COURSE STRUCTURE(R20)
AND
DETAILED SYLLABUS
(III YEAR)

ELECTRICAL & ELCTRONICS ENGINEERING

For
B.Tech., Four Year Degree Course
(Applicable for the batches admitted from 2020-21)

LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUK, Kakinada
Accredited by NAAC with "A" Grade and NBA (CSE, ECE,EEE & ME)
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B. Tech III-Year Course Structure and Syllabus –R20

III Year – I SEMESTER							
S. No.	**Course code**	**Subjects**	**Category**	**L**	**T**	**P**	**Credits**
1	R20EEE-PC3101	Power Systems-II	PC	3	0	0	3
2	R20EEE -PC3102	Electrical Measurements and Instrumentation	PC	3	0	0	3
3	R20EEE-PC3103	Power Electronics	PC	3	0	0	3
4	R20ECE-OE3101 R20CSE-OE3101 R20ECE-OE3102 R20CSE-OE3102	**Open Elective-I** **1.** Linear and Digital IC Applications **2.** Big Data Analytics 3. Basics of VLSI **4.** Python Programming	OE	3	0	0	3
5	R20EEE-PE3101.1 R20EEE-PE3101.2 R20EEE-PE3101.3 R20EEE-PE3101.4	**Professional Elective – I** 1. Signals and Systems **2.** Digital Control Systems **3.** Electrical Machine Design 4. Embedded Systems	PE	3	0	0	3
6	R20EEE-PC3104	Electrical Measurements and Instrumentation Lab	PC	0	0	3	1.5
7	R20EEE-PC3105	Power Electronics Lab	PC	0	0	3	1.5
8	R20BSH-SC3101	Soft skills for job seekers (Skill Oriented Course-3)	SC	1	0	2	2
9	R20BSH-MC3101	Entrepreneurship and Incubation (Mandatory Course)	MC	2	0	0	0
10	R20EEE-SI3101	Summer Internship-1 (Evaluation)	SI	0	0	0	1.5
Total				**18**	**0**	**8**	**21.5**
Honors courses -2/Minor courses -2							

III Year – II SEMESTER							
S. No.	**Course code**	**Subjects**	**Category**	**L**	**T**	**P**	**Credits**
1	R20EEE-PC3201	Power System Analysis	PC	3	0	0	3
2	R20EEE-PC3202	Switchgear and Protection	PC	3	0	0	3
3	R20EEE-PC3203	Microprocessors and Microcontrollers	PC	3	0	0	3
4	R20EEE-PE3201.1 R20EEE-PE3201.2 R20EEE-PE3201.3 R20EEE-PE3201.4	**Professional Elective – II** **1.** Advanced Control Systems 2. Electric Drives **3.** HVAC Transmission **4.** Special Electrical Machines	PE	3	0	0	3
5	R20ECE-OE3201 R20CSE-OE3201 R20CSE-OE3202 R20CSE-OE3203	**Open Elective-II** 1. Communication Systems 2. Data Structures **3.** Data Base Management System 4. OOPS Through JAVA	OE	3	0	0	3
6	R20EEE-PC3204	Power Systems and Simulation Lab	PC	0	0	3	1.5
7	R20EEE-PC3205	Electrical Engineering Virtual Lab	PC	0	0	3	1.5
8	R20EEE-PC3206	Microprocessors and Microcontrollers Lab	PC	0	0	3	1.5
9	R20EEE-SC3201	Electric Vehicle Technology (Skill Oriented Course-4)	SC	1	0	2	2
10	R20BSH-MC3201	Constitution of India (Mandatory Course)	MC	2	0	0	0
Total				**16**	**0**	**11**	**21.5**
Honors Course -3/Minor Course-3							
Summer Internship-2(After Second Year & Evaluated in IV-I Semester)							

**The Eligible students who opted the courses for B.Tech with Honors/Minor only*
Note:L-Lecture, T-Tutorial, P-Practical, C-Credits

III Year, I-Semester Syllabus (R20)

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PC3101	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 sag and tension computation of transmission lines as well as to 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. Calculate sag of transmission line or equal and unequal heights of towers and different types of insulators (L3)

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

Learning outcomes: The students are able to

- Compute the transmission line parameters for single phase, single and double circuit lines (L3)
- Compute the transmission line parameters for three phase, single and double circuit lines (L3)

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 Constants– Surge Impedance and SIL of Long Lines–Wave Length and Velocity of Propagation of Waves Numerical Problems .

Learning outcomes: The students are able to

- Analyze the transmission lines and represent them by suitable equivalent circuits (L4)
- Understand the concept of surge impedance loading, wavelength, and velocity of Propagation (L2)

UNIT-III

Power System Transients: Types of System Transients – 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.

Learning outcomes: The students are able to

- Analyze the types of power system transients (L4)

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.

Learning outcomes: The students are able to

- Analyze the phenomenon of corona and various effects in Transmission lines (L4)

UNIT – V

Sag and Tension Calculations and Overhead Line Insulators: 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 –Types of Insulators– String efficiency and Methods for its improvement– Voltage distribution Calculation of string efficiency– Capacitance grading and Static Shielding, Numerical Problems.

Learning outcomes: The students are able to

- Analyse the importance of sag/tension in transmission lines (L4)
- Understand the need of line insulators (L2)

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, TuranGonen, 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 Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE–PC3102	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 formeasurement of parameters –Resistance, Inductance and Capacitance.
- To learn about various Transducers and Display devices.

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

1. Choose the right type of instrument for measurement of voltage and current for ACand DC (L1)
2. Understand the principle of operation and working of different types of instruments(L2)
3. Calibrate ammeter, voltmeter, and wattmeter by using potentiometer (L3)
4. Select suitable bridge for measurement of electrical parameters (L2)
5. Identify different types of transducers and understand the operation and working ofvarious of digital devices (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.

Learning outcomes: The students are able to

- Understand the static and dynamic characteristics of instruments (L2)
- Choose the right type of instrument for measurement of voltage and current for AC and DC (L1)

UNIT-II

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

Learning outcomes: The students are able to

- Understand the measurement of single phase and three phase power and energy (L2)
- Understand the operation of instrument transformer (L2)

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

Learning outcomes: The students are able to

- Find the unknown parameters using potentiometer (L1)
- Understand the principle of operation and standardization of potentiometers (L2)
- Calibrate the measuring instruments (L3)

UNIT-IV

AC and DC Bridges :DC bridges: Sensitivity of Wheat stone's bridge – Carey Foster's bridge– Kelvin's double bridge formeasuring 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.

Learning outcomes: The students are able to

- Select suitable bridge for measurement of electrical parameters (L2)

UNIT-V

Transducers and Digital Meters: Transducers: 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.

Learning outcomes: The students are able to

- Understand the concepts various transducers (L2)
- Understand the measurement of electrical quantities using digital meters (L2)

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 2004.

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.
3. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
4. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, PrenticeHall of India, 2003.

Web Links:

1. https://nptel.ac.in/courses/108/105/108105153

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE–PC3103	Power Electronics	3:0:0	3

Course Objectives:

- To study the characteristics of power semiconductor 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 1-Φ and 3-Φ 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 process of Turn-on and Turn-off semiconductor switches. (L3)
2. Design the controlled rectifier circuits with R and RL-Loads. (L3)
3. Design the DC to DC choppers. (L3)
4. Analyze the operation of AC-AC converters. (L3)
5. Demonstrate the operation of single and their phase voltage source inverters. (L2)

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. Transistor Family: Power MOSFET, Power IGBT

Learning outcomes: The students are able to

- Examine the characteristics of power semiconductor switching devices. (L3)
- Design the gating circuits for thyristors, MOSFET and IGBT. (L3)

UNIT-II

AC-DC Controlled rectifiers: Single-phase half-wave controlled rectifier with R and RL load with and without freewheeling diode; 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 R and RL loads, Three phase semi-converter ;Numerical Problems

Learning outcomes: The students are able to

- Analyse the operation of single-phase controlled rectifiers. (L3)
- Understand the operation of three phase-controlled rectifiers. (L2)

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

Learning outcomes: The students are able to

- Understand the operation of different types of DC-DC converters(L2)
- Analyze the operation of buck, boost and Buck-Boost converters. (L3)

UNIT-IV

AC Voltage Controllers and Cycle 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 cyclo-converter with R load.

Learning outcomes: The students are able to

- Analyze the operation of the voltage regulator (L3).
- Understand the concept of cyclo-converter (L2).

