressing an attribute test conditions, measures for selecting the best split, Algorithm for decision tree induction.

Classification: Alterative Techniques, Bayesian Classifier: Bayes theorem, using bayes theorem for classification, Native Bayes Classifier: Bayes error rate, Bayesian Belief Networks: Model representation, model building (Tan)

Learning Outcomes: Student should be able to

1. Summarize the process of classification.(L2)
2. Apply the process of classification on sample data.(L3)
3. Construct a decision tree for any sample data.(L3)
4. Calculate Bayes probability for any given data(L3)
5. Calculate Naïve Bayes probability.(L3)

UNIT –IV:

Association Analysis: Basic Concepts and Algorithms: Problem defination, Frequent Item Set generation, Rule generation, compact representation of frequent item sets, FP-Growth Algorithm. **(Tan &Vipin)**

Learning Outcomes: Student should be able to

1. Apply the Apriori algorithm on any sample data.(L3)
2. Construct an FP tree for any sample data. (L3)

UNIT –V

Cluster Analysis: Basic Concepts and Algorithms: Overview: What Is Cluster Analysis? Different Types of Clustering, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bisecting K-means, Strengths and Weaknesses; Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. **(Tan &Vipin)**

Learning Outcomes: Student should be able to

1. Identify the data objects and partition them into different clusters.(L2)
2. Apply the different clustering techniques on sample data.(L3)
3. Acquire the knowledge of The strenthg and weakness of clustering algorithms.(L2)

TEXT BOOKS:

1. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson.
2. Data Mining concepts and Techniques, 3/e, Jiawei Han, Michel Kamber, Elsevier.

REFERENCE BOOKS:

1. Data Mining Techniques and Applications: An Introduction, Hongbo Du, Cengage Learning.
2. Data Mining : VikramPudi and P. Radha Krishna, Oxford.
3. Data Mining and Analysis - Fundamental Concepts and Algorithms; Mohammed J. Zaki,Wagner Meira, Jr, Oxford
4. Data Warehousing Data Mining & OLAP, Alex Berson, Stephen Smith, TMH.

MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2				1			2	2	1	2
CO2	2	3	2	1	2				1			2	2	1	1
CO3	3	2	2	1	2				1			2	2	1	1
CO4	3	3	2	2	2				1			2	2	1	3
CO5	3	2	3	1	2				1			2	2	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0009	**FUNDAMENTALS OF WEB TECHNOLOGIES**	3	0	0	3

COURSE OBJECTIVES:

1. Creating Web User Interfaces
2. Creating dynamic Web pages
3. Implementing the usage of Scripts in Web Pages
4. Analyzing real world objects into Web Pages as Scripts Handlers
5. Analyzing look and feel kind of applications which are useful for real world
6. Web framework implementation using Model View Controller
7. Writing background scripts to run the virtual machines and servers

COURSE OUTCOMES:

1. Demonstrate knowledge on web page design elements.
2. Design web pages with dynamic content
3. Create Responsive layout with customized forms
4. Implement simple client-side scripts using AJAX
5. Build web applications using PHP

UNIT-I:

HTML: Introduction: Fundamentals of HTML, Working with text, Organizing text in HTML, Working with links and URLs, Creating tables, Working with images, Canvas, Forms, Frames and Multimedia.
HTML5: Introduction, HTML5 document structure, Creating editable content, Checking spelling mistakes.

Learning Outcomes:

After completion of this unit, student will be able to

- Identify basic steps that are followed to develop web applications [L2]
- Understand the functions of different HTML5 tags and how to use them [L2]
- Design and develop basic web pages using HTML5[L3]

UNIT-II:

CSS AND JAVASCRIPT: CSS: Introduction, CSS selectors, Inserting CSS in an HTML document, Backgrounds, Fonts and Text styles, Creating boxes, Displaying, Positioning and floating elements, Features of CSS3,Media queries. JavaScript: Overview of JavaScript, JavaScript functions, Events, Image maps and animations, JavaScript objects, working with browser and document objects.

Learning Outcomes:

After completion of this unit, student will be able to

- Learn the basic syntax of the CSS Style rule[L2]
- Get an idea about different CSS Selectors[L2]
- Use style rules to apply styles to different elements[L3]
- Understand HTML5 DOM object hierarchy[L2]
- Understand java script event handling mechanism[L2]

UNIT -III:

JQUERY and BOOTSTRAP: JQuery: Introduction, JQuery selectors, Events, Methods to access HTML elements and attribute. Bootstrap: Getting started with Bootstrap, Creating responsive layouts using Bootstrap CSS - Basic HTML structure for Bootstrap, Responsive classes, Rendering images, the grid system, Constructing data entry forms.

Learning Outcomes:

After completion of this unit, student will be able to

- Understanding the Bootstrap file structure[L2]
- Learning the basics of responsive design[L2]
- Understanding the all-important grid system in Bootstrap[L2]
- Introduce Bootstrap as a responsive design framework[L2]

UNIT –IV:

XML: Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches, AJAX A New Approach: Introduction to AJAX, Integrating PHP and AJAX.

Learning Outcomes:

After completion of this unit, student will be able to

- Learn the basic building blocks of XML Documents [L1]
- Understand how name clashes are avoided using namespaces [L2]
- Learn how to create forms dynamically [L2]
- Learn how to generate dynamic tables[L2]
- Write interactive web applications using AJAX [L3]

UNIT-V:

INTRODUCTION TO PHP: Introduction, Data types, Variables, Constants, Expressions, String interpolation, Control structures, Functions, Arrays, Embedding PHP code in web pages, Object Oriented PHP.PHP Web forms: PHP and web forms, Sending form data to a server, Working with cookies and session handlers PHP with MySQL: Interacting with the database, Prepared statement, Database transactions.

Learning Outcomes:

After completion of this unit, student will be able to

- Examine the relationship between PHP and MySQL L2]
- Plan a PHP Web application [L4]
- Create and use a Logon Window [L6]
- Manage User sessions using cookies and sessions [L3]

Text Books:

1. Kogent Learning Solutions Inc, HTML 5 Black Book: Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP and JQuery, Dreamtech Press, Second Edition, 2016.
2. W. Jason Gilmore, Beginning PHP and MySQL, APress, Fourth Edition, 2011.

Reference Books:

1. Snig Bahumik, Bootstrap Essentials, PACKT Publishing, 2015 (e-book).
2. Thomas A. Powell, The Complete Reference: HTML and CSS, Tata McGraw Hill, Fifth Edition, 2010
3. Andrea Tarr, PHP and MySQL, Willy India, 2012.
4. Ruby on Rails Up and Running, Lightning fast Web development, Bruce Tate, Curt Hibbs, Oreilly (2006)

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

COs	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	3	2	2	2	2				1			2	2	1	2
CO2	2	3	2	1	2				1			2	2	1	1
CO3	3	2	2	1	2				1			2	2	1	1
CO4	3	3	2	2	2				1			2	2	1	3
CO5	3	2	3	1	2				1			2	2	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0010	**FUNDAMENTALS OF COMPUTER NETWORKS**	3	0	0	3

Course Objectives:

1. To introduce the fundamental various types of computer networks.
2. To understand state-of-the-art in network protocols, architectures, andapplications.
3. To explore the various layers of OSI Model.

Course Outcomes:

The students can

1. Understand OSI and TCP/IP reference models with an emphasis to Physical Layer, Data Link Layer and NetworkLayer.
2. Analyze the issues related to data link, medium access and transport layers by using channel allocation and connection management schemes. Analyze MAC layer protocols and LANtechnologies.
3. Solve problems related to Flow control, Error control, Congestioncontroland Network Routing.
4. Design and compute subnet masks and addresses for networkingrequirements.
5. Understand how internet works

UNIT-I:

Introduction: Network Hardware and software Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN.

Physical Layer: Guided Transmission Media, Digital Modulation and Multiplexing: frequency division multiplexing, wavelength division multiplexing, synchronous time division multiplexing, statistical time division multiplexing.

UNIT-II:

The Data Link Layer - Design Issues, Services Provided to the Network Layer – Framing – Error Control – Flow Control, Error Detection and Correction – Error-Correcting Codes – Error Detecting Codes, Elementary Data Link Protocols, Sliding Window Protocols.

Channel allocation methods: TDM, FDM, ALOHA, Carrier sense Multiple access protocols, Collision Free protocols – IEEE standard 802 for LANS – Ethernet, Token Bus, Token ring, Bridges and IEEE 802.11 and 802.16. Data link layer switching, virtual LANs.

UNIT-III:

Network layer Routing Algorithms: Design Issues, Routing Algorithms-Shortest path, Flooding,

Flow based Distance vector, Link state, Hierarchical, Broadcast routing, Congestion Control algorithms-General principles of congestion control, Congestion prevention polices, Choke packets, Load shedding, and Jitter Control.

Internet Working: Tunnelling, internetworking, Fragmentation, Network layer in the internet– IP protocols, IP address, Subnets, Internet control protocols, OSPF, BGP, Internet multicasting, Mobile IP, IPV6.

UNIT IV:

The Transport Layer: Elements of transport protocols – addressing, establishing a connection, releasing connection, flow control and buffering and crash recovery, End to end protocols: UDP, Real Time Tran sport Protocol.

The Internet Transport Protocol: TCP- reliable Byte Stream (TCP) end to end format, segment format, connection establishment and termination, sliding window revisited, adaptive retransmission, TCP extension, Remote Procedure Call.

UNIT – V:

Application Layer: WWW and HTTP: Architecture- Client (Browser), Server, Uniform Resource Locator HTTP: HTTP Transaction, HTTP Operational Model and Client/Server Communication**,** HTTP Generic Message Format, HTTP Request Message Format, HTTP Response Message Format.

The Domain Name System: The DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery.

Text Books:

1. Data Communications and Networks – Behrouz A. Forouzan, Third Edition ,TMH.
2. Computer Networks, 5ed, David Patterson,Elsevier
3. Computer Networks: Andrew S Tanenbaum, 5th Edition. PearsonEducation/PHI
4. Computer Networks, Mayank Dave, CENGAGE

References:

1. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010
2. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGraw Hill Education
3. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, PearsonEducation.
4. Understanding communications and Networks, 3rd Edition, W.A. Shay, ThomsonThe TCP/IP Guide, by Charles M. Kozierok, Free online Resource,http://www.tcpipguide.com/free/index.htm.

Subject Code	|Subject Name	L	T	P	C
R23CSE-OE0011	**BASICS OF CLOUD COMPUTING**	**3**	**0**	**0**	**3**

Course Objective :

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
3. To enable students exploring some important cloud computing driven commercial systems and applications.

Course Outcomes :

Upon completion of the course, it is expected that student will be able to:

1. Understand and analyze different computing paradigms
2. Understand the basics of cloud computing and different cloud deployment models.
3. Understand different cloud implementation and management strategies.
4. Understand and evaluate different cloud service models.
5. Identify, analyze and use different cloud services /applications/tools available from key cloud providers.

UNIT-I:

Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing..

UNIT-II:

Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud Computing, Cloud Computing is a Service, Cloud Computing is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models

UNIT-III:

Cloud Computing Architecture and Management: Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure, Managing the Cloud Application, Migrating Application to Cloud, Phases of Cloud Migration Approaches for Cloud Migration.

UNIT-IV:

Cloud Service Models: Infrastructure as a Service, Characteristics of IaaS. Suitability of IaaS, Pros and Cons of IaaS, Summary of IaaS Providers, Platformas a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Summary of PaaS Providers, Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Summary of SaaS Providers, Other Cloud Service Models.