UNIT-V

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

Learning outcomes: The students are able to

- Analyze the operation of single-phase inverter with square wave modulation. (L3)
- Evaluate the operation of voltage source inverter with sinusoidal modulation. (L3)
- Design the power circuit of a three-phase voltage source inverter. (L3)
- Analyze the voltage waveforms at different switching states of the VSI inverter. (L3)

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
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 Code	Course Title	Hrs./Week L: T: P	Credits
R20ECE -OE3101	Linear and Digital IC Applications **(Open Elective-1)**	3:0:0	3

Course Objectives:

- To introduce the basic building blocks and operation of linear integrated circuits.
- To understand the linear and non-linear applications of operational amplifiers.
- To acquire the knowledge in analysis and design of different types of active filters and analog multipliers using op-amps.
- To learn the internal structure, operation and applications of different analog ICs such as Timers and PLL.
- To understand the various types of ADCs and DACS using ICs.

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

1. Understand the internal components and characteristics of Op-Amp (L1).
2. Understand the various linear and non-linear applications using Op-amps (L2).
3. Analyze active filters using Op-amp and understand the frequency response of the amplifier configurations (L3).
4. Understand thoroughly the function of ICs such as 555 and PLL (L4).
5. Acquire the knowledge about various techniques of ADCs and DACs (L5).

UNIT I

Introduction to Operational Amplifiers: Differential Amplifier- DC and AC analysis of Dual input Balanced output Configuration and Properties of other differential amplifier configuration, Introduction and Classification of IC's, basic information of Op-Amp IC741 Op-Amp and its features, Op-Amp internal circuit, Op-Amp characteristics - DC and AC, Op-Amp parameters and Measurements.

Applications:

- Op-amps are used as amplifier
- Op-amps used as voltage regulator current regulator
- Op-amps used as Oscillators and waveform generators.

Learning Outcomes: The students are able to

- Understand the internal components and pin diagram of Op-Amp (L1).
- Understand the characteristics of Op-Amp (L1).

UNIT II

Linear Applications of OP-AMPS: Inverting and Non-inverting amplifier, adder, Difference amplifier, Integrator and differentiator, Instrumentation amplifier, AC amplifier, V to I and I to V converters. Non-Linear Applications of OP-AMPS: Sample and Hold circuits, Log and Anti log Amplifiers, Comparators, Schmitt trigger, Precision rectifiers, Triangular and Square wave generators.

Applications:

- Sign changer, scale changer, inverting, and non-inverting amplifier.
- Integrator, differentiator, and its application in analog computer.
- Used as a conversion circuits.
- Different circuits using op amps are analyzed with input and output signal waveforms.

Learning Outcomes: The students are able to

- Understand the linear applications using Op-amps (L2).
- Understand the non-linear applications using Op-amps (L2).

UNIT III

Active Filters: Introduction, Design and Analysis of Butterworth active filters – 1st order, 2nd order low pass and high pass filters, band pass, band reject and all pass filters. Analog multiplier using emitter coupled transistor pair, multiplier and divider.

Applications:

- Active filters are used in communication systems for suppressing noise
- Active filters are used in biomedical instruments
- Used in Pre-amplification, Equalization, Tone Control in Audio Systems
- They are used in Radio tuning to a specific frequency

Learning Outcomes: The students are able to

- Analyze active filters using Op-amp and understand the frequency response (L3).
- Able to design a filter using Op-amp (L3).

UNIT IV

Timers: Introduction to 555 timer, functional diagram, Multivibrators – Astable Multivibrators, Monostable Multivibrators description, functional diagram and Applications, Schmitt trigger. Phased Locked Loop: Introduction, block schematic, principles and description of Individual blocks of 565 PLL, PLL Applications for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization, VCO, Applications of VCO (566).

Applications:

- PLL is used to synthesize new frequencies
- Recovery of clock timing information from a data stream such as from a disk drive
- VCOs are used in function generators
- VCOs are used in Electronic jamming equipment.

Learning Outcomes: The students are able to

- Understand the function of 555 IC (L4).
- Understand thoroughly the function of PLL and VCO (L4).

UNIT V

Analog to Digital and Digital to Analog Converters: Introduction, Different types of ADCs – Flash type, Successive Approximation type, Dual Slope type, A/D Converter using Voltage-to-Time Conversion, Different types of DACs -weighted resistor type, R-2R Ladder type, R - 2R Ladder types, DAC and ADC Specifications. Voltage RegulatoRS: Introduction, Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator.

Applications:

- DACs can in Televisions and mobile phones to convert digital data to analog audio signal.
- DACs can in music players to convert digital data to analog audio signal.
- ADCs can used in microcontrollers, digital signal processing.
- ADCs can used in digital storage oscilloscopes, scientific instruments etc.

Learning Outcomes: The students are able to

- Understand various techniques of ADCs (L5).
- Understand various techniques of DACs (L5).

Text Books

1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition,2003.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI, 1987.

References

1. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma; SK Kataria& Sons;2nd Edition,2010
2. Design with Operational Amplifiers & Analog Integrated Circuits – Sergio Franco, McGraw Hill, 1988.
3. OP AMPS and Linear Integrated Circuits concepts and Applications, James M Fiore, Cenage Learning India Ltd.
4. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin& Fredrick Driscoll, PHI, 6th Edition. 5. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition
5. Digital Fundamentals - Floyd and Jain, Pearson Education

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20CSE -OE3101	Big Data Analytics **(Open Elective-1)**	3:0:0	3

Course Objectives:

- Optimize business decisions and create competitive advantage with Big Data analytics
- Introducing Java concepts required for developing map reduce programs
- Derive business benefit from unstructured data
- Imparting the architectural concepts of Hadoop and introducing map reduce paradigm
- To introduce programming tools PIG & HIVE in Hadoop echo system.

Course Outcomes:

1. Understand the generic data structures and implement the persistence of object using file IO.
2. Create and configure distributed Hadoop cluster by understanding HDFS architecture.
3. Implement the map reduce paradigm by analyzing different case studies.
4. Analyze data across distributed environment using hadoop writable APIs.
5. Generate map reduce jobs by writing pig latin scripts and HIVE to handle different kinds of data.

UNIT I

Data structures in Java: Linked List, Stacks, Queues, Sets, Maps; Generics: Generic classes and Type parameters, Implementing Generic Types, Generic Methods, Wrapper Classes, Concept of Serialization.

Reference: Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC

Learning Outcomes: After completion of this unit Student will be able to,

- Understand the concepts of data structures in JAVA. (L2)
- Implement Generic Data Structures and iterables. (L3)

Applications:

- **Banking Sector**
- Health Care

UNIT II

Working with Big Data: Google File System, Hadoop Distributed File System (HDFS) – Building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, JobTracker, Task Tracker), Introducing and Configuring Hadoop cluster (Local, Pseudo-distributed mode, Fully Distributed mode), Configuring XML files.

References: Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly Hadoop in Action by Chuck Lam, MANNING Publ.

Learning Outcomes: After completion of this unit Student will be able to,

- Understand GFS and HDFS architectures with multiple clusters. (L2)
- Understand Hadoop Cluster using different modes of installation. (L2)

Applications:

- Health care
- Manufacturing
- Media & Entertainment
- IoT (Internet on Things)

UNIT III

Writing MapReduce Programs: A Weather Dataset, Understanding Hadoop API for MapReduce Framework (Old and New), Basic programs of Hadoop MapReduce: Driver code, Mapper code, Reducer code, RecordReader, Combiner, Partitioner

Reference: Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly

Learning Outcomes: After completion of this unit Student will be able to,

- Understand Map Reduce framework architecture and work flow. (L2)
- Implement Hadoop map reduce API for real time scenarios. (L3)

Applications:

- Weather Patterns
- Transportation Industry

UNIT IV

Hadoop I/O: The Writable Interface, WritableComparable and comparators, Writable Classes: Writable wrappers for Java primitives, Text, BytesWritable, NullWritable, ObjectWritable and GenericWritable, Writable collections, Implementing a Custom Writable: Implementing a RawComparator for speed, Custom comparators

Reference: Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly

Learning Outcomes: After completion of this unit Student will be able to,

- Implement hadoop core APIs for writable classes. (L3)
- Implement custom comparables and comparators for efficiency. (L3)

Applications:

- IoT (Internet on Things)
- Weather Patterns

UNIT V

Pig: Hadoop Programming Made Easier Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin.

Reference: Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss

Applying Structure to Hadoop Data with Hive: Saying Hello to Hive, Seeing How the Hive is Put Together, Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works, Querying and Analyzing Data

References: Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss.

Learning Outcomes: After completion of this unit Student will be able to,

- Understand Pig and Hive architectures and their interfaces. (L2)
- Generate external and internal data tables into HDFS databases. (L3)
- Apply complex Pig Latin Scripts for user defined objects. (L3)

Applications:

- IoT (Internet on Things)
- Weather Patterns
- Transportation Industry
- Banking Sector

Text Books:

1. Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC
2. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly
3. Hadoop in Action by Chuck Lam, MANNING Publ.
4. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss

References:

1. Hadoop in Practice by Alex Holmes, MANNING Publ.
2. Hadoop MapReduce Cookbook,Srinath Perera, Thilina Gunarathne
3. Software Links: Hadoop:http://hadoop.apache.org/
4. Hive: https://cwiki.apache.org/confluence/display/Hive/Home
5. Piglatin: http://pig.apache.org/docs/r0.7.0/tutorial.html

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20ECE -OE3102	Basics of VLSI **(Open Elective-1)**	3:0:0	3

Course Objectives:

- To understand the Basic NMOS, CMOS & Bi CMOS circuits and their process technology.
- To understand the Designing of stick diagrams and layouts for OS transistors.
- To learn the concepts of modelling of Delay techniques and MOS layers.
- 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: After completion of the course, the student will be able to

1. Knowledge on various I.C fabrication technologies like NMOS, PMOS, CMOS
2. and Bi-CMOS and their Electrical properties Draw the stick diagrams and layout diagrams of various logic circuits and
3. analyze various design rules. Design various combinational gate level logics
4. Implement and design of building blocks of data path and array sub systems
5. Design and implement different programmable logic devices.

UNIT-I :

Review of microelectronics and Introduction to MOS technology: Introduction MOS and related VLSI technology – NMOS-CMOS-BICMOS-Gas Technologies – thermal aspects of processing – production of E beam masks.

Learning outcomes: The students are able to

- Outline CMOS fabrication process flow and λ-based design rules (L2)
- Derive the electrical parameters of MOS transistor (L4)
- Derive the driving parameters of Inverters (L4)

Applications:

- used for switching and amplifying electronics signals in the electronic devices
- can be used in electronic DC relay

UNIT-II:

MOS and BICMOS circuit design process: MOS layers – stick diagrams – design rules and layout – 2 µm meter – 1.2 µm meter CMOS rules – Layout diagrams – Symbolic diagrams.

Learning outcomes: The students are able to

- Outline MOS design rules (L2)
- Draw stick diagrams and layouts for MOS gates (L3)

Applications:

- Stick diagrams are useful for planning the layout and routing of integrated circuits
- CMOS used in microcontrollers, static RAM, registers, microchips and other digital circuits

UNIT-III

Basic Circuit Concepts: Sheet resistance – Area capacitance of layers – delay unit – wiring capacitances – choice of layers.

Learning outcomes: The students are able to

- Estimate scaling effects on device parameters (L5)
- Draw VTC of a CMOS inverter and estimate the switching threshold (VSP) for different $(\beta p/\ \beta n)$ ratios (L3)
- Find Noise Margins and propagation delays for skewed inverters (unloaded) (L5)
- Size cascaded inverters for driving large capacitance loads (L4)

Applications: Scaling scenarios for wire capacitance

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.

Learning outcomes: The students are able to

- Compare CMOS and pseudo-NMOS inverters with respect to area and speed (L2)
- Compare TG logic and Pass Transistor logic gates (L2)
- Distinguish between static and dynamic logic styles (L4)
- Evaluate performance of simple arithmetic circuits designed using CMOS (L5)
- Estimate max. frequency of a latch using timing parameters such as set-up time, hold time, skew etc (L5)

Applications:

- Flash memory chip designing
- Used to design application-specific integrated circuits (ASICs)

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 – etc.

Learning outcomes: The students are able to

- Identify the significance of testable design.
- Evaluate fabrication defects, errors and faults.
- Apply combinational and sequential circuit test generation algorithms.

Applications:

- Ensure high yield and proper detection of faulty chips after manufacturing.
- Predictive analysis to ensure that the synthesized design when manufactured will perform the given I/O function.

TEXT BOOKS:

1. Basic VLSI design by Douglas A, Pucknell, Kamran Eshraghian, Prantice Hall, 1996 3rd edition.

REFERENCE BOOK:

1. Mead, C.A and Conway, L.A., Introduction to VLSI Systems, Wesley – Wesley.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20CSE -OE3102	Python Programming **(Open Elective-1)**	3:0:0	3

Course Objectives:

- Understand structure and data types of python script.
- Implement iterations and functions in python.
- Implement modules and data structures using mutable & immutable objects.
- Understand object oriented concepts on real world scenarios.
- Understand packages for statistics and gaming.

Course Outcomes:

1. Understand program structure python REPL shell environment.
2. Implement iterators and functions for data processing.
3. Implement different modules and objects to organise data.
4. Implement different data structures and their functionalities.
5. Understand Object oriented concepts and handle different errors through exceptions.

Unit I:

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, Operators, Type conversions, Expressions.

Learning Outcomes:

After completing this chapter, student will be able to

- Understand the environment of python. (L2)
- Create and run simple scripts in python.(L2)
- Understand data types and their conversions. (L2)
- Understand operators for doing operations on different expressions. (L2)

Unit II:

Control Flow: Control Flow- if, if-elif-else, for, while, break, continue, pass.

Functions: Defining Functions, Calling Functions, Passing 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, Lambdas, map, reduce and filter.

Learning Outcomes:

After completing this chapter, student will be able to

- Understand the iterations using looping structures. (L2)
- Make decisions through conditional statements. (L2)
- Understand functions to define call and pass as arguments. (L2)
- Write anonymous functions for resolving complex problems. (L2)

Unit III:

Modules: Creating modules, import statement, from Import statement, name space, builtin modules- os, random, math, json, request, date, RegEx, itertools.

Packages: Introduction to PIP**,** Installing packages using PIP.

Exploring Data Science Libraries: NumPy, Pandas, Matplotlib

After completing this chapter, student will be able to

- Create and implement modules using import. (L3)
- Understand different built-in modules. (L2)
- Understand data science libraries. (L2)

Unit IV:

Strings & Data Structures: String**,** String Formatting**,** List, String and List Slicing, Tuple, Sets, Frozen Sets, Dictionaries, Comprehensions, Built-in methods of all sequences, File I/O Operations.

Learning Outcomes:

After completing this chapter, student will be able to

- Implement String operations and formatting. (L3)
- Understand fundamentals of data structures and their methods. (L2)
- Implementing file operations for data processing. (L3)

Unit V:

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

- Implement Object oriented concepts with real world scenarios. (L3)
- Understand class hierarchies and abstraction. (L2)
- Understand error handling and handle exceptions. (L2)

TEXT BOOKS:

1. Python Programming: Using Problem Solving Approach by Reema Theraja, Oxford publications
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.

REFERENCE BOOKS:

1. Fundamentals of Python by Kenneth H Lambert, Cengage
2. Learning Python, Mark Lutz, Orielly.
3. Python Programming by Ashok N Kamathane, McGrawhill

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE -PE3101.1	Signals and Systems **(Professional Elective-1)**	3:0:0	3

Course Objectives:

- To explain the basic properties of signals and systems and identify the systems based on their properties
- To develop expertise in time domain and frequency domain approaches to the analysis of continuous and discrete systems through Fourier series and Fourier transform tools.
- To analyze the process of sampling and the effect of under sampling.
- To develop the mathematical skills to solve problems involving convolution and correlation.
- To apply the Laplace transform as mathematical tool to convert time domain signals into s-domain signals.
- To analyze DT systems & their realization using Z-transform.

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

1. Analyze the signal characteristics, operations on signals and system properties (L4).
2. Apply the Fourier series and Fourier transform to obtain the spectral characteristics of continuous time periodic and aperiodic signals (L3).
3. Determine the Nyquist rates of low pass and band pass signals by using sampling theorem (L3).
4. Analyze the linear time invariant systems by applying the concepts of convolution and correlation (L4).
5. Use Laplace transform and Z - transform to obtain pole-zero plot with ROC for continuous time discrete time signals (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.

Learning outcomes: The students are able to

- Define basic continuous and discrete time signals mathematically and sketch the signals that involve simple modification of the independent/dependent variable (L2).
- Familiar with commonly used signals such as the unit step, ramp, impulse function, sinusoidal signals and complex exponentials (L1).
- Classify signals as continuous-time Vs. discrete-time, periodic Vs. non-periodic, energy signal Vs. power signal, odd Vs. even etc (L4).
- Calculate the various characteristics of a signal such as even part, odd part, energy,
- Power and period etc., (L3).
- Construct or represent any arbitrary signal by using basic signals such as impulse and step signals (L3).
- Test a given system for a linearity, causality, stability, time invariance, inevitability and memory properties (L3).
- Analyze the systems according their properties (L4).
- Determine the Fourier series coefficients for any periodic signal and plot the frequency spectrum of that periodic signal (L3).