UNIT-V:

Cloud Providers and Applications : EMC, EMC IT, Captiva Cloud Toolkit, Google Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM, Cloud Models, IBM Smart Cloud, SAP Labs, SAP HANA Cloud Platform, Virtualization Services Provided by SAP, Sales force, Sales Cloud, Service Cloud: Knowledge as a Service, Rack space, VMware, Manjra soft, Aneka Platform**.**

Text Book:

i. Essentials of Cloud Computing, K. Chandra sekhran, CRC press.

Reference Books:

i. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrzej M. Goscinski,Wiley.
ii. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier.
iii. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumara swamy, Shahed Latif, O 'Reilly.

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0012	**INTRODUCTION TO MACHINE LEARNING**	3	0	0	3

Course Objectives:

- To familiarize with a set of well-known Machine Learning (ML) algorithms.
- The ability to implement machine learning algorithms.
- To understand how machine learning algorithms are evaluated.
- To formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms with their pros and cons.

Course Outcomes:

- Illustrate the characteristics of machine learning algorithms.
- Summarize the process of classification using decision tree approach.
- Apply Bayesian classifier to label data points an ML approach.
- Understand computational and instance-based learning.
- Understand advanced computational and types of learning.

UNIT I: (10 Hours)

Introduction: Well- posed learning problems, designing a learning system, perspectives, and issues in machine learning. Applications of machine learning. **Concept Learning:** Concept learning and the general to specific ordering. Concept learning task, Concept learning as search, Find-s: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias.

Learning Outcomes: Student will be able to

- Summarize the process of machine learning.
- Recognize various machine learning Applications.
- Understand various candidate elimination algorithms

UNIT II: (09 Hours)

Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, the basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning

Learning Outcomes: Student will be able to

- Summarize the process of classification.
- Construct a decision tree for any sample data.

UNIT III: (11 Hours)

Bayesian learning: Bayes theorem, Byes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Bayes optimal classifier, An example learning to classify text, Bayesian belief networks

Learning Outcomes: Student will be able to

- Calculate Bayes probability for any given data.
- Calculate Naïve Bayes probability.
- Distinguish the process of Bayes and Naïve Bayes probability calculation.

UNIT IV: (09 Hours)

Computational learning theory – 1: Probability learning an approximately correct hypothesis, Sample complexity for infinite Hypothesis spaces, The mistake bound model of learning- Instance- Based learning- Introduction.

Learning Outcomes: Student will be able to

- Understand Probability learning and Instance- Based learning.

UNIT V: (09 Hours)

Computational learning theory – 2: K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning

Learning Outcomes: Student will be able to

- Understand the concept of classification.
- Distinguish lazy Lazy and Eager Learning.

Contemporary Problems:

Explore Modern Tools- Altair Rapid Miner Tools- Scalability Issues- Regularity Complex-Black Box Problem

Text Books

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Raschka, Sebastian and Mirjalili, Vahid, Python Machine Learning, 3rd Edition, Packt Publishing., 2019
3. Stephen Marsland- Machine Learning – An Algorithmic Perspective – Second Edition – Chap Man & Hall CRC Press, 2015

References

1. Ethem Alpaydin, Introduction to machine learning, 2nd edition, PHI.
2. Kevin P. Murphy, "Machine Learning," A Probabilistic Perspective, MIT Press, 2012

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO1	3	3	1	2	2			1	2	1		2	1	2	1
CO2	3	3	1	2	2			1	2	1		2	1	2	1
CO3	3	3	3	3	3			1	2	1		2	1	2	1
CO4	3	3	1	2	2			1	2	1		2	1	2	1
CO5	3	3	1	2	2			1	2	1		2	1	2	1

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0013	**ESSENTIALS OF CYBER SECURITY**	3	0	0	3

Course Objectives:

1. Understand the fundamental concepts and principles of cyber security.
2. Understand Security architecture, risk management, attacks, incidents, and emerging IT and IS technologies.
3. To Provide the importance of Cyber Security and the integral role of Cyber Security professionals.
4. Recognize the importance of cybersecurity in protecting digital assets and information.
5. Analyze real-world cyber-attack scenarios and case studies.

Course Outcomes:

1. Understand Cyber Security architecture principles
2. Analyze the System and application security threats and vulnerabilities
3. Estimate operational cyber security strategies and policies.
4. Apply security model to handle mobile, wireless devices and related security issues.
5. Analyze the functionality of Security Technologies and Controls in Cybersecurity

UNIT - I: (8 Hours)

Introduction to Cyber Security: Need for Cyber security - History of Cyber security - Defining Cyberspace and Cyber security, scope of Cyber security, Importance of Cyber security in the modern world, Evolution of cyber threats,Importance of Cybersecurity in the digital age.

Foundations of Cyber Security: Cyber Security principles, threat models, and cyber laws. Confidentiality, integrity, and availability (CIA) Triad– Cyber security Framework, Security principles and concepts, Risk management.to better understand the dynamics of Cyber Security.

Learning Outcomes:student will be able to

- Outline the Importance of Cyber security. (L2)
- Understand the Security architecture principles and concepts. (L2)
- Understand the Design of Cyber security Framework. (L2)

UNIT-II: (10 Hours)

Common Threats and Attack Vectors: Introduction, Proxy Servers and Anonymizers, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Social Engineering attacks: Introduction, Phishing, spear phishing, pretexting, Identity Theft (ID Theft).

Learning Outcomes:student will be able to

- Understand about the Cyber security Threats and Attacks. (L2)
- Summarize the various types of application security vulnerabilities(L2)
- Analyze the System and application security threats and vulnerabilities(L4)

UNIT-III: (12 Hours)

Introduction to Cyber Crime, law and Investigation: Introduction to Cybercrime**,** Definition and scope of cybercrime, Categories of cybercrimes, Impact of cybercrime, Cybercrime and Information Security, classifications of cybercrimes, Cybercrime: The Legal Perspectives, cybercrime and theIndian IT Act 2000, a Global perspective on Cybercrimes.

Cyber laws: Introduction to Cyber Laws, Need for Cyber laws The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Information Security Planning and Governance, Information Security Policy Standards.

Learning Outcomes: student will be able to

- Extend The Categories of cybercrimes and Impact of cybercrime(L2)
- Understand about the Need for Cyber laws and Cybercrime Scenario in India(L2)
- Estimate operational cyber security strategies and policies(L5)
- Develop an understanding of cybercrimes and various legal perspectives involved(L3)

UNIT-IV: (10 Hours)

Cybercrime-Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Authentication Service Security, Attacks on Mobile/Cell Phones.

Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Learning Outcomes: student will be able to

- Understand Various devices and related security issues (L2)
- Develop a security model to handle Policies and Measures in Computing era(L3)
- Develop a security model to handle mobile, wireless devices and related security issues of an organization (L3)

UNIT-V: (8 Hours)

Security Technologies and Controls in Cyber security: Access control mechanisms, Encryption, Firewalls, intrusion detection systems (IDS), intrusion prevention systems (IPS), Network Security, Security Information and Event Management (SIEM),functionality of cyber security tools.

Legal and Ethical Aspects of Cyber Security: Laws and regulations governing cyber security,
Ethical considerations in cyber security practices, Privacy issues.

Learning Outcomes: student will be able to

- Analyze the functionality of Security Technologies and Controls in Cyber security(L4)
- Outline the Ethical considerations in cyber security practices(L2)
- Understand the functionality of cyber security tools(L2)

Text Books:

1. Computer Security: Principles and Practice, Third Edition, William Stallings, Lawrie Brown ,Pearson Education, 2014.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole, SunitBelapure, 1st Edition Publication Wiley, 2011.
3. William Stallings, Effective Cyber security: A Guide to Using Best Practices and Standards, 1st edition, 2019.
4. Mark Rhodes, Ousley, Information Security, 1st Edition, MGH, 2013.

Reference Books:

1. Principles of Information Security, MichaelE. Whitman and Herbert J. Mattord, CengageLearning.
2. 2. Charles J. Brooks, Christopher Grow, Philip A. Craig, Donald Short, Cybersecurity Essentials, Wiley Publisher, 2018.
3. Yuri Diogenes, ErdalOzkaya, Cyber security - Attack and Defense Strategies, Packt Publishers,

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

CNO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	3	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**
	3	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**1**
	3	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**
	3	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**1**
	3	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**2**	**-**
	3	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**2**	**1**

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0014	**INTRODUCTION TO REACT JS**	3	0	0	3

Course Objectives:

- To learn essential React JS skills for front-end development.
- To explore client-side JavaScript application development and the React library.
- To implement React components, hooks, and state management for building interactive UIs.
- To gain experience with React.js, JSX, HTML, CSS, and JavaScript.
- To create a functional front-end web application using React.

Course Outcomes:

1. Understand the anatomy of React Java Script. (L2)
2. Understand the life cycle methods of React JS. (L2)
3. Implement React components for building applications. (L3)
4. Apply React hooks for component reusability and monitoring. (L3)
5. Implement React rendering for interactive applications. (L3)

Unit 1 (10 Hours)

React JS: Introduction to React JS, React vs Angular, React Version History, Architecture of the React Application, Installation, Creating and Running React App, Anatomy of React Project.
Templating using JSX: Expressions, Operators, Attributes, Fragments.

Learning Outcomes: Student will be able to

- Understand react framework for building applications. (L2)
- Understand the installations of react packages. (L2)
- Implement templates in react applications. (L3)

Unit 2 (8 Hours)

React Core: Props, State, Event Handling, Lists and Keys, Styling, Pagination, React Life Cycle, Life Cycle Methods, State Management, Mounting Life Cycle.

Learning Outcomes: Student will be able to

- Understand event handling in React. (L2).
- Implement life cycle methods in react. (L3).
- Implement props and states in building react apps. (L3)

Unit 3 (10 Hours)

React Components: Pure Components, memo, Refs, Portals, Higher Order Components (HOC), Context, HTTP requests (POST & GET).

Learning Outcomes: Student will be able to

- Understand http request methods in handling end points. (L2)
- Implement components to handle react requests. (L3)
- Implement higher order components and refs in react. (L3)

Unit 4 (12 Hours)

React Hooks: Introduction to Hooks, useState, useEffect, Run Effects, Fetching Data, useContext, useReducer, useCallBack, useMemo, useRef, Custom Hooks

Learning Outcomes: Student will be able to

- Understand react hooks. (L2)
- Apply hooks and custom methods for handling components. (L3)
- Implement context and callback methods in hooks. (L3)

Unit 5 (8 Hours)

React Render: Introduction to Rendering, useState, useReducer, State Immutability, Parent & Child, Memo, Context, useCallBack.

Learning Outcomes: Student will be able to

- Understand the working react rendering. (L2)
- Implement userReducer and context for rendering react apps. (L3)

TEXT BOOKS:

1. React.js Book: Learning React JavaScript Library From Scratch by Greg Sidelnikov, Learning Curve.
2. React: Quickstart Step-By-Step Guide To Learning React Javascript Library (React.js, Reactjs, Learning React JS, React Javascript, React Programming) by Lionel Lopez

REFERENCE BOOKS:

- Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js, 2nd Edition by Shama Hoque, Packt

Course Code	Subject Name	L	T	P	C
R23CSE-OE0015	**Deep Learning**	3	0	0	3

Course Objectives

1. Understand the fundamentals of machine learning algorithms and their challenges.
2. Learn the architecture and training of deep feedforward networks.
3. Master regularization techniques to improve deep learning model performance.
4. Explore optimization methods for training deep neural networks.
5. Gain comprehensive knowledge of convolutional neural networks and their applications.

Course Outcomes: Upon successful completion of course , students will be able to

1. Apply machine learning algorithms to solve practical problems, demonstrating understanding of overfitting and underfitting (Application).
2. Analyse and design deep feedforward networks using gradient-based learning techniques (Analysis).
3. Evaluate the effectiveness of various regularization techniques to enhance model performance and robustness (Evaluation).
4. Analyse advanced optimization strategies to efficiently train deep neural networks (Synthesis).
5. Understand the convolutional neural networks, explaining their significance in the context of deep learning history and neuroscientific principles.