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.

Learning outcomes: The students are able to

- Apply Fourier transform to obtain frequency spectrum of periodic and aperiodic signals (L3)
- Apply properties of the Fourier transform including linearity, shift, symmetry, scaling, modulation and convolution etc., in communication and filtering applications (L3)
- Determine the continuous-time signal corresponding to their transforms by applying Inverse Fourier transform (L3).
- Illustrate the effect of sampling of a continuous time signal for various sampling rates (L3).
- Determine the Nyquist sampling rate for a continuous-time signal by applying sampling theorem (L3).
- Explain the importance of sampling theorem for both low pass and band pass signals (L2).

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 functions of LTI system. Properties of linear time-invariant systems, Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, Relationship between bandwidth and rise time. Energy and Power Spectral Densities Cross-correlation and auto-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between autocorrelation function and energy/power spectral density function. Relationship between convolution and correlation.

Learning outcomes: The students are able to

- Determine the impulse response/transfer function of a given LTI system (L3)
- Find the response of a given LTI system for any input signal (L3)
- Explain the filter characteristics of linear systems for example LPF, HPF and BPF (L2).
- Analyze the LTI systems according their properties (L4).
- Find the energy/power of a signal by applying correlation properties and Parseval's theorem (L3)

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.

Learning outcomes: The students are able to

- Determine the Laplace transform and the associated region of convergence and pole-zero plot for a continuous time signal (L3).

- Apply Inverse Laplace transform to obtain the signal in the time domain by using partial fraction expansion method and some specific constraints on the ROC (L3).
- Find the Laplace transform of certain signals which are synthesized in the form of other basic waveforms (L3).
- Use the Laplace transform as an analytical tool in the analysis and study of LTI systems which are represented by linear constant -coefficient differential equations (L4).
- Apply Laplace transform properties to find the Laplace transform and the associated region of convergence and pole-zero plot for a continuous time signal if that signal is represented as (i) linear combination of other signals (ii) time shifted of other signal (iii) time scaling of other signal, (iv) convolution of other signals (v) Differentiation of other signal (vi) Integration of other signal (vii) multiplication of other signals (ix) other signal which is multiplied with time (x) other signal which is multiplied with exponential signal etc. (L3).

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.

Learning outcomes: The students are able to

- Determine the Z - transform and the associated region of convergence and pole-zero plot for a discrete time sequence (L3).
- Distinguish between Fourier and Z transforms (L2).
- Apply Inverse Z - transform to obtain the sequence in the time domain by using partial fraction expansion method, long division method and some specific constraints on the ROC (L3).
- Use the Z - transform as an analytical tool in the analysis and study of LSI systems which are represented by linear constant -coefficient difference equations (L4).
- Apply Z – transform properties to find the Z – transform and the associated region of convergence and pole-zero plot for a discrete time sequence if that sequence is represented as (i) linear combination of other sequences (ii) time shifted of other sequence (iii) time reversal of other signal, (iv) convolution of other signals (v) Accumulation of other signals (vi) time expansion of other signal etc. (L3).

Textbooks:

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, 2ndEdn.
3. Signals & Systems- Anand Kumar PHI 3rd Edn

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. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition,2008.
4. Signals and Systems – T K Rawat , Oxford University press, 2011

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PE3101.2	Digital Control Systems **(Professional Elective-1)**	3:0:0	3

Course Objectives:

- To understand the concepts of digital control systems.
- To understand z–transformations and mathematical analysis of digital control systems.
- To understand 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: After completion of the course, the student will be able to

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

UNIT – I

Introduction and signal processing: 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.

Learning Outcomes: The students are able to

- Understand discrete time control systems (L2)
- Analyze the mathematical Concepts of zero order hold (L4)

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.

Learning Outcomes: The students are able to

- Understand the concepts of z–transforms and inverse Z- transforms (L2).
- Analyze the Concept of difference equation approach(L4)

UNIT – III

State space analysis and the concepts of Controllability and Observability: State space representation of discrete time systems – State transition matrix and methods of evaluation – Discretization of continuous – Time state equations – Concepts of controllability and observability – Tests(without proof).

Learning Outcomes: The students are able to

- Understand State Space Representation of discrete time systems (L2)
- Analyze the Concepts of Controllability and Observability (L4)

UNIT – IV

Stability analysis: 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.

Learning Outcomes: The students are able to

- Understand the concept of S-plane and Z-plane (L2)
- Apply the different stability methods for digital systems (L3)

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.

Learning Outcomes: The students are able to

- Understand discrete time control system by conventional methods for Lead, Lag and Lead-Lag compensators (L2)
- Analyze of state feedback controller through pole placement (L4)

Textbooks:

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

Reference Books:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Systems and Control by Stains law H. Zak , Oxford Press, 2003.
3. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996

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

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PE3101.3	Electrical Machine Design **(Professional Elective-1)**	3:0:0	3

Course Objectives

- To study mmf calculation and thermal rating of various types of electrical machines.
- To design armature and field systems for D.C. machines.
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines and synchronous machines.
- To study the limitation of traditional designs and analyze the need of CAD for electrical machine design.

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

1. Understand the various factors influence the design of electrical machines. (L2)
2. Design the armature, commutator and brushes of DC machines. (L4)
3. Design the core, yoke, windings of transformers and also deign the rotor bars & slots and end rings of Induction motor. (L4)
4. Design the field winding, damper winding and rotor of synchronous machines. (L4)
5. Use the software tools to design the calculation. (L3)

Unit 1:

Introduction to Machine Design: Major considerations in Electrical Machine Design – Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings – Thermal considerations – Heat flow – Temperature rise and Rating of machines.

Learning Outcomes: The students are able to

- Discuss the major considerations and engineering materials used in Electrical machine design. (L2)
- Calculate the specific electrical and magnetic loading (L5)

Unit 2:

Design of DC Machines: Output Equations – Main Dimensions – Choice of Specific Electric and Magnetic Loading Maganetic Circuits Calculations – Carter's Coefficient – Net length of Iron –Real & Apparent flux densities –Selection of number of poles – Design of Armature – Design of commutator and brushes – performance prediction using design values.

Learning Outcomes: The students are able to

- Derive the output equation for DC machine. (L4)
- Design the Armature, commutator and brushes of the DC machine and also analyze the machine performance by using design values. (L5).

Unit 3:

Design of Transformers and Induction Motors : Transformer Design: Sizing of a transformer, Main Dimensions – KVA output for single and three phase transformers – Window space factor – Overall dimensions –Regulation- No load current – Temperature rise in Transformers – Methods for cooling of Transformers.

Induction Motor Design: Sizing of an induction motor, Main dimensions – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of poly-phase machines- Magnetizing current – Short circuit current.

Learning Outcomes: The students are able to

- Discuss the Main dimensions of transformer and also calculate the output equation for single and three phase transformers. (L2)
- Design the different methods for cooling of transformers (L5)
- Design of rotor bars & slots and end rings of induction motors. (L5)

- Calculate the Leakage reactance, Magnetizing current and Short circuit current.(L6)

Unit 4:

Design of Synchronous Machines: Sizing of a synchronous machine, main dimensions – Design of salient pole machines –Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design.

Learning Outcomes: The students are able to

- Design of armature, rotor and damper winding of salient pole synchronous machine. (L5)
- Design of field winding and turbo alternator. (L5)

Unit 5:

Computer aided design (CAD): Limitations of traditional designs need for CAD analysis, synchronous and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design, SRM and claw-pole machines.

Learning Outcomes: The students are able to

- Discuss the limitations of traditional designs and need for CAD analysis (L2)
- Discuss the different methods used in CAD (L6)

Textbooks:

1. A.K.Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. Ramamoorthy M, "Computer Aided Design of Electrical Equipment", East-West Press.

References:

1. M.G.Say, "Theory & Performance & Design of A.C.Machines", ELBS London.
2. R. K. Agarwal, "Principles of Electrical Machine Design", Essakay Publications, Delhi.
3. S.K.Sen, "Principles of Electrical Machine Design with Computer programmes", Oxford and IBH Publishing, 2006.

Web Links:

1. https://jcboseust.ac.in/electrical/images/transformer_design.pdf
2. https://rmd.ac.in/dept/eee/sp/6/DEA/unit4.pdf

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20ECE-PE3101.4	Embedded Systems **(Professional Elective-1)**	3:0:0	3

Course Objectives:

- To introduce major components of an embedded system
- To introduce INTEL 8051 micro controller
- To explain interfacing of various communication and I/O devices to an embedded system
- To expose role of firmware, operating systems in correlation with hardware systems.
- To explain embedded software development tools
- To demonstrate implementation of embedded system

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

1. Interpret embedded system and its hardware and software.
2. Comprehend the knowledge of microcontrollers
3. Develop interfacing with hardware
4. Illustrate different types of operating systems and Multitasking
5. Apply embedded Software development tools and Design and develop the embedded system

Unit 1:

Introduction to Embedded Systems: What is embedded system, embedded systems vs general computing systems, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, Processor and OS trends in embedded system. Embedded hardware units and devices in a system, embedded software in a system and an overview of programming languages, skills required for an embedded system designer, examples of the embedded systems.

Learning Outcomes: The students are able to

- Differentiate embedded system and general computing system (L4)
- Classify embedded systems based on performance, complexity and era in which they are evolved (L4)
- Discuss basic hardware and software units used in embedded systems (L2)

Unit 2:

Intel 8051 micro controller: Microcontrollers and embedded processors, Introduction to Classic 8051 family Architecture, Von Neumann Architecture and Harvard architecture, Address and data bus with multiplexed I/O pins. Addressing modes, instruction set, I/O programming and other application programming in Assembly and C language.

Learning Outcomes: The students are able to

- Differentiate processor architectures (L4)
- Discuss instruction set and addressing modes (L2)
- Discuss basic programming in Assembly and C language (L2)

Unit 3:

Interfacing : Interfacing with Keyboards, Displays, D/A and A/D Conversions, Multiple Interrupts, Serial Data Communication.

Learning Outcomes: The students are able to

- Understand and apply Interfacing (L2)
- Understand Serial Data Communication(L2)

Unit 4:

Hardware& software Codesign: Operating system basics, Types of operating systems,

Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronisation, Device Drivers, Fundamental Issues in Hardware Software Co-Design.

Learning Outcomes: The students are able to

- Understand and apply hardware & software architectures(L2)
- Describe scheduling of Tasks(L2)

Unit 5:

Embedded Software development tools and debugging techniques: Embedded Software development tools, Host and target systems, cross compilers, linkers, locators for embedded systems. Getting embedded software in to the target system. Debugging techniques. Testing on host machine, Instruction set emulators, logic analyzers. In-circuit emulators and monitors.

Learning Outcomes: The students are able to

- Understanding and use tools for Embedded Software development(L2)
- Burning embedded software in to the target system(L3)
- Apply debugging techniques (L3)

Text Books:

1. Computers as Components-principles of embedded computer system design, Wayne Wolf, Elseveir.
2. Ali Mazidi Mohammed Gillispie, Mazide Janice, "The 8051Microcontroller and Embedded Systems using assembly& C", 2nd Edition, Pearson Education, 2009.
3. An Embedded Software Primer, David E. Simon, Pearson Education.

References:

1. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 3rd edition, McGraw Hill Education, 2017.
2. Shibu K V, Introduction to Embedded Systems, 2nd edition, McGraw Hill Education,2017.
3. Embedding system building blocks, Labrosse, via CMP publishers.
4. The 8051 Microcontroller, Third Edition, Kenneth J.Ayala, Thomson.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PC3104	Electrical Measurements and Instrumentation Lab	0:0:3	1.5

Course Objectives:

- To understand the testing of oil transformer.
- To understand the design and working of DC, 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.

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

1. Understand the testing of transformer oil. (L2)
2. Understand the working of DC, AC bridges. (L2)
3. Analyze the calibration of various instruments. (L4)
4. Understand the measurement of frequency and phase difference by using CRO. (L2)
5. Understand the measurement of various non-electrical parameters using transducers. (L2)

Lectures/Demonstrations:

1. Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.
2. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation.
3. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.
4. Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers.
5. Measurements of R, L and C.
6. Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
7. Digital Storage Oscilloscope.

Experiments

1. Dielectric oil testing using H.T test kit.
2. Measurement of Inductance using Anderson Bridge.
3. Measurement of Capacitance using a Schering bridge.
4. Measurement of Low Resistance using Kelvin's double bridge.
5. Measurement of High resistance and Insulation resistance using Megger.
6. Calibration and testing of single-phase Energy meter.
7. Calibration of dynamometer wattmeter using phantom loading.
8. Calibration of Voltmeter and Ammeter by using DC Crompton Potentiometer.
9. Measurement of frequency and phase difference by using CRO.
10. Measurement of displacement with the help of LVDT.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PC3105	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 (L3)
3. Design the Buck converter and Boost converter (L3).
4. Develop the single phase and 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 Thyristor, MOSFET & IGBT.
2. Design and development of a firing circuit for Thyristor.
3. Single -Phase Half controlled converter with R and RL load.
4. Single -Phase fully controlled bridge converter with R and RL load.
5. Single Phase Dual Converter with R Load.
6. Verification of voltages gain of Boost converter in Continuous Conduction Mode (CCM) and Discontinuous Conduction Mode(DCM).
7. Verification of voltages ripple in buck converter in CCM operation.
8. Single -Phase AC Voltage Regulator with R and RL Load.
9. Three-phase AC-AC voltage regulator with R-load.
10. Single-Phase Cyclo-converter with R load.
11. Single -Phase square wave bridge inverter with R and RL Load.
12. Single -phase PWM inverter with sine triangle PWM technique.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20BSH-SC3101	Soft Skills for Job Seekers **(Skill Oriented Course-3)**	1:0:2	2

Course Objectives

- Encourage use of a wide range of grammatical structures and vocabulary in speech and writing
- Demonstrate good writing skills for effective paraphrasing, argumentative essays, and formal correspondence
- Provide training and opportunities to develop fluency in English through participation informal group discussions and presentations using audio-visual aids
- Knowing the best practices at the workplace to perform well in the interview.
- Encouraging smart self-learning, communication skills that focus on employability.

Course Outcomes

1. understand the grammatical forms of English and the use of these forms in specific communicative and career context
2. use a wide range of reading comprehension strategies appropriate to texts, to retrieve information
3. strengthen their ability to write paragraphs, essays, emails and summaries
4. improve their speaking ability in English both in terms of fluency and comprehensibility by participating in Group discussion and oral assignments
5. prepare their own resume and answer interview related questions unhesitatingly with acceptable soft skills

Unit 1

Preparing for Written Assessment **[6 Hours]**

Grammar: Articles: Know how to use different types of Articles**,** use articles appropriately in context Identify errors in the use of articles, **Prepositions**: Learn to use prepositions in context, Identifying errors in the use of prepositions, Look at the different functions of Prepositions, **Tenses**: understand the different form of tense used in sentences, know the various purposes of using different Tense forms, Use appropriate tense forms of verbs in context, Identify the errors in the use of tense forms, **Concord**: Know how to identify Subject-Verb-Agreement in
sentences, Use SVA appropriately in Context, identify the errors in the use of SVA, **Voices**:Know when to use Active or Passive Voice, Convert Active sentences to Passive ones,Relative Clause: Know what relative pronouns are, know when to use relative clauses,know the functions of Relative Clauses.

Soft Skills: Leadership:Introduction to Leadership, Leadership Power, Leadership Styles, Leadership in Administration. **Interpersonal Relations**:Introduction to Interpersonal Relations, Analysis of different ego states, Analysis of Transactions, Analysis of Strokes, Analysis of Life position.