Unit-I – Machine Learning Basics (8 Hours)

Learning Algorithms-Capacity,OverfittingandUnderfitting-HyperparametersandValidationSets-Estimators,BiasandVariance -SupervisedLearningAlgorithms -UnsupervisedLearningAlgorithms -ChallengesMotivatingDeepLearning.

Learning Outcomes: Student will be able to understand the fundamentals of machine learning.

Application:ML Algorithms can use in health care, NLP and computer vision applications.

Unit – II: DeepNetworks (8 Hours)

Deep Feed forward Networks: Example: Learning XOR - Gradient-Based Learning - Hidden Units - Architecture Design – BackPropagation and Other Differentiation Algorithms.

Learning Outcomes: Student will be able to analyse the fundamentals of deep learning.

Application: Deep Networks can use in NLP and finance applications for solving complex problems.

Unit – III: Regularization for Deep Learning (8 Hours)

Parameter Norm Penalties – Norm Penaltiesas Constrained Optimization- Regularization and Under Constrained Problems – DatasetAugmentation-NoiseRobustness- SemiSupervisedLearning- MultiTaskLearning- EarlyStopping - ParameterTyingandParameterSharing – SparseRepresentations -BaggingandOtherEnsembleMethods -Dropout.

Learning Outcomes: Student will be able to evaluate the regularization importance in deep neural networks.

Application: Regularization is used for improve the performance of network in various applications like computer vision and NLP etc.

Unit – IV: Optimization for Training Deep Models (8 Hours)

How Learning Differs from Pure Optimization- Challenges in Neural Network Optimization- Basic Algorithms – Parameter Initialization Strategies – Algorithms with Adaptive Learning Rates- Approximate Second Order Methods- Optimization Strategies and Meta-Algorithms.

Learning Outcomes: Student will be able to analyse the fundamentals of optimization techniques in deep learning.

Application: Optimization techniques are using in many applications like NLP,computer vision and finance sector.

Unit – V: Convolutional Networks (8 Hours)

The Convolution Operation- Motivation- Pooling – Convolution and Pooling as an Infinitely Strong Prior – Variants of the Basic Convolution Function- The Neuro scientific Basis for Convolutional Networks – Convolutional Networks and the History of Deep Learning.

Learning Outcomes: Student will be able tounderstand the purpose of CNN and its importance in deep learning.

Application:CNN used in the area of computer vision applications and many more like NLP, finance and manufacturing sectors.

Text Books: Ian Goodfellow and Yoshua Bengio and Aaron Courville," Deep Learning"MIT Press, 2017.
References Books:
1. Shai ShalevShwartz, Shai BenDavid"Understanding Machine Learning: From Theory to Algorithms" , Cambridge Press
2.Peter Harington " Machine Learning in Action", , 2012, Cengage.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	2	1	1	1							1			1
C02	3	2	1	1	1							1			1
C03	3	2	1	1	1							1			1
C04	3	2	1	1	1							1			1
C05	3	2	1	1	1							1			1

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0016	**DevOps**	3	0	0	3

Course Objectives:
DevOps improves collaboration and productivity by automating infrastructure and workflows and continuously measuring applications performance.
(Need to write at least 5 objects for this course)

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

1. Enumerate the principles of continuous development and deployment, automation of configuration management, inter-team collaboration, and IT service agility
2. Understand different actions performed through Version control tools like Git.
3. Illustrate the types of version control systems, continuous integration tools, continuous monitoring tools, and cloud models
4. Ability to Perform Automated Continuous Deployment
5. Understand to leverage Cloud-based DevOps tools using Azure DevOps

Need to write what is the skill gained by student at the end of each unit and mention the blooms taxonomy levels in parenthesis for each course outcome

UNIT –I:
Introduction to Software Engineering: Phases of Software Development life cycle. Models ,Values and principles of agile software development.
Learning outcomes:

- Identify and describe the phases of the Software Development Life Cycle (SDLC) (Knowledge, Understanding). (L1 & L2)
- Compare and contrast different software development models (e.g., Waterfall, Agile) and their applications (L3)
- Apply the values and principles of agile software development in real-world scenarios (L3)

UNIT -II: Introduction To DevOps -Devops Essentials – Introduction To AWS, GCP, Azure – Version control systems: Git and Github.
Learning outcomes:

- Understand the essentials of DevOps and its importance in modern software development (L2)
- Demonstrate the use of version control systems(L3)
- Compare cloud platforms and their relevance to DevOps practices (L3)

UNIT –III:
DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes.
Learning outcomes:

- Analyze the technology aspects required for successful DevOps adoption (L4)
- Analyze the agile capabilities and tool stack implementation for DevOps in various projects (L4)
- Analyze the people and process aspects necessary for DevOps adoption and their impact on project success (L4)

UNIT -IV:

CONTINUOUS INTEGRATION USING JENKINS: Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

Learning outcomes:

- Install and configure Jenkins for continuous integration (L3)
- implement Jenkins jobs and pipelines, including configuring jobs and adding plugins (L3)
- Understand Jenkins in continuous integration by creating and managing builds (L2)

UNIT–V: BUILDING DEVOPS PIPELINES USING AZURE : Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file

Learning outcomes:

- Create and manage repositories on GitHub and integrate them with Azure DevOps (Application). (L3)
- Implement new pipeline in Azure DevOps and build sample code using azure-pipelines.yaml file(L3)
- Analyze the Modification and optimization Azure DevOps pipelines for continuous deployment (L4)

Text Books:

- Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
- Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014

Reference Books:

- Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for … DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni
- Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
- David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
- MariotTsitoara, "Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.

Web References :

- https://www.jenkins.io/user-handbook.pdf
- https://maven.apache.org/guides/getting-started/

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

Course	CNO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
DevOps		3	3	2	2					2			1	3	1	2
		3	3	2	2					2			1	3	1	2
		3	3	2		2				2			1	3	1	2
		3	3	2		2				2			1	3	1	2
		3	3	2		2				2			1	3	1	2
		3	3	2	2	2				2			1	3	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0017	**Mobile Computing**	3	0	0	3

Course Objective:

1. Understand the fundamental concepts, architecture, and paradigms of mobile computing and GSM.
2. Comprehend the motivation for specialized MAC techniques in wireless communications, addressing issues such as hidden and exposed terminals, near and far terminals and IEEE 802.11.
3. Analyze the IP and Mobile IP network layers, focusing on packet delivery, handover management, location management, registration, tunneling, encapsulation and DHCP.
4. Understand conventional TCP/IP protocols and specialized protocols like Indirect TCP, Snooping TCP, and Mobile TCP for mobile networks and database issues in mobile computing.
5. Introduce the concept, applications, and challenges of Mobile Ad hoc Networks (MANETs), and to explore various routing algorithms such as DSR, AODV, and DSDV.

Course Outcomes: Upon Successful completion of Course, the students will be able to

1. Understand t the fundamental concepts, architecture, and paradigms of mobile computing and GSM.
2. Understand the need for specialized MAC techniques in wireless communications, addressing challenges like hidden and exposed terminals, near and far terminals and IEEE 802.11.
3. Understand the concept of the IP and Mobile IP network layers, focusing on packet delivery, handover management, location management, registration, tunnelling, encapsulation, route optimization, and DHCP.
4. Understand proficient in conventional TCP/IP protocols as well as specialized protocols like Indirect TCP, Snooping TCP, and Mobile TCP.
5. Understand the concept, applications, and challenges of Mobile Ad hoc Networks (MANETs).

UNIT I

Introduction: Mobile Communications, Mobile Computing – Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Handheld Devices, Limitations of Mobile and Handheld Devices.

GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization and Calling, Handover, Security, New Data Services, GPRS.

Learning Outcome:

1) Student able to understand the basic concepts of mobile communications and GSM.

UNIT –II

(Wireless) Medium Access Control (MAC): Motivation for a specialized MAC (Hidden and exposed Terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.

Learning Outcome:

1) Student able to differentiate the SDMA,FDMA,TDMA and CDMA.

UNIT –III

Mobile Network Layer:IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunnelling and Encapsulation, Route Optimization, DHCP.

Learning Outcome:

1) Student able to explain the Mobile IP in mobile networks.

UNIT –IV

Mobile Transport Layer: Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks.

Learning Outcome:

1) Student able to understand the issues of databases and Mobile TCP/IP in mobile networks.

UNIT V

Mobile Ad hoc Networks (MANETs): Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc., Mobile Agents, Service Discovery. **Protocols and Platforms for Mobile Computing:** WAP, Bluetooth, XML, J2ME, Java Card, PalmOS, Windows CE, SymbianOS, Linux for Mobile Devices, Android.

Learning Outcomes:

1) Student able to identify the best routing protocol for mobile networks for data transmission.

Text Books:

1. Jochen Schiller, “Mobile Communications”, Addison-Wesley, Second Edition, 2009.
2. Raj Kamal, “Mobile Computing”, Oxford University Press, 2007, ISBN: 0195686772

Reference Book:

1. ASOKE K TALUKDER, HASAN AHMED, ROOPA R YAVAGAL, “Mobile Computing, Technology Applications and Service Creation” Second Edition, Mc Graw Hill.
2. UWE Hansmann, Lother Merk, Martin S. Nocklous, Thomas Stober, “Principles of Mobile Computing,” Second Edition, Springer.

Course Code	Subject Name	L	T	P	C
R23CSE-OE0018	Java Full-Stack Development (Open Elective)	0	1	2	2

Course Objectives:

1. Understand the basics of full-stack web development and the software development life cycle.
2. Design simple and responsive web pages using HTML, CSS, and JavaScript.
3. Develop basic backend applications using Java Servlets, JSP, and connect to databases.
4. Learn how to use SQL for database management.
5. Build and deploy a simple full-stack project using basic tools.

Course Outcomes: After completing this course, students will be able to:

1. Understand the structure of a full-stack web application.
2. Design interactive and responsive web pages.
3. Write basic backend logic and connect to a database.
4. Apply simple SQL queries to manage data effectively.
5. Build and deploy a simple full-stack project.

Unit 1: Frontend Development

Introduction to Full-Stack Development

- What is Full-Stack Development?
- Frontend, Backend, and Databases overview

HTML & CSS Basics

- HTML5: Elements, Forms, Tables
- CSS3: Selectors, Flexbox, Grid
- Responsive design with media queries

JavaScript Basics

- Variables, Loops, Functions
- Simple DOM Manipulation and Event Handling

Unit 2: Backend Development

Java Servlets & JSP

- Servlet lifecycle
- Handling HTTP requests and responses
- Basic JSP: Scripting and Expressions

Introduction to Hibernate

- What is Hibernate?
- Basic setup and configuration
- Mapping simple Java classes to database tables

Unit 3: Database Development

SQL Basics

- SELECT, INSERT, UPDATE, DELETE
- Simple JOINs
- Basic database normalization

Hibernate Basics

- Using annotations for mapping
- Simple one-to-many relationships
- Basic queries with HQL

Unit 4: Introduction to Frameworks

Spring & Spring Boot

- What is Spring? IoC and Dependency Injection
- Introduction to Spring Boot: Starter packs, auto-configuration
- Simple Spring Boot application connecting to a database

Unit 5: REST APIs & Deployment

RESTful APIs

- Basic REST concepts: GET, POST, PUT, DELETE
- Building a simple REST API with Spring Boot

Deployment Basics

- Using Git/GitHub for version control
- Testing APIs with Postman
- Simple project deployment (local server)

Project & Capstone

Mini Projects:

- Online Book Store
- Student Portal or basic E-Commerce App

Tools:

- Git/GitHub for version control
- Maven/Gradle for builds
- Postman for testing

Project & Deployment Tools

- Git & GitHub – Version Control
- Maven/Gradle – Build Tools
- Postman – API Testing

Full-Stack Capstone Project

- Online Book Store / Student Portal
- E-Commerce App with Payment Gateway.