Learning Outcomes

At the end of the module, the learners will be able to

- Comprehend the factors that influence use of grammar and vocabulary in speech and writing(L3)
- Produce a range of valid grammatical sentences in the real world situations and professional environment.(L3)
- develop employability skills through Leadership skills and interpersonal skills (L3)

Unit 2

Reading Comprehension **[6 Hours]**

Purposes & Strategies of Reading:know the general purpose of Reading,assess your skills of reading ,develop reading Strategies **Skimming for details**:Skim through a variety of passages, understand how skimming will orient you to the text, **Identifying main Ideas**:Identify the main ideas in the give text,Look for supporting statements in a passage, understand how the writer supports main ideas with details **Scanning for information:**Scan passages for factual information, understand how scanning can help find certain answers quickly,know how to look for factual answers,**drawing inferences:**Understand how to draw inferences,infer meanings while reading passages, **vocabulary**:Learn strategies to understand difficult words used in the passage,Apply strategies of reading to understand a variety of passages,**practise tests**

Soft Skills:Communication: Introduction to Communication, Flow of Communication, Listening, Barriers of Communication, How to overcome barriers of communication. **Stress Management**:Introduction to Stress, Causes of Stress, Impact Stress, Managing Stress

Learning Outcomes

At the end of the module, the learners will be able to

- assess the reading skill by developing reading strategies (L3)
- Understand the skimming & scanning techniques orients to identify the theme,purpose and statements.(L2)
- develop employability skills through communication skills and stress management(L3)

Unit 3

Writing paragraphs & Essays **[6 Hours]**

Features of Good Writing:understand what makes a piece of writing good,Analyse & discuss some samples of good & bad writing, **Gathering Ideas**: Discuss various techniques for gathering ideas before you start writing, practice some of the techniques that can be used in the Prewriting stage ,**Purposes of Writing:**understand the importance of purpose of writing,explore various purpose of writing,choose content & language based on the purpose **Writing for Specific audience:**Study ways of tailoring content to suit a target audience,analyse text to deduce the target audience,discuss how language is used to suit the target audience **organizing ideas:**understand the importance of organising ideas in a text,Learn the different ways of organising ideas,practice organising ideas while writing **Writing an introduction:**Know the importance of a good introduction, understand the different ways in which writers catch the attention of readers, **Developing supporting ideas:**Learn how to develop your ideas in a paragraph, discuss a variety of supporting ideas **Writing a conclusion:**Learn the different parts of a conclusion, Practice writing an effective conclusion **Using linkers:**Learn the different types of Linkers or cohesive devices, Discuss why it is important to use connectors in writing,**Choosing the right words:**Discuss why writers make a careful choice of language,Learn how to select language to make the intended impact, **Writing film & book reviews:** Learn the different categories of books & films,Know the elements which go into analysing books & films,Write your own film & book reviews **Common errors in writing, editing & proofreading**.:Practice correcting errors in basic sentence structure,Learn to proof-read & edit your draft before writing the final version

Soft Skills:Group Dynamics and Team Building: Importance of groups in organization,Interactions in group, Group Decision Taking, Team Building, Interaction with the Team, How to build a good team?

Learning Outcomes

At the end of the module, the learners will be able to

- produce logically coherent argumentative essays (L3)
- understand the use of passive voice in academic writing (L2)
- use appropriate vocabulary to express ideas and opinions (L2)
- develop employability skills through group dynamics and team building (L3)

Unit 4

Preparing for oral Assignment [6 Hours]

Group Discussion: Group Discussions as a tool for selection, skills for GD,Leadership & Problem-Solving Skills, Types of GD, Group Dynamics, Roles & Functions: Beginning, Presenting, Elaborating, Roles & Functions: Clarifying, Synthesising & Challenging, Roles & Functions: Agreeing, Disagreeing & Summarizing., Etiquette: Body Language & Time Management, GD Activities

Soft Skills: Conflict Management:Introduction to Conflict, Causes of Conflict, Managing Conflict **Time Management:** Time as a Resource, Identify Important Time Wasters, Individual Time Management Styles, Techniques for Better Time Management.

Learning Outcomes

At the end of the module, the learners will be able to

- participate in group discussions using appropriate conventions and language strategies and develop advanced listening skills for in-depth understanding of academic text(L3)
- collaborate with a partner to make discussions (L2)
- develop employability skills through conflict management and time management(L3)

Unit 5

Interview Skills [6 Hours]

Purpose of interviews: Know what recruiters looking for during Interviews,Become familiar with the process of career search, understand your skills,interests,achievements and attitude better **Preparing a Resume:**Understand what a job application is,know the details to be included in a CV,Know how to lay out details of a CV & prepare CV on your own **Writing a Cover Letter:**Study the information which is included in a cover letter.Learn how to organise information in a cover letter ,**Before and at the interview:**Learn how to prepare for an interview,learn how to behave during the interview, discuss what the interviewer might assess you on **Answering FAQs about yourself & your families:**Learn how to answer questions about yourself & family, Learn how to identify & talk about your strengths and Weaknesses **Answering FAQs about Likes & Dislikes:**Learn to choose interests which will be relevant to your Interview.learn to speak about your likes & Dislikes **Answering FAQs about Justifying your candidature:**Know what you need to say to answer a question about yourself, Be able to answer questions about your suitability for a job **Answering FAQs about Priorities, Attitudes & Biases:**Understand what your priorities will be in a job & learn to talk about them,learn to correct understanding of your attitude, biases & prejudice, if any, towards others,know positive qualities that are valued at work **Answering FAQs about Professional goals:** Become aware of the things you need to keep in mind while choosing a job,Set goals for your professional growth & plan how to achieve them **Public Speaking: Planning, Practice & Delivery:**Plan one minute speeches on simple topics, understand how to capture the audience's attention, be able to create strong closing statements.

Soft Skills:Motivation: Introduction to Motivation, Relevance and types of Motivation, Motivating subordinates, Analysis of Motivation

Learning Outcomes

At the end of the module, the learners will be able to

- prepare a CV with a cover letter to seek internship/ job (L2)
- understand the structure of Interviews and familiar with frequently asked questions while interview and how to respond to it (L3)

- develop employability skills through motivation and analysis of motivation (L3)

Reference Books

1. Skilful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
2. Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012. (Student Book, Teacher Resource Book, CD & DVD)
3. Word Power Made Easy by Norman Lewis
4. Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.

ASSESSMENT

The learners will demonstrate their knowledge and abilities through completion of the following required assessments while or at the end of this course. —1 Quiz, 1 GD, 2 Activities on Interview Readiness and Softskills, 1 Personal Interview

Quiz: (10M) : Quiz is conducted on Grammar, Vocabulary, Personal Inquisitive Questions, Paragraph, Essay, Picture Perception and Reading Comprehension. The Quiz consists of 50 questions and will be scaled down to 10 Marks. Duration of the quiz is 1hr 30 Min only and it is Computer Based Test (CBT)

Resume:(10 M) : Each student is required to submit 3 independently written Resumes along with a Cover Letter and a Statement of Purpose during the course . (SOP by assuming the candidate is applying for an Abroad University).

GD:(10 M) :

1. Each student has to perform 5 Group Discussions during the course on a peer evaluation basis which fetches them 5 Marks.
2. The Final Assessment through one formal GD by the Internal Examiner is for 5 marks.

The GD will be assessed on the following criteria :

- Content (3M)
- Body Language(2M)
- Group dynamics & Leadership Skills (3M)
- Communication Skills (2M)

Soft Skills:(10M)

Student will be assessed on

- Presentation of his/her Readiness of Interview (Grooming) with Prepared Visume (5M)
- Aptitude based/Case Study based /Behavior based Questions (5M)

Activities on Interview Readiness:(10M)

The External Examiners assess on Interview readiness

1) Tell something about Yourself (5M)

Assessment Parameters:

a) Initiation
b) Confidence level
c) Body Language
d) Attention Grabbing

2) **JAM/Face to Face Interview (5M):**Student will be given a topic on-Spot for JAM and will be assessed by the External examiner on

- Flow of Speech (2M)
- Accuracy and Language (2M)
- Confidence (1M)

Grading:

Assessment Model	Points
Quiz	**10**
Resume	**10**
GD	**10**
Soft Skills Activity	**10**
Personal Interview	**10**
Total	**50**

Pass Criterion:

1. Student has to Secure 30 Marks to pass this examination
2. Student who has an achievement certificate of any National or International Level Quiz/Psychometric Analysis, he/she has to secure a Minimum 20 Marks in this examination (Certificate+20 Marks) to pass the summative exam.
3. Clearing all categories is mandatory. Need to get 60% in each category.
4. 20M +Certificate=Successful or 30M+No certificate=Successful

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20BSH-MC3101	Entrepreneurship and Incubation **(Mandatory Course)**	2:0:0	0

Course Objectives:

- Creation of environment and facilities to instruct students and assist in identifying products or services.
- Develop innovative products, services, processes and techniques.
- Able to prepare financial proposals and start-ups.
- Promote the ideas to collaborate with entrepreneur skills in establishment of start-ups.
- Encourage the students to learn current trends of Science and Technology opportunities.

Course outcomes:

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

Unit I:

Fundamentals of Entrepreneurship: Entrepreneurship-Concept, Importance, Characteristics –Myths of Entrepreneurship -Role of Entrepreneurs in Indian economy – Social and Ethical Perspectives of 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 a nation.(L3)

Unit II:

Ideation and Evaluation of Business Ideas: Opportunity identification – Ideations process - Sources of business ideas – Role of creativity – Sources of Innovation –Technological Innovation and Entrepreneurship - Product/ Service design – Design Thinking.

Case lets: 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. (L3)
- Evaluate the business idea. (L2)

Unit III:

Feasibility Analysis and Business plan: Thrust areas of entrepreneurship - Techno-economic feasibility assessment- Financial feasibility

Market feasibility – Preparation of Business plan – Business canvas & Lean canvas. Activity: Preparation of business plan (draft)

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

- Evaluate technical feasibility.(L1)
- Develop Lean canvas. (L4)

Unit IV:

Business Incubation and startups: Fundamentals of business incubation - Services of incubators - Start-ups-meaning, significance - start up strategy-Present scenario of startups.

Activity: Analyze and evaluate new start-up..

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.

Activity: Business plan final version

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.(L3)

Text Book:

1. T.V Rao, Donald F. Kuratko, Entrepreneurship, A South-Asian Perspective, Cengage Learning, 2012
2. Datsy Davies, Indian Startups, Amazon Asia-Pacific Holdings Private Limited, 2016

Reference Books:

1. P.N.Rath, Sarjue Pandita, Entrepreneurship: Startup India & Stand up India, Lexicon Publishing House, 2018
2. MadhurimaLall, Shikha Sahai, Entrepreneurship, Excel Books (P) Ltd. 2008
3. Rajeev Roy, 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-canvas
3. https://canvanizer.com/new/lean-canvas
4. https://msme.gov.in/
5. https://t-hub.co/
6. http://www.apinnovationsociety.com/index.php
7. https://aim.gov.in/atal-incubation-centres.php
8. https://nptel.ac.in/courses/110/106/110106141/

III Year –II Semester Syllabus

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PC3201	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 the mathematical knowledge of per-unit quantities for the formation of Y-bus matrix to the power system (L3)
2. Analyze the numerical methods for the power flow studies(L4)
3. Develop the Z_{BUS} Matrix using step by step procedure of a power system network(L3)
4. Analyze the unsymmetrical faults in power system (L4)
5. Explain stability and various methods to improve stability of 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.

Learning Outcomes: The students are able to

- Model the impedance& Reactance diagram for a power system network (L1)
- Understand the per unit quantities (L2).
- Develop a Y_{bus} matrix for a power system network (L3).

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.

Learning Outcomes: The students are able to

- Analyze the load flow solution of a power system (L4).
- Compare different iterative techniques for load flow studies (L4).

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.

Learning Outcomes: The students are able to

- Understand the concept of Z_{bus} building algorithm (L2)
- Develop a Z_{bus} matrix for a power system networks (L3)
- Understand the effects of Symmetrical faults(L2)

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.

Learning Outcomes: The students are able to

- Understand the effects of Unsymmetrical faults (L2)
- Determine the fault currents for various types of faults in a power system (L5).

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.

Learning outcomes: The students are able to

- Analyze the steady state, transient and dynamic stability concepts of a power system (L4).
- Derive the Swing equation of a single machine connected system(L3)

Textbooks:

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

Reference Books:

1. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc.
2. Power System Analysis by HadiSaadat – 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 Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PC3202	Switch Gear and Protection	3:0:0	3

Course Objectives:

- To examine the technical aspects involved in the operation of circuit breakers.
- To understand different types of electromagnetic relays.
- To determine the Generator and Transformers protection schemes.
- To understand the protection of feeders and lines.
- To analyze the different types of static Relays, microprocessor based relays and Generation of over voltages and protection from over voltages.

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

1. Solve numerical problems for arc interruption and recovery in circuit breakers (L3)
2. Understand the principles of operation of electromagnetic relays (L2)
3. Determine the unprotected percentage of generator and transformer winding under fault conditions (L3)
4. Explain the use of relays in protecting feeders, lines and bus bars (L2)
5. Understand the working principle and operation of different types of static relays, different types of over voltages and protective schemes (L2)

UNIT – I

Circuit Breakers: Elementary Principles of Arc Interruption, Restriking Voltage and Recovery Voltage - Restriking Phenomenon, RRRV, Average and Max. RRRV, Current Chopping and Resistance Switching - Description and Operation of Following Types of Circuit Breakers: Oil Circuit Breakers, Air Blast Circuit Breakers, Vacuum and SF6 Circuit Breakers–CB Ratings, Specifications and Applications- Concept of Auto Reclosing.

Learning outcomes: The students are able to

- Understand the principle of arc interruption (L2)
- Examine the Construction and Operation of different types of circuit breakers (L3)

UNIT – II

Electromagnetic Protection Relays: Balanced beam type attracted armature relay - induction disc and induction cup relays–Torque equation - Relays classification– Instantaneous– DMT and IDMT types– Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.

Learning outcomes: The students are able to

- Understand the working principle and operation of different types of relays (L2)
- Classify the characteristics of relays (L2)

UNIT – III

Generator Protection: Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection– Numerical examples. Transformer Protection

Protection of transformers: Percentage differential protection– Design of CT's ratio– Buchholz relay protection–Numerical examples.

Learning outcomes: The students are able to

- Identify faults for high power generator and transformers (L3)
- Identify protective schemes for high power generator and transformers (L3)

UNIT – IV

Feeder and Bus bar Protection: Protection of lines: Over current Protection schemes – PSM,TMS - Numerical examples -Carrier current and three zone distance relay using impedance relays–Protection of bus bars by using Differential protection.

Learning outcomes: The students are able to

- Understand protective schemes used for feeder (L2)
- Understand protective schemes used for bus bar (L2)

UNIT – V

Static and Digital Relays & Protection against over voltage and grounding: Static relays: Static relay components– Static over current relays– Static distance relay– Microprocessor based over current relay.

Generation of over voltages in power systems: Protection against lightning over voltages– Valve type and zinc oxide lighting arresters – Grounded and ungrounded neutral systems– Effects of ungrounded neutral on system performance– Methods of neutral grounding: Solid–resistance– Reactance–Arcing grounds and grounding Practices.

Learning outcomes: The students are able to

- Understand and compare the working principle of different types of static relays (L4)
- Understand the reason of generating over voltages in power systems (L2)
- Analyse the need of Lightning arresters in power systems and protective schemes required (L4)

Textbooks:

1. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications, 2011.
2. Switchgear and Protection, Sunil S Rao, Khanna Publishers, 1992.

Reference Books:

1. Electrical Power Systems, C.L.Wadhwa, New Age international (P) Limited, Publishers, 2012.
2. Transmission network Protection, Y.G. Paithankar, Taylor and Francis,2009.
3. Power system protection and switch gear, Bhuvanesh Oza, TMH, 2010.

Web Links:

1. https://nptel.ac.in/courses/108/107/108107167/
2. https://nptel.ac.in/courses/108/101/108101039/

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20ECE-PC3203	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 memory and I/O interfacing with 8086 and 8051.

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

1. Distinguish between microprocessors & microcontrollers (L2)
2. Develop assembly language programming Using assembler directives.(L2)
3. Describe interfacing of 8086 with peripheral devices (L3)
4. Discuss architecture and features of Intel 8051 microcontroller (L2)
5. Develop assembly language programming Using 8051 instructions. (L3)

Unit I

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

Applications:

- Construct the machine code generation like arithmetic, logical, shift and rotate instructions.

Learning Outcomes: The students are able to

- Summarize features of a 8085 microprocessor (L2)
- Explain about Instruction cycle and timing diagram of 8085 (L3)

Unit II

8085 Microprocessor programming: Interrupts of 8085, instructions set of 8085 and addressing modes, programming of 8085.

Applications:

- Construct the machine code generation like arithmetic, logical, string, branch and machine controlling instructions

Learning Outcomes: The students are able to

- Develop assembly language programs for various problems (L3)
- Explain about ISR and interrupt structure of 8086 (L2)

Unit III

8086 Microprocessor: Introduction **,** Register Organization of 8086, Architecture, Pin Diagram, Physical Memory concept, Interrupt structure of 8086. Minimum and maximum mode microprocessor system, Timing diagram and General Bus operation.

Applications:

- Using assembler directives Construct simple programs like addition, subtraction, multiplication, division, shift, rotate etc**.**

Learning Outcomes: The students are able to

- Summarize features of a 8086 microprocessor (L2).
- Explain about Instruction cycle and timing diagram of 8086 (L3).