CONTEMPORARY TOPICS:

1. Micro services Architecture using Spring Boot and Spring Cloud
2. JWT-Based Authentication and Authorization in Web Applications
3. Containerization and Deployment using Docker and Kubernetes
4. Integration of No SQL Databases like MongoDB with Java Applications

APPLICATIONS:

1. **Online Book Store**
   - Features: User registration/login, book catalog, shopping cart, order management, admin panel
   - Tech Stack: Java Spring Boot , React/HTML-CSS-JS , MySQL
2. **Student Information Portal**
   - Features: Student profiles, course registration, grade tracking, admin dashboard
   - Tech Stack: Java Servlets + Hibernate, Bootstrap + JavaScript , PostgreSQL
3. **Job Placement Management System**
   - Features: Company registration, student applications, interview tracking, placement stats
   - Tech Stack: Spring Boot + JSP , HTML/CSS + JavaScript , MySQL

TEXT BOOKS:

1. "Learning Web Design" by Jennifer Niederst Robbins, 5th Edition, O'Reilly Media
2. "Beginning Hibernate: For Hibernate 5" by Joseph B. Ottinger, Jeff Linwood, Dave Minter, 4th Edition, Apress

REFERENCE BOOKS:

1. "Web Programming and Internet Technologies"byUttam K. Roy, Published 2010, Oxford University Press.
2. "Java: The Complete Reference" By Herbert Schildt, Published 2023, McGraw Hill Education

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**)**

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO 3**
117.1	3	2	2	1	3				1		1	1	2	3	3
117.2	3	2	2	1	3				1		1	1	2	3	3
117.3	3	3	3	2	3				1		1	2	3	3	3
117.4	3	3	3	2	3				1		1	2	3	3	3
117.5	2	2	2	2	2				1		1	1	2	2	2
117*	3	2	2	2	3				1		1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0019	Human Computer Interface	3	0	0	3

Course Objectives:

1. Demonstrate an understanding of guidelines, principles, and theories influencing human Computer interaction.
2. Recognize how a computer system may be modified to include human diversity.
3. Select an effective style for a specific application.
4. Design mock ups and carry out user and expert evaluation of interfaces.
5. Carry out the steps of experimental design, usability and experimental testing, and evaluation of human computer interaction systems.
6. Use the information sources available, and be aware of the methodologies and technologies supporting advances in HCI.

Course Outcomes:

UNIT-I:

The User Interface: Introduction, Importance of the User Interface, Importance and benefits of Good Design History of Human Computer Interface. Characteristics of Graphical and Web User Interface: Graphical User Interface, popularity of graphics, concepts of Direct Manipulation, Graphical System advantage and disadvantage, Characteristics of GUI. Web User Interface, popularity of web, Characteristics of Web Interface, Merging of Graphical Business systems& the Web, Principles of User Interface Design.

UNIT-II:

The User Interface Design Process: Obstacles and Pitfall in the development Process, Usability, The Design Team, Human Interaction with Computers, Important Human Characteristics in Design, Human Consideration in Design, Human Interaction Speeds, Performance versus Preference, Methods for Gaining and Understanding of Users

UNIT-III:

Understanding Business Functions: Business Definitions & Requirement analysis, Determining Business Functions, Design standards or Style Guides, System Training and Documentation

UNIT-IV:

Principles of Good Screen Design: Human considerations in screen Design, interface design goals, test for a good design, screen meaning and purpose, Technological considerations in Interface Design System Menus and Navigation Schemes: Structure, Functions, Context, Formatting, Phrasing and Selecting, Navigating of Menus, Kinds of Graphical Menus Windows Interface: Windows characteristic, Components of Window, Windows Presentation Styles, Types of Windows, Window Management, Web systems.

UNIT-V:

Device and Screen-Based Control: Device based controls, Operable Controls, Text entry/read-Only Controls, Section Controls, Combining Entry/Selection Controls, Other Operable Controls and Presentation Controls, Selecting proper controls

Text Books:

1. Wilbert O. Galitz, “The Essential Guide to User Interface Design”, Wiley India Edition
2. Prece, Rogers, “Sharps Interaction Design”, Wiley India.
3. Ben Shneidermann,”Designing the user interfaces”. 3rd Edition, Pearson Education Asia.

References Books:

1. Soren Lauesen, “User Interface Design” , Pearson Education
2. Alan Cooper, Robert Riemann, David Cronin, “Essentials of Interaction Design”, Wiley
3. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell, Bealg,”HumanComputer Interaction”, Pearson Education

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0020	**Cryptography and network security**	3	0	0	3

Course Objectives:

- Understand the fundamentals of Information Security
- Acquire knowledge on Security Needs to provide confidentiality, integrity and authenticity.
- Understand the various key cryptography concepts
- Design security applications using security policies
- Understand the Security Issues in TCP/IP

Course Outcomes:

1. Analyze the vulnerabilities in any computing system and hence be able to design a security solution
2. Identify the security needs in the network
3. Explain the basic objectives of symmetric &Asymmetric key cryptography technique to secure the communication over the internet
4. Identify the security policies to provide strong authentication
5. Understand basic ecommerce security protocols.

Unit 1: Introduction.

The History of Information Security, Balancing Information Security and Access, Introduction and Security Trends, General Security Concepts and introduction to what is an "info sphere", Operational Security and People's Role in Information Security.

Learning outcomes: Student should be able to

1. Understand various types of Information Security concepts (L2)
2. Analyze the role of information security.(L4)

Unit 2: Security Needs.

The Need for Security, Business Needs, Needs to protect against Threats and Attacks, Security in Emails. Secure Software Development.

Learning outcomes: Student should be able to

1. Understand the need of security to deal with the threats and attacks.(L2)

Unit 3: Cryptography Concepts.

Concepts of Data encryption, Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric& Asymmetric key Cryptography. Public Key Infrastructure (PKI), Different attacks on Cryptosystems

Network Security & Web Security.

Security Issues in TCP/IP – TCP, DNS, Routing (Topics such as basic problems of security in TCP/IP, IPsec, BGP Security, DNS Cache poisoning etc), Network Defense tools – Firewalls, Intrusion Detection, Filtering, DNSSec, NSec3, Distributed Firewalls

Learning outcomes: Student should be able to

1. Understand various Cryptography Concepts (L2)
2. Analyze the impact of Symmetric& Asymmetric key Cryptography in real time applications (L4)
3. Understand Security Issues in TCP/IP. (L2)
4. Identify the tools to provide the web and network security. (L2)

Unit 4: Security Policies and Security Handshake Pitfalls:
What is security policy, high and low level policy, user issues? Protocol problems, assumptions, Shared secret protocols, public key protocols, mutual authentication, reflection attacks, use of timestamps, nonce and sequence numbers, session keys, one-and two-way public key based authentication.
Learning Outcomes: Student should be able to

1. Understand various Security Policies for authentication (L2)
2. Identity various Security Handshake (L2)

Unit 5: Network Security:
Electronic mail security, IP security, Network management security. Security for electronic commerce: E-commerce security analysis, protocol, SSL, SET
System Security:
Intruders and Viruses, Firewalls, Intrusion Detection.
Learning outcomes: Student should be able to

1. Apply the concepts of the cryptography and security in case studies. (L4)

Text Books:
1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi.
2 Micki Krause, Harold F. Tipton, " Handbook of Information Security Management", CRC Press LLC
3. AtulKahate, Cryptography and Network Security, McGraw Hill
4 Kaufman, c., Perlman, R., and Speciner, M., Network Security, Private Communication in a public world, 2nd ed., Prentice Hall PTR., 2002
5. Stallings, W.,.Cryptography and Network Security: Principles and Practice, 3rd ed., Prentice Hall PTR.,2003
6. Stallings, W. Network security Essentials: Applications and standards, Prentice Hall, 2000

COURSE OUTCOMES VS POS MAPPING (HIGH:3; MEDIUM:2;LOW:1**):**

CNO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
	3	2						1				2		1	1
	2	2						1				2		1	1
	2	2						1				2		1	1
	2	2						1				2		1	1
	2	2						1				2		1	1
	2	2						1				2		1	1

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0021	**QUANTUM COMPUTING**	**3**	**0**	**0**	**3**

Course Objectives:

1. To understand the components of computing in a Quantum world
2. To gain knowledge on mathematical representation of quantum physics and operations.
3. To write computations in the real world (standard) in a Quantum computer and simulator.

Course Outcomes:

By the end of this course, the student is able to

1. Analyze the behavior of basic quantum algorithms
2. Implement simple quantum algorithms and information channels in the quantum circuit model
3. Simulate a simple quantum error-correcting code
4. Prove basic facts about quantum information channels
5. Know about Quantum Computing Models

UNIT –I:

Introduction: Quantum Measurements Density Matrices, Positive-Operator Valued Measure, Fragility of quantum information: Decoherence, Quantum Superposition and Entanglement, Quantum Gates and Circuits.

UNIT –II:

Quantum Basics and Principles: No cloning theorem & Quantum Teleportation, Bell's inequality and its implications, Quantum Algorithms & Circuits.

UNIT -III:

Algorithms: Deutsch and Deutsch–Jozsa algorithms, Grover's Search Algorithm, Quantum Fourier Transform, Shore's Factorization Algorithm.

UNIT –IV:

Performance, Security and Scalability: Quantum Error Correction: Fault tolerance; Quantum Cryptography, Implementing Quantum Computing: issues of fidelity; Scalability in quantum computing.

UNIT -V:

Quantum Computing Models: NMR Quantum Computing, Spintronics and QED MODEL, Linear Optical MODEL, Nonlinear Optical Approaches; Limits of all the discussed approaches, Future of Quantum computing.

Text Books:

1. Eric R. Johnston, Nic Harrigan, Mercedes and Gimeno-Segovia “Programming Quantum Computers: Essential Algorithms And Code Samples, SHROFF/O’Reilly.
2. Dr. Christine Corbett Moran, Mastering Quantum Computing with IBM QX: Explore the world of quantum computing using the Quantum Composer and Qiskit, Kindle Edition Packt

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0022	**BIG DATA ANALYTICS**	3	0	0	3

Course Objectives:

- Optimize business decisions and create a competitive advantage with Big Data analytics
- Introducing Hadoop concepts for developing solutions.
- Derive business benefits from unstructured data
- Imparting the architectural concepts of Hadoop and introducing map- reduce paradigm
- To introduce programming tools PIG & HIVE in the Hadoop ecosystem.

Course Outcomes:

1. Understands the basic concepts and challenges of handling Big Data.
2. Applying data modelling techniques of Big Data.
3. Analyze Hadoop components & its applications.
4. Analyze spark for optimized query execution and memory caching.
5. Understand the Big data frame work and its applications.

UNIT-I

Introduction: Introduction to Big data, Characteristics &Classification of Data, Challenges of conventional systems(storage), Intelligent data analysis, The Life cycle of Big Data Analytics, Typesof Big Data Analytics, Analytic processes, and tools, Big Data Industry Applications, Analysisvs. Reporting.

Learning Outcomes: Students will be able to

- Understands the Basic concept of Big Data.
- Understands their challenges in the industry

UNIT-II

Working with Big Data: Google File System, Hadoop Distributed File System (HDFS) –Building blocksof Hadoop (Name node, Datanode, Secondary Name node, Job Tracker,Task Tracker),WhatisNoSQL,WhyNoSQL, Use of No SQL in Industry, Comparison of SQL, No SQL, and New SQL ,No SQL Business Drivers ,No SQL Case Studies,

Learning Outcomes:Students will be able to

- Understand HDFS and its basic building blocks
- Understand No SQL for working with Data sets.

UNIT-III

IntroductiontoHadoop:why Hadoop, RDBMS versus Hadoop, History of Hadoop, Components of Hadoop, Hadoop Distributed File System (HDFS), Processing Data withHadoop, How Map Reduce Works, Anatomy of a Map Reduce Job run ,Map Reduce Features Hadoop environment. Interacting with Hadoop Ecosystem.

Learning Outcomes:Studentswill beableto

- UnderstandandimplementHadoopComponents.
- UnderstandtheConceptofInteractingwiththeHadoopEcosystem.

UNIT-IV

SPARK: SPARK BASICS, Using the Spark Shell, RDD Data Types and RDD Creation, RDDs (Resilient Distributed Datasets) in Spark, General RDD Operations: Transformations & Actions, RDD Lineage, RDD Persistence, Overview, Distributed Persistence

Learning Outcomes: Student will be able to

- Understand Hadoop Architecture,
- Explain about Hadoop Ecosystem components.

UNIT-V

Frameworks and Applications: HIVE : Hive Shell, Hive Services, Hive Meta store, Comparison with Traditional Databases **Learning,**Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive Architecture of Hive, Hive services, HiveQL, Querying Data in Hive, fundamentals of H Base and Zoo keeper.

Outcomes: Students will be able to

- Work with PIG and Hive Tech.
- Understandprogrammingtoolsof HIVEintheHadoopechosystem.
- Appling acompletebusinessdataanalyticsolution.

Text Books :

1. BigDataAnalytics2ndEdition,SeemaAcharya,SubhashiniChellappan,WileyIndiaPvt.Ltd, SecondEdition,1Jan 2019.
2. Min Chen, Shiwen Mao, Yin Zhang,Victor C.M. Leung, "Big Data: Related Technologies, Challenges and Future Prospects", Springer; 2014.
3. BigJava4thEdition,CayHorstman,WileyJohnWiley&Sons,INC,byWileyIndiaPvt. Ltd,2008.
4. Hadoop:TheDefinitiveGuidebyTomWhite,3rdEdition,O'Reilly,12June 2012.
5. Tom White, "Hadoop- The Definitive Guide", O'reilly, 4th Edition, April 2015.

Reference Books :

1. HadoopinPracticebyAlexHolmes,MANNINGPubl,SecondEdition,5Feb2015.
2. HadoopMapReduceCookbook,SrinathPerera,ThilinaGunarathne,Ingramshorttitle, 1Jan 2013.
3. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, RomanB.Melnyk,BruceBrown,Rafael Coss,byForDummies, FirstEdition,7 May2014.
4. Eric Sammer, "Hadoop Operations", O'Reilley, 2nd Edition., October 2012.

Software Links :

1. Hadoop:http://hadoop.apache.org/+
2. Hive:https://cwiki.apache.org/confluence/display/Hive/Home
3. Piglatin:http://pig.apache.org/docs/r0.7.0/tutorial.html
4. http://www.jbonneau.com/doc/2012-04-27-big_data_lecture_1.pdf
5. https: //www.ibm.com / developerworks / community / blogs / Susan Visser Editionntry/flash book understanding big data analytics for enterprise class hadoop and streaming data? Langen

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
x.1	1	2	2	3	1	2	1	1	1	-	2	1	1	2	1
x.2	2	1	3	3	3	-	-	-	1	-	-	1	2	3	1
x.3	1	2	1	3	3	3	-	-	1	-	1	1	3	3	1
x.4	2	2	3	3	3	1	1	-	-	-	1	1	3	3	3
x.5	2	2	3	3	3	1	1	-	-	-	1	1	3	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0023	**BLOCK CHAIN TECHNOLOGIES**	**3**	**0**	**0**	**3**

Course Objective:

1. To provide conceptual understanding of the function of Blockchain as a method of securing distributed ledgers.
2. To understand the structure of a Blockchain and why/when it is better than a simple distributed database
3. To make students understand the technological underpinnings of Blockchain operations as distributed data structures and decision making systems.

Course Outcomes:

Upon completion of the course, it is expected that student will be able to:

1. Define and explain the fundamentals of Blockchain.
2. Understand decentralization and the role of Blockchain in it.
3. UnderstandandanalyzeBitcioinCryptocurrencyandunderlyingBlockchainnetwork.
4. Understand Etherium currency and platform, and develop applications using Solidity.
5. Understand Hyper ledger project and its components; critically analyze the challenges and future opportunities in Block chain technology.

UNIT-I:

Introduction: History and basics, Types of Blockchain, Consensus, CAP Theorem.

Cryptographic Hash Functions: Properties of hash functions, Secure Hash Algorithm, Merkle trees, Patricia trees.

UNIT-II:

Decentralization: Decentralization using Blockchain, Methods of decentralization, decentralization framework, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations, Platforms for decentralization.

UNIT-III:

Bitcoin: Introduction to Bitcoin, Digital keys and addresses, Transactions, Blockchain, The Bitcoin network, Bitcoin payments, Bitcoin Clients and APIs, Alternatives to Proof of Work, Bitcoin limitations.

UNIT-IV:

Etherium: Smart Contracts, Introduction to Ethereum, The Ethereum network, Components of the Ethereum ecosystem, Blocks and Blockchain, Fee schedule, Ethereum Development Environment, Solidity.

UNIT-V:

Hyperledger: Introduction, Hyperledger Projects, Protocol, Architecture, Hyperledger Fabric, Sawtooth Lake, Corda.

Challenges and Opportunities: Scalability, Privacy, Blockchain for IoT, Emerging trends

Text Book:

1. Mastering Block chain, Imran Bashir, Second Edition, PacktPublishing.

References:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 3rd Edition Andreas Antonopoulos,O'Reilly.
2. Blockchain Blueprint for a New Economy, Melanie Swan,O'Reilly.
3. Mastering Bitcoin: Programming the Open Blockchain, Antonopoulos, Andreas M. O'Reilly.
4. Blockchain Technology: Cryptocurrency and Applications, S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford University Press

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0024	**MULTIMEDIA APPLICATION DEVELOPMENT**	3	0	0	3

COURSE OBJECTIVES: To learn

1. To understand the definition of multimedia
2. To understand and differentiate text, image, video & audio.
3. To describe the ways in which multimedia information is captured, processed, and rendered
4. Introduce multimedia quality of service (QoS) and to compare subjective and objective methods of assessing user satisfaction and multicast protocols to provide QoS guarantees
5. Discuss privacy and copyright issues in the context of multimedia

COURSE OUTCOMES: Upon successful completion of the course, the student is able to

1. Describe different realizations of multimedia tools and the way in which they are used
2. Analyze the structure of the tools in the light of low-level constraints imposed by the adoption of various QoS schemes (i.e. bottom up approach)
3. Analyze the effects of scale and use on both presentation and lower-level requirements (i.e. top down approach)
4. State the properties of different media streams;
5. Compare and contrast different network protocols and to describe mechanisms for providing QoS guarantees in the network.

UNIT – I Classes: 12

Introduction: Definitions - Brief history of Multimedia; its market; content and copyright –public Domain, establishment of Copyright, fair use, multimedia copyright issues; resources for multimedia developers – Uses of multimedia - Making multimedia : Stages of a project

UNIT – II Classes: 14

Hardware Macintosh Versus Windows Platform – Connections – SCSI – IDE – EIDE – ULTRA – IDE – ATA – ULTRA - ATA - Memory and Storage Devices - Input Devices - Output Hardware – CommunicationDevices Basic Software Tools :Text Editing - Word Processing - OCR Software - Painting and Drawing Tools - 3D Modeling and Animation Tools - Image Editing - Sound Editing – Animation – Video - Digital Movie tools - Movie Editors - Compressing Movie Files MLR Institute of Technology B.Tech-IT Academic Regulations &Syllabi – MLR18

UNIT – III Classes: 14

Text : Fonts – Designing – Choosing -Menus for Navigation - Buttons for Interaction – Fields for Readings - HTML Documents - Symbols and Icons – Animating - Fonts Foundries – Managing Fonts - Character sets and Alphabets - Mapping Text – Fontographer - Hypermedia Structures – Hypertext tools Sound : Power of sound - Multimedia System Sound - MIDI Versus Digital Audio - Preparing Digital Audio Files - Making MIDI Audio - Audio File Formats - Sound for the World Wide Web – Adding Sound to Your Multimedia Project - Toward Professional Sound - The Red Book Standard – Space Considerations - Production Tips - Audio Recording -

Keeping Track of Your Sounds - Testing and Evaluation

UNIT – IV Classes: 12

Introduction: The Bandwidth Bottleneck - Internet Services - MIME-Types - World Wide Web and HTML – Dynamic Web Pages and XML - Multimedia on the Web. Tools for the World Wide Web: Web Servers - Web Browsers - Web Page Makers and Site Builders - Plug ins and Delivery Vehicles - Text – Images –Sound - Animation, Video and Presentation - Beyond HTML - 3D Worlds, designing for the World Wide Web..

UNIT – V Classes: 08

Multimedia File Handling: Compression & De compression - Data & file formats standards - Digital voice, Audio, video – Video image and Animation - Full motion video - storage and retrieval Technologies

Text Books:

1. Multimedia making it work Tay Vaughan Tata McGrawHill, Delhi
2. Multimedia – Technology and applications David Hillman Galgotia Publications, Delhi

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0025	**MOBILE AD-HOC NETWORKS**	3	0	0	3

Course Objectives:

- To understand the concepts of Ad Hoc Wireless Networks
- To understand the Data Transmission in MANETS
- To understand the MAC protocols for ad-hoc networks
- To understand and analyze the various routing protocols and model link cost
- Understanding cross layer design in Adhoc Networks

Course Outcomes:

1. Evaluate the principles and characteristics of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks
2. Discuss the challenges in designing MAC, routing, and transport protocols for wireless ad-hoc sensor networks
3.. Understand the MAC Protocols for Ad Hoc Wireless Networks
4. Illustrate the various Routing Protocols And Transport Layer In Ad Hoc Wireless
5. Demonstrate the issues and challenges in security provisioning and also familiar with the mechanisms for implementing security and trust mechanisms in MANETs and WSNs

UNIT - 1

INTRODUCTION: Introduction to ad-hoc networks – definition, characteristics features, applications. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.

UNIT - 2

MEDIUM ACCESS PROTOCOLS: MAC Protocols: Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

UNIT - 3

NETWORK PROTOCOLS: Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.

UNIT - 4

END – END DELIVERY AND SECURITY: Transport Layer: Issues in designing – Transport layer classification, adhoc transport protocols.
Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT – 5

CROSS LAYER DESIGN:
Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration of adhoc with Mobile IP networks.

TEXT BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols, 2nd edition, Pearson Edition, 2007.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

REFERENCES:

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hoc networking, Wiley-IEEE press, 2004.
2. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
3. T. Camp, J. Boleng, and V. Davies " A Survey of Mobility Models for Ad-hoc Network"
4. Research, "Wireless Commun, and Mobile Comp.. Special Issue on Mobile Ad-hoc Networking Research, Trends and Applications, Vol. 2, no. 5, 2002, pp. 483 – 502.
5. A survey of integrating IP mobility protocols and Mobile Ad-hoc networks, Fekri M.bduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, no: 12007.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2									2	
CO2	3	3	3	1	2									2	
CO3	3	3	3	1	2									2	
CO4	3	3	3	1	2									2	
CO5	3	3	3	1	2									2	

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0001	Operating Systems	3	0	0	3

Course Objectives:

- Provide knowledge about the services rendered by operating systems.
- Present detail discussion on processes, threads and scheduling algorithms.
- Expose the student with different techniques of handling deadlocks.
- Discuss various file-system implementation issues and memory management techniques.
- Learn the basics of Linux system and Android Software Platform.

Course Outcomes:

1. Understand the importance of operating systems and different types of system calls
2. Analyze process scheduling algorithms and various IPC mechanisms.
3. Understand the process synchronization, different ways for dead locks handling.
4. Analyze different page replacement methods, various File management techniques
5. Understand Linux and Android environment and behavior

Unit: 1: Operating Systems Overview: Introduction: What Operating systems Do, Types of Operating systems, Computer system Architecture, Computer system organization, Operating system functions, Operating systems operations, Protection and Security.

Virtualization: Types of Virtualizations, Benefits, and Challenges.

System structure: Operating System Services, User and Operating - System Interface, System calls, Types of System Calls, Operating system debugging, System Boot.

Learning Outcomes: Student will be able to

- Understand operating system structure and functions.
- Understand operating system services and system calls
- Comprehend the basics of virtualization

Unit: 2: Process Management: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication.

Multithreaded Programming: Overview, Multithreading models, Threading Issues.

Process scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

Learning Outcomes: Student will be able to

- Identify various message sharing mechanisms used in IPC.
- Understand how to handling multiple threads.
- Differentiate between preemptive, non-preemptive and real time CPU scheduling

Unit: 3: Synchronization: Process Synchronization, The Critical-Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples Principles of deadlock – System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock, Concurrency in Distributed Systems, Consistency, and Replication.

Learning Outcomes: Student will be able to

- Analyze various solutions for process synchronization.
- Analyze the reasons for deadlocks and proposed solutions to detect, avoid, recovery from deadlocks.
- Understand concurrency issues in distributed systems

Unit: 4: Memory Management:

Memory Management strategies: Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.

Virtual Memory Management: Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing.

File system Interface and Introduction to Network Programming: - the concept of a file, Access Methods, OSI model, Unix standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application.

Learning Outcomes: Student will be able to

- Demonstrate the ability to implement various memory management techniques
- Illustrate various demand paging techniques.
- Identify various file management and optimization techniques.

Unit: 5: Network Programming and OS Security:

Sockets: Address structures, value – result arguments, Byte ordering and manipulation function and related functions.

Elementary TCP sockets – Socket, connect, bind, listen,accept, fork and exec function, concurrent servers. Close function and related function.

Elementary UDP sockets: Introduction UDP Echo server function, lost datagram, summary of UDP example, Lack of flow control with UDP, determining outgoing interface with UDP.

OS Security - Security Policies, Intrusion Detection, and Prevention.

Learning Outcomes: Student will be able to

- Understand socket programming.
- Understand basics of UDP (L2), Comprehend OS security concepts

Text Books:

1. Silbers chatz A, Galvin PB, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2013
2. Tanenbaum AS, Modern Operating Systems, 3rd edition, Pearson Education, 2008. (for Inter process Communication and File systems).

References:

1. Tanenbaum AS, Woodhull AS,Operating Systems Design and Implementation, 3rd edition, PHI, 2006.
2. Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, Tata Mc Graw-Hill, 2012.
3. Stallings W, Operating Systems –Internals and Design Principles, 6th edition, Pearson Education, 2009
4. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004.

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0002	Red Hat Linux	3	0	0	3

Course Objectives:

- Master essential command-line tools for file manipulation, system access, and documentation in a RHEL environment.
- Implement core system administration tasks, including booting, process control, service control (systemd), and managing user/group accounts.
- Configure and manage local storage using partitions, filesystems (XFS/Ext4), and Logical Volume Management (LVM).
- Secure the system by configuring the firewall (firewalld), managing file permissions, and enforcing SE Linux policies.
- Perform network configuration, package management, and write basic Bash shell scripts for task automation.

Course Outcomes:

1. Navigate and operate a Red Hat Enterprise Linux system entirely from the command line.
2. Manage local security policies, including users, groups, and file permissions.
3. Diagnose and troubleshoot boot process failures and service issues.
4. Apply proper file system management techniques, including creating and extending LVM.
5. Automate routine administrative tasks using shell scripting and scheduled utilities.

Unit 1: Essentials and System Access

Introduction to RHEL: Command Line Interface (CLI), Shell basics, using grep and regular expressions.
Getting Help: Utilizing man pages and system documentation.
File Management: Standard commands (ls, cp, mv), hard and soft links.
Text Editing and Remote Access: Using vim/nano for configuration; Secure Shell (ssh) usage.

Unit 2: Running Systems and Management

System Boot and Processes: Boot procedure, run levels, interrupting boot for recovery.
Process Control: Identifying, managing, and adjusting process priority (top, kill, nice).
Service Control: Managing system services and daemons using systemctl (systemd).
Package Management: Installing, updating, and removing software using dnf / yum (RPM).
User and Group Administration: Creating, modifying, and managing local users, groups, and password policies.

Unit 3: Storage Administration

Disk Partitioning: Understanding MBR/GPT and creating partitions.
Filesystems: Creating, mounting and managing XFS/Ext4 filesystems, and configuring /etc/fstab.
Logical Volume Management (LVM): PVs, VGs, LVs, creating, resizing, and extending logical volumes.
Network Storage: Basics of mounting **NFS** and **SMB/CIFS** shares.

Unit 4: Networking and Security

Basic Networking Configuration: Configuring IPv4/IPv6 addresses and network interfaces.
Firewall Management: Configuring network access restrictions using firewalld.
Security Contexts: Managing Access Control Lists (ACLs) for granular permissions.
SELinux: Introduction to SELinux modes, contexts, and troubleshooting access issues.
System Logging: Locating and interpreting system logs using journal ctl.

Unit 5: Automation and Advanced Topics

Archiving and Scheduling: Using **tar** and compression utilities; scheduling tasks with **cron** and at.
Bash Shell Scripting: Introduction, variables, conditional execution (if), loops, and processing script inputs/outputs.
Kernel and Updates: Managing kernel modules and performing system maintenance/updates.
Virtualization / Containers: Overview of enterprise virtualization and container concepts (e.g., Podman).

Text Books:

1. Red Hat RHCSA [RHEL Version] Cert Guide (Exam EX200), Sander van Vugt
2. UNIX and Linux System Administration Handbook, Evi Nemeth, Garth Snyder

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0003	Cloud Computing	3	0	0	3

Course Objectives:

- To implement Virtualization
- To implement Task Scheduling algorithms
- Apply Map-Reduce concept to applications
- To build Private Cloud
- Broadly educate to know the impact of engineering on legal and societal issues involved

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

1. Interpret the key dimensions of the challenge of Cloud Computing
2. Examine the economics, financial, and technological implications for selecting cloud computing for own organization
3. Assessing the financial, technological, and organizational capacity of employers for actively initiating and installing cloud-based applications
4. Evaluate own organizations. needs for capacity building and training in cloud computing-related IT areas
5. Illustrate Virtualization for Data-Center Automation

UNIT I

Introduction: Network centric computing, Network centric content, peer-to .peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing. Parallel and Distributed Systems: introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, and model concurrency with Petri Nets.

UNIT II

Cloud Infrastructure: At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing, Cloud Computing : Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, HPC on cloud.

UNIT III

Cloud Resource virtualization: Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization, Case Study: Xen, vBlades, Cloud Resource Management and Scheduling: Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource management and dynamic application scaling.

UNIT IV

Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore (text book 1), Amazon Simple Storage Service(S3) (Text book 2), Cloud Security: Cloud security risks, security . a top concern for cloud users, privacy and

privacy impact assessment, trust, OS security, Virtual machine security, Security risks.

UNIT V

Cloud Application Development: Amazon Web Services : EC2 – instances, connecting clients, security rules, launching, usage of S3 in Java, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming (Text Book 1), Google: Google App Engine, Google Web Toolkit (Text Book 2), Microsoft: Azure Services Platform, Windows live, Exchange Online, Share Point Services, Microsoft Dynamics CRM (Text Book 2)

Text Books:

1. Cloud Computing, Theory and Practice,1st Edition, Dan C Marinescu, MK Elsevier publisher ,2013
2. Cloud Computing, A Practical Approach, 1st Edition, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH,2017

Reference Books:

1. Mastering Cloud Computing, Foundations and Application Programming,1st Edition, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH,2013
2. Essential of Cloud Computing, 1st Edition, K Chandrasekharan, CRC Press, 2014.
3. Cloud Computing, A Hands on Approach, ArshdeepBahga, Vijay Madisetti, Universities Press, 2014.

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0004	Distributed Operating Systems	3	0	0	3

Course Objectives:

- To study the concepts and design principles of Distributed Operating Systems,
- To understand clock synchronization protocols and distributed file system implementation,
- To gain knowledge on communication, synchronization, and consistency models in distributed systems.

Course Outcomes: On successful completion of the course, students will be able to:

- Explain the architecture and components of distributed systems,
- Understand various synchronization and coordination mechanisms,
- Analyze consistency and fault tolerance issues,
- Describe distributed file systems and object-based distributed environments,
- Apply concepts of distributed systems in real-time applications.

Detailed Syllabus:

Unit I – Fundamentals of Distributed Systems

Introduction to distributed systems, Goals of distributed systems, Hardware and software concepts, Design issues, Network operating systems, Comparison between time-sharing, multiprocessor, and true distributed systems, System architectures for distributed systems.

Unit II – Communication in Distributed Systems

Basics of communication systems, Layered protocols, ATM models, Client–Server model, Blocking and non-blocking primitives, Buffered and unbuffered communication, Reliable and unreliable primitives, Message passing, Remote Procedure Call (RPC).

Unit III – Synchronization and Processes

Clock synchronization, Mutual exclusion in distributed systems, Election algorithms, Atomic transactions, Deadlock handling, Processes and threads in distributed systems, System models, Processor allocation, Process scheduling in distributed systems.

Unit IV – Consistency, Replication, and Fault Tolerance

Data-centric and client-centric consistency models, Replica management, Consistency protocols, Fault tolerance in distributed systems, Process resilience, Distributed commit protocols, Reliable client–server communication.

Unit V – Distributed Object-Based Systems and File Systems

Distributed object-based systems, Object-oriented architecture, Processes and communication in object-based systems, Synchronization in object environments, Consistency and replication in object-based systems, Distributed file system design and implementation.

Reference Books:

- Andrew S. Tanenbaum, *Distributed Operating Systems*, Pearson Education, Reprint, 2011,
- Andrew S. Tanenbaum and Maarten Van Steen, *Distributed Systems – Principles and Paradigms*, 2nd Edition, PHI, 2007,
- Pradeep K. Sinha, *Distributed Operating Systems – Concepts and Design*, PHI, 2007.

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0001	Basics of Computer Networks	3	0	0	3

Course Objectives:

1. understand the contemporary technologies in network protocols and network architecture
2. To acquire the knowledge on design principles of network infrastructure. the basics Physical layer and their functionality.
3. Understand the functionalities of the Data Link Layer and their protocols.
4. Understand the functionalities of the Network Link Layer and routing Algorithms.
5. Analyze different protocols in Application Layer

Course Outcomes:

1. Analyze different types of network topologies, various Reference models.[L2]
2. Analyze network performance metrics and data transmission Techniques.[L4]
3. Analyze different data link layer framing techniques and Link Layer Protocols.[L4]
4. Analyze the medium access techniques and different routing algorithms.[L4]
5. Understand various Application layer protocols.[L2]

Unit 1: **10-Hours**

Introduction: Components of a Data Communication system, Dataflow **,** Network Topologies Categories of Networks: LAN, MAN,WAN. Reference models- The OSI Reference Model- the TCP/IP Reference Model, Networking and Internet working Devices.

Learning Outcomes: Student will be able to

- Understand the Basics of Computer Networks (L2).
- Understand the data flow in a Computer Network and the use of protocols.(L2)
- Analyze the importance of each layer in the reference models.(L4).

Applications:

Conceptual Framework of a Network, ATM, Online reservation systems, reservation systems.

Unit 2: **9-Hours**

Physical Layer:

Transmission Media: Guided,Unguided.Bandwidth,throughput,Latency.

Multiplexing: frequency division multiplexing, wave length division multiplexing, synchronous time division multiplexing, statistical time division multiplexing, switching techniques.

Learning Outcomes: Studentwill be able to

- Understand the Basics of physical functionality .(L2).
- Analyze different types of Multiplexing Techniques. (L4).
- Analyze the Network performance Evaluation metrics . (L4).

Applications:

Identify the use of different devices in real time computer networks and data processing tasks.

Unit 3: **10- Hours**

Data Link Layer: Design issues, Framing, flow control, error control, error detection and correction, CRC. **Data Link Layer protocols**: simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel. Sliding window protocols. HDLC configuration and transfer modes, HDLC frame format, control field

Learning Outcomes: Student will be able to

- Understand DataLink Layer Services to the Network Layer. (L2)
- Understand Error Correction and Detection techniques. (L2)
- Apply Detecting Codes for sample data. (L3)

Applications: Error correction and detecting procedures on binary data.

Unit 4: **10- Hours**

Random Access: ALOHA protocols, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance

Network Layer: Routing algorithm, shortest path routing, Flooding, distance vector routing, Link state routing Algorithms, IPv4 address, subnetting, Congestion Control Algorithms.

Learning Outcomes: Student will be able to

- Understand random access protocols in data link layer and their functions. (L2)
- Analyze the static and dynamic routing Algorithms. (L4)
- Analyze the IPv4 Addressing ,sub netting.(L4)

Applications: setting up the routes for data packets to take, checking to see if a server in another network is up and running, and addressing and receiving IP packets from other networks.

UNIT –5 : **09-Hours**

The Transport Layer: addressing, TCP establishing a connection, releasing connection, TCP Header format, End to end protocols: UDP,.

Application layer: File Transfer(FTP), WWW: architeture ,client / server ,uniform resource locator, cookies, web documents: static ,dynamic, active document, HTTP transaction: persistant, non-persistent, Proxy server, HTTP Generic Message Format, HTTP Request Message Format, HTTP Response Message Format, Domain Name System (DNS), SMTP (Simple Mail Transfer Protocol).

Learning Outcomes: Student will be able to

- Understand the functions of Transport Layer protocols.(L2)
- Analyze the various protocols in application layer .(L4)

Applications: Users can forward several emails and it also provides a storage facility, allows users to access, retrieve and manage files in a remote computer layer provides access to global information about various services.

Text Books:

1. Data Communications and Networking ,Behrouz A Forouzan,fifth Edition.
2. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010

Reference Books:

1. Computer Networks, Mayank Dave, CENGAGE
2. Larry L. Peterson and Bruce S. Davie, "Computer Networks - A Systems Approach" (5th ed), Morgan Kaufmann/ Elsevier, 2011

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

SNO	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
Cxx.1	3	3	2	1	3				3			1		2	3
Cxx.2	3	3	2	1					3			1		2	3
Cxx.3	3	3	2	1					3					2	3
Cxx.4	3	3	2	1	3				3			1		2	3
Cxx.5	3	1	1	1	3				3			1		2	3
Cxx.*	3	3	2	1	3				3			1		2	3

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0002	Cryptography & Network Security	3	0	0	3

Course Objectives:

- Classical systems, symmetric block ciphers (DES, AES, other contemporary symmetric ciphers) are Introduced.
- Introduction to Public- key cryptography (RSA, discrete logarithms) is provided.
- Algorithms for factoring and discrete logarithms, cryptographic protocols, hash functions, authentication, key management, key exchange, signature schemes are learnt.
- An overview of e-mail and web security is provided.
- An overview of viruses, firewalls and system security is provided.

Course Outcomes:

1. Understand the basics of Cryptography, the goals, services and mechanisms.
2. Analyze the Symmetric Encryption Algorithms.
3. Analyze the Asymmetric Cryptographic Algorithms.
4. Understand the Digital signature Schemes.
5. Understand the email security and system security.

UNIT- I

Basic Principles Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography

Learning Outcomes: Student will be able to

- Understand what is meant by Cryptography.(L1)
- Understand the goals, mechanisms and services of Cryptography.(L1)

UNIT- II

Symmetric Encryption Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.

Learning Outcomes: Student will be able to

- Understand symmetric key Cryptography (L2)
- Analyze the various algorithms of Symmetric key Cryptography (L3)

UNIT- III

Asymmetric Encryption Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography

Learning Outcomes: Student will be able to

- Understand symmetric key Cryptography (L1)
- Analyze the various algorithms of Asymmetric key Cryptography(L2)

UNIT- IV

Data Integrity, Digital Signature Schemes & Key Management Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, KeyManagement.

Learning Outcomes: Student will be able to

- Understand about Digital Signature and the security schemes.(L1)
- Understand the Hash functions and its importance.(L2)

UNIT -V

Network Security: Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, IPSec, System Security.

Learning Outcomes: Student will be able to

- Understand email-security.(L1)
- Understand the mechanisms of Transport Layer Security.(L1)
- Understandabout system security.(L2)

Text Books:

1. Cryptography and Network Security, Behrouz A Forouzan, Debdeep Mukhopadhyay, (3e) McGraw Hill.
2. Cryptography and Network Security, William Stallings, (6e)Pearson.
3. Everyday Cryptography, KeithM.Martin, Oxford.

Reference Books:

4. Network Security and Cryptography, Bernard Meneges, Cengage Learning

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	2	1	1	1	1	1	2	3	2	2
CO2	3	3	2	2	3	1	1	1	1	1	1	2	3	3	2
CO3	3	3	3	2	3	1	1	1	2	2	2	3	3	3	3
CO4	3	3	2	3	3	1	1	1	2	2	2	3	3	3	3
CO5	3	3	2	3	3	1	1	1	2	2	2	3	3	3	3
	3	3	3	3	3	1	1	1	2	2	2	3	3	3	3

**For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0003	Mobile Computing	3	0	0	3

Course Objectives:

- To understand the fundamentals of mobile communication
- To understand the architecture of various Wireless Communication Networks
- To understand the significance of different layers in mobile system Course Contents
- To understand the mobility supported protocols
- To apply the mobility support in real time

Course Outcomes:

1. Understand the fundamentals of mobile Networks
2. Apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
3. Comprehend, design, and develop a lightweight network stack
4. Analyze the Mobile Network Layer system working
5. Understand WAP Model

UNIT- I

Introduction to Wireless Networks: Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems: Frequency Management and Channel Assignment, types of hand-off and their characteristics.

Learning Outcomes: Student will be able to

1. Understand the basic concepts of wireless networks (L2)
2. Understand the fundamentals of cellular system(L2)

UNIT-II

MAC – Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM: Architecture Location tracking and call setup, Mobility management, Handover, Security, GSM, SMS, International roaming for GSM, call recording functions, subscriber and service data management, DECT, TETRA, UMTS, IMT-2000.

Learning Outcomes: Student will be able to

1. Understand the MAC layer functionalities (L2)
2. apply the strategy of subscriber and service data management(L3)

UNIT-III

Wireless LAN: Infrared vs. Radio transmission, Infrastructure, Adhoc Network, IEEE 802.11WLAN Standards, Architecture, Services, HIPERLAN, Bluetooth Architecture & protocols.

Learning Outcomes: Student will be able to

1. Understand the wireless LAN functionalities(L2)
2. Understand the the various protocols in WLAN(L2)

UNIT-IV

Mobile Network Layer: Mobile IP, Dynamic Host Configuration Protocol, Mobile Transport Layer, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/Fast recovery, Transmission/Time-out freezing, Selective retransmission, Transaction Oriented TCP.

Learning Outcomes: Student will be able to

1. Understand the working of mobile network layer (L2)
2. Understand the concepts of mobile transport layer(L2)

UNIT-V

Support for Mobility: Wireless Application Protocol: Architecture, Wireless Datagram Protocol, Wireless Transport Layer Security, Wireless Transaction Protocol, Wireless Session Protocol, Wireless Application Environment, Wireless Markup Language, WML Scripts, Wireless Telephone Application.

Learning Outcomes: Student will be able to

1. Understand the working functionality of wireless protocols(L2)
2. Apply the wireless markup language in real time (L3)

Text Books:

1. Jochen Schiller, "Mobile Communication", Second Edition, Pearson Education, 2008.
2. "Mobile Computing: Principles and Practices" by Asoke K. Talukder, Roopa R. Yavagal

Reference Books:

1. William Stallings, "Wireless Communications and Networks", Second Edition, Pearson Education, 2004.
2. C. Siva Ram Murthy, B. S. Manoj, "Adhoc Wireless Networks: Architectures and Protocols", Second Edition, Pearson Education, 2008.

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2	2	2				1		1	2	3	1	2
CO2	3	3	2	2	2				1			2	3	1	2
CO3	3	3	2		2			1			1	2	3	1	2
CO4	3	3	2		2			1	1			2	3	1	2
CO5	3	3	2		2			1	1		1	2	3	1	2
CO*	3	3	2	2	2				1			2	3	1	2

**For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0004	Wireless Sensor Networks	3	0	0	3

Course Objectives:

- Define WSN and Dynamic modulation scaling.
- Explore working of the MAC protocols
- Demonstrate Routing and Data gathering protocols
- Illustrate working of Embedded OS.
- Explore a wide range of WSN applications in different sectors

Course Outcomes:

1. Understand the basics, characteristics and challenges of Wireless Sensor Network
2. Apply the knowledge to identify appropriate physical and MAC layer protocol
3. Apply the knowledge to identify the suitable routing algorithm based on the network and user requirement
4. Analysis of OS used in Wireless Sensor Networks and build basic modules
5. Analyze specific WSN application using a case study approach

Unit-I – CHARACTERISTICS OF WSN (8 Hours)

Characteristic requirements for WSN – Challenges for WSNs – WSN vsAdhoc Networks – Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Learning Outcomes:

- Identify and explain the key characteristics
- Differentiate between Wireless Sensor Networks (WSNs) and Ad-hoc Networks
- Understand the role and functionalities of each component within the sensor node.

Unit – II: MEDIUM ACCESS CONTROL PROTOCOLS (10 Hours)

Fundamentals of MAC protocols – Low duty cycle protocols and wakeup concepts – Contention based protocols – Schedule-based protocols – SMAC – BMAC – Traffic adaptive medium access protocol (TRAMA) – The IEEE 802.15.4 MAC protocol.

Learning Outcomes:

- Describe the main challenges of MAC protocols in wireless sensor networks (WSNs)
- Understand the concept of low duty cycle operation and its importance
- Evaluate the performance characteristics of contention-based protocols, including throughput, latency, and energy efficiency

Unit – III: ROUTING AND DATA GATHERING PROTOCOLS (10 Hours)

Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing – Gradient-based routing –Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing – LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP – Data aggregation - data aggregation operations – Aggregate Queries in Sensor Networks – Aggregation Techniques – TAG, Tiny DB.

Learning Outcomes:

- Identify the key routing challenges in WSNs compared to traditional wired networks
- Analyze popular hierarchical routing protocols
- Analyze location-based routing protocols, Real-Time Routing Protocols

Unit – IV: EMBEDDED OPERATING SYSTEMS (10 Hours)

Operating Systems for Wireless Sensor Networks – Introduction – Operating System Design Issues – Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS – OSPM – EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules – Configurations and Wiring – Generic Components – Programming in Tiny OS using NesC, Emulator TOSSIM.

Learning Outcomes:

- Understand the role and importance of operating systems in managing the resources and functionalities of Wireless Sensor Networks.
- Compare and contrast prominent WSN operating systems like TinyOS, Mate, MagnetOS, MANTIS, OSPM, EYES OS, SenOS, EMERALDS, and PicOS.
- Understand the strengths and weaknesses of each operating system in terms of features, resource management, and suitability.

Unit – V: APPLICATIONS OF WSN (10 Hours)

WSN Applications – Home Control – Building Automation – Industrial Automation – Medical Applications – Reconfigurable Sensor Networks – Highway Monitoring – Military Applications – Civil and Environmental Engineering Applications – Wildfire Instrumentation – Habitat Monitoring – Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard – Target detection and tracking – Contour/edge detection – Field sampling

Learning Outcomes:

- Identify the key characteristics of Wireless Sensor Networks (WSNs) that make them suitable for various applications.
- Analyze a specific WSN application through a Case Study
- Develop a basic understanding of common data analysis techniques used with WSN data

Text Books:

1. Wireless Sensor Networks Technology, Protocols, and Applications, KazemSohraby, Daniel Minoli and TaiebZnati, John Wiley & Sons, 2007
2. Protocols and Architectures for Wireless Sensor Network, Holger Karl and Andreas Willig John Wiley & Sons, Ltd ,2005

References Books:

1. A survey of routing protocols in wireless sensor networks , K. Akkaya and M. Younis, Elsevier
2. Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
3. TinyOS Programming , Philip Levis
4. Wireless Sensor Network Designs , Anna Ha´c , John Wiley & Sons Ltd

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1 **) :**

CO	**PO1**	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	2	1	3								2		
CO2	3	2	2	1	3								2		
CO3	3	2	2	1	3								2		
CO4	3	3	2	1	3								2		
CO5	3	3	2	1	3								2		

Course Code	Subject Name	L	T	P	C
R23CSM-OE0001	An Introduction to Artificial Intelligence	3	0	0	3

Prerequisites:

- Basic knowledge of programming, linear algebra, and probability & statistics.

Course Objectives:

- To focus is made on definition, scope, foundations, historical development, applications of AI, and core concepts such as the Turing Test and intelligent agents.
- To work on uninformed and informed search techniques, including heuristic and game-based approaches, to solve AI problems effectively.
- To differentiate between various knowledge representation techniques such as logic-based, semantic networks, frames, scripts, and conceptual dependency
- To introduce students to fundamental reasoning and learning techniques in Artificial Intelligence
- To analyse the impact of AI technologies on society, identify ethical challenges, and discuss current trends in AI research, robotics, and perception.

Course Outcomes:

- Understand the Fundamentals and Scope of AI
- Develop Problem-Solving and Search Strategy Skills
- Acquire Knowledge Representation Techniques
- Apply reasoning techniques and learning methods to solve problems under uncertainty
- Explore Emerging AI Topics and Ethical Considerations

Unit-1:

Introduction to Artificial Intelligence- Definition and scope of AI- AI Applications- Foundations of AI- History and Philosophy of AI- Turing Test and Intelligent Agents.

Unit-2:

Problem Solving and Search- Problem formulation- Uninformed search: BFS, DFS- Heuristic search: Hill Climbing, Best-First, A*- Game playing: Minimax, Alpha-Beta pruning.

Unit-3:

Knowledge Representation- Declarative vs Procedural Knowledge- Logic-Based Representations- Semantic networks, Frames, Scripts- Conceptual Dependency.

Unit-4:

Reasoning and Learning- Rule-based systems and Expert Systems, Fuzzy Sets and Fuzzy Logic, Machine Learning -Types of learning – Learning by analogy- explanation based learning.

Unit-5:

Emerging Topics and AI Ethics- Robotics and Perception- AI in society: Ethics, Bias, Safety- Current trends in AI research.

Text Book:

1. *Elaine Rich, Kevin Knight, and Shivashankar B. Nair , Artificial Intelligence, Tata McGraw-Hill Education*
2. *Stuart Russell and Peter Norvig – Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson*
3. George F. Luger - Artificial Intelligence Principles and Practice (2025) -Springer

Reference Text Books:

4. N.P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press
5. *Nick Bostrom, Superintelligence: Paths, Dangers, Strategies*
6. *Cathy O'Neil, Weapons of Math Destruction*

Course Code	Subject Name	L	T	P	C
R23CSM-OE0002	Introduction to Machine Learning Using Python	3	0	0	3

Prerequisites:

- Basic knowledge of mathematics (linear algebra, probability, and statistics) and fundamental programming concepts.

Course Objectives:

- To introduce the fundamental concepts, types, and real-world applications of machine learning, and to familiarize students with essential tools such as Python, Jupyter Notebooks, and scikit-learn.
- To enable students to understand and perform essential data pre processing techniques including data cleaning, transformation, and visualization for machine learning tasks.
- To provide a solid foundation in implementing and evaluating supervised learning algorithms such as linear regression, logistic regression, decision trees, and k-nearest neighbours.
- To familiarize students with unsupervised learning methods including clustering and dimensionality reduction techniques, and their application to engineering problems.
- To develop students' ability to validate and tune machine learning models using appropriate techniques and apply their knowledge through case studies relevant to engineering domains.

Course Outcomes:

- Describe the fundamental concepts of machine learning and its types.
- Pre process and represent data effectively using Python libraries
- Implement basic supervised learning algorithms and evaluate their performance.
- Apply unsupervised learning techniques for data grouping and dimensionality reduction
- Perform model validation, avoid over fitting, and analyze real-world ML case studies.

Unit-1:

Introduction to Machine Learning -What is Machine Learning? - Types of Machine Learning: Supervised, Unsupervised, Reinforcement- ML in real-world engineering applications, Introduction to Python, scikit-learn, and Jupyter Notebooks, ML pipeline overview.

Unit-2:

Data Representation and Pre-Processing - Data types: numerical, categorical, Feature extraction and representation, handling missing values, scaling, normalization, encoding categorical variables, splitting data: train-test split, validation set, Visualization using Matplot lib.

Unit-3:

Supervised Learning Algorithms - Linear Regression, Logistic Regression, Decision Trees, K-Nearest Neighbours, Model evaluation: accuracy, confusion matrix, Bias-variance trade-off.

Unit-4:

Unsupervised Learning Algorithm and Dimensionality Reduction- Clustering: K-Means, Hierarchical clustering, Evaluation of clustering, Principal Component Analysis (PCA).

Unit-5:

Model Validation and Applications - Cross-validation, Over fitting and under fitting. Case Studies - Predictive maintenance, Demand Forecasting, Simple Recommendation Systems.

Text Book:

1. Andreas C. Müller & Sarah Guido – Introduction to Machine Learning with Python (O'Reilly, 2016)
2. Tom M. Mitchell – Machine Learning (McGraw-Hill, 1997) – for foundational concepts
3. Zhen _Leo_ Liu - Artificial Intelligence for Engineers_ Basics and Implementations (AI) (2025)-Springer

Reference Text Books:

4. Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow (O’Reilly) – for optional deeper reading/projects

Course Code	Subject Name	L	T	P	C
R23CSM-OE0003	Foundation of Deep Learning for Engineering Applications	3	0	0	3

Prerequisites:

- Basic knowledge on python programming and overview on AI and Machine Learning

Course Objectives:

- To introduce the fundamentals of artificial and deep neural networks.
- To familiarize students with the working of popular deep learning architectures.
- To train students to implement and apply deep learning models using Python-based tools.
- To expose students to practical applications of deep learning across various engineering domains.
- To highlight the ethical and responsible use of deep learning technologies.

Course Outcomes:

- Describe the basic concepts and architecture of neural networks and their relevance to engineering applications.
- Explain the training process of neural networks and optimization techniques.
- Implement and evaluate convolutional and recurrent neural networks for solving problems in image and time-series.
- Apply deep learning techniques to domain-specific case studies.
- Analyse the ethical implications, limitations, and emerging trends in deep learning.

Unit-1:

Introduction to Neural Networks- Introduction to Artificial Neural Networks (ANN)- Biological inspiration, Perceptron, Activation functions, Neural network architecture: Input, Hidden, Output layers, Applications of deep learning in various engineering fields

Unit-2:

Training Neural Networks- Forward and backward propagation, Loss functions and optimization, Gradient descent and learning rate, Overfitting and underfitting. Introduction to TensorFlow and Keras frameworks

Unit-3:

Deep Architectures – CNN and RNN- Convolutional Neural Networks (CNN): Basics, layers, and applications, CNN for image classification and object detection, Recurrent Neural Networks (RNN): Basics, vanishing gradients

Unit-4:

Applications and Case Studies- Image processing -Defect detection, Biomedical imaging- Predictive maintenance in mechanical systems- Speech and signal recognition- Forecasting in energy and climate models

Unit-5:

Ethics, Challenges & Future Trends- Interpretability and explainability in deep learning, Bias and fairness in deep learning systems, Deep fakes and misuse of AI, Green AI and energy-efficient training. Future trends: Generative AI, Edge AI, TinyML

Text Book:

1. François Chollet – *Deep Learning with Python* – Manning Publications
2. Ian Good fellow, Yoshua Bengio, Aaron Courville – *Deep Learning* – MIT Press
3. Michael Nielsen – *Neural Networks and Deep Learning* – Online book

Reference Text Books:

4. Melanie Mitchell – Artificial Intelligence: A Guide for Thinking Humans-Farrar, Straus and Giroux

Course Code	Subject Name	L	T	P	C
R23CSM-OE0004	Natural Language Processing– Frontiers Approach	3	0	0	3

Prerequisites:

- A foundational understanding of programming, basic linguistics, and probability/statistics is essential.

Course Objectives:

- To learn the fundamentals of natural language processing
- To understand the use of CFG and PCFG in NLP
- To understand the role of semantics of sentences and Pragmatics
- To gain knowledge in automated natural language generation and machine translation
- To understand language modeling

Course Outcomes:

- Understand the fundamentals of basic language features
- Analyse the words involved in NLP
- Analyse the syntactic analysis involved in NLP
- Apply semantic Analysis for NLP
- Compare different statistical approaches of NLP applications.

Unit-1:

Introduction: Origins and challenges of NLP, Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling errors.

Unit-2:

Word level analysis: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in Po Stagging –Hidden Markov and Maximum Entropy models.

Unit-3:

Syntactic analysis: Context-Free Grammars, Grammar rules for English, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

Unit-4:

SemanticsAnalysis: Requirementsforrepresentation,First-OrderLogic,DescriptionLogics – Syntax-DrivenSemanticanalysis,Semanticattachments–WordSenses,Relationsbetween Senses, Thematic Roles, selection restrictions – Word Sense Disambiguation

Unit-5:

Discourse Analysis and Lexical Resources: Discourse segmentation, Coherence– Reference Phenomena, Anaphora Resolution using Hobbsand Centering Algorithm– Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, Word Net, Prop Bank, Frame Net, Brown Corpus, British National Corpus (BNC).

Text Book:

1. Daniel Jurafsky, JamesH.Martin — Speechand Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.

Reference Text Books:

3. BreckBaldwin,— Language Processing with Javaand Ling Pipe Cook book, Atlantic Publisher, 2015.
4. Richard M Reese,—Natural Language Processing with Java, OReilly Media, 2015.
5. Nitin Indurkhyaand Fred J.Damerau,—Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
6. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.