Unit IV

Programming and interacting with 8086: Addressing Modes, Instruction Set of 8086, Assembler Directives, Assembly Language Programming: Simple programs, Procedures and Macros Programme. Programmable Peripheral Interface 8255, Programmable Interrupt

Controller 8259, Programmable Communication Interface 8251 USART, DMA Controller 8257.

Applications:

- Design interfacing with 8086 to generate the square wave forms, 8251 interfacing asynchronous and synchronous to telephone lines.

Learning Outcomes: The students are able to

- Understand instruction set of 8086 microprocessor (L2)
- Develop assembly language programs for various problems (L2)
- Demonstrate memory & I/O interfacing with 8086 (L3)

Unit V

Intel 8051 Microcontroller: 8051 Microcontroller Architecture, Microcontroller 8051 pin diagram, 8051 Ports, Internal and External Memory, Counters and Timers, Serial Communication in 8051, Interrupts in 8051, Addressing Modes, Data Transfer Instructions, Data and Bit-Manipulation Instructions, Arithmetic Instructions, simple programs.

Applications:

- Construct the controller programs like addition, subtraction, multiplication, division, shift, rotate etc.

Learning Outcomes: The students are able to

- Distinguish between microprocessor and a microcontroller (L4)
- Describe architecture and features of Intel 8051 microcontroller (L2)
- Develop assembly language programs to perform various operations using 8051 (L3)

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

References:

1. The 8085 microprocessor: Architecture, programming and interfacing- K.Uday Kumar, B.S.Umashankar,2008
2. D.V.Hall, Microprocessors and Interfacing. TMGH, 2nd edition Kenneth J. Ayala, The 8051 Microcontroller, 3rd edition, Cengage Learning, 2004.
3. Barry B.Brey, "The Intel Microprocessors: Architecture, Programming and Interfacing", PHI, 6th Edition.
4. The 8051 microcontrollers, architecture and programming and applications- K.UmaRao, Andhe Pallavi., Pearson, 2009.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PE3201.1	Advanced Control Systems **(Professional Elective-2)**	3:0:0	3

Course Objectives:

- To evaluate the state space representation of a control system and formulation of different models from the signal flow graph.
- To understand the concept of controllability, observability and design of plant controller by using pole placement technique.
- To analyze nonlinear system using describing function approach and phase plane analysis.
- To analyze the stability of a system using Lyapunov's method.
- To understand the different types of non-linear controllers.

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

1. Understand the State space representation of control system and formulation of different state models (L2).
2. Design of control system using the pole placement technique after introducing the concept of controllability and observability(L5)
3. Analyze the nonlinear system using the describing function technique and phase plane analysis(L4)
4. Analyze the stability of nonlinear systems using Lyapunov's method(L4)
5. Understand the concept of different nonlinear controllers(L2)

UNIT – I:

State space analysis: State Space Representation – Solution of state equation – State transition matrix, –Canonical forms – Controllable canonical form – Observable canonical form, Diagonal Canonical Form.

Learning outcomes: The students are able to

- Understand the State space representation of control system and formulation of different state models (L2).
- Analyze the different Canonical forms of state space models (L4).

UNIT – II:

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.

Learning outcomes: The students are able to

- Understand the concept of Controllability & Observability Canonical forms of state model (L2).
- Design the controller using the pole placement technique (L5).

UNIT – III:

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.

Learning outcomes: The students are able to

- Analyze the nonlinear system using the describing function technique and phase plane analysis (L4).

UNIT–IV:

Stability analysis: Lyapunov's stability and Lyapunov's instability theorems. Direct method of Lyapunov for the linear, methods of constructing Lyapunov's functions for nonlinear systems.

Learning outcomes: The students are able to

- Analyze the Stability for linear and nonlinear systems using Lyapunov's method (L4).

UNIT – V:

Advances in control systems: Overview of nonlinear controllers: Adaptive control, Fuzzy Logic control and Neural Networks.

Learning outcomes: The students are able to

- Understand the different types of nonlinear controllers (L2).

Textbooks:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998
2. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication

Reference Books:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996
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
4. Companies, 1997.
5. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.
6. 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/

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PE3201.2	Electric Drives **(Professional Elective-2)**	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 characteristics of a DC motors.(L3)
2. Understand the process for speed control of DC motors by controlled converters. (L2)
3. Analyze the process for speed control of DC motors in four quadrants.(L3)
4. Analyze the Speed control of Induction Motor on stator side.(L3)
5. To understand the speed control of Induction Motor on rotor side.(L2)

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.

Learning outcomes: The students are able to

- Observe the speed torque characteristics of a DC machine. (L2)
- Develop the speed control methods for a DC motor. (L3)

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.

Learning outcomes: The students are able to

- Design the controlled converter fed DC drive. (L3)
- Study the operation of dual converter fed DC motor drive . (L2)

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).

Learning outcomes: The students are able to

- Study the operation of four quadrants in all modes. (L2)
- Study the closed loop operation of DC drive. (L2)
- Analyze the speed-torque characteristics of dc motor drives.(L3)

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).

Learning outcomes: The students are able to

- Observe the speed torque characteristics for an induction motor.(L2)
- Study the Closed loop v/f control of induction motor drives.(L2)

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)

Learning outcomes: The students are able to

- Analyze the slip power recovery schemes (L3)
- Study the closed loop operation of Synchronous motor drive. (L2)

Textbooks:

1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall,1989.
2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control" , Prentice Hall, 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 Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PE3201.3	HVAC Transmission **(Professional Elective-2)**	3:0:0	3

Course Objective: The objectives of the course are to make the students learn about:

- To learn about the trends in EHV AC transmission
- To apply knowledge to calculate the line inductance and capacitance of bundle conductors.
- To understand the effect of Corona and radio interference..
- To Explore the concept of Electrostatic field and the travelling wave theory
- To Analyze compensated devices for voltage control..

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

1. Calculate the line inductance and capacitance of bundle conductors.(L3)
2. Calculate electrostatic field of AC lines and Effect of high electrostatic field on biological organisms and human beings (L3)
3. Understand the sources and impacts of corona in EHV lines(L2)
4. Analyze compensated devices for voltage control(L4)
5. Design filters for suppressing harmonics injected into the system (L3)

UNIT-I

E.H.V. A.C. Transmission, line trends and preliminary aspects, standard transmission voltages – power handling capacities and line losses – mechanical aspects. Calculation of line resistance and inductance: resistance of conductors, temperature rise of conductor and current carrying capacity. Properties of bundled conductors and geometric mean radius of bundle, inductance of two conductor lines and multi conductor lines, Maxwell's coefficient matrix. Line capacitance calculation: capacitance of two conductor line, and capacitance of multi conductor lines, potential coefficients for bundled conductor lines, sequence inductances and capacitances and Diagonalization.

Learning Outcomes: The students are able to

- Understand the trends in EHV AC transmission (L2)
- Calculate the line inductance and capacitance of bundle conductors (L3)

UNIT -II

Calculation of electrostatic field of AC lines - Effect of high electrostatic field on biological organisms and human beings. Surface voltage Gradient on conductors, surface gradient on two conductor bundle and cosine law, maximum surface voltage gradient of bundle with more than 3 sub conductors, Mangolt formula.

Learning Outcomes: The students are able to

- Calculate the electrostatic field of AC lines (L3)
- Understand the effect of high electrostatic field on biological organisms and human beings (L2)

UNIT-III

Corona : Corona in EHV lines – corona loss formulae – attenuation of traveling waves due to corona – Audio noise due to corona, its generation, characteristics and limits, measurement of audio noise.

Learning Outcomes: The students are able to

- Analyze attenuation of traveling waves due to corona (L4)
- Understand the sources and impacts of corona in EHV lines (L2)

UNIT-IV

Power Frequency voltage control : Problems at power frequency, generalized constants, No load voltage conditions and charging currents, voltage control using synchronous condenser, cascade connection of components : Shunt and series compensation, sub synchronous resonance in series – capacitor compensated lines

Learning Outcomes: The students are able to

- Understand the concepts of power frequency voltage control (L2)
- Understand the methods of Shunt and series compensation(L2)

UNIT –V

Static reactive compensating systems: Introduction, SVC schemes, Harmonics injected into network by TCR, design of filters for suppressing harmonics injected into the system.

Learning Outcomes: The students are able to

- Understand the operation of SVC systems (L2)
- Design filters for suppressing harmonics injected into the system (L3)

Textbooks:

1. Extra High Voltage AC Transmission Engineering – Rakesh Das Begamudre, Wiley Eastern ltd., New Delhi – 1987.
2. EHV Transmission line reference book – Edison Electric Institute (GEC) 1986.

Reference Books:

1. HVAC and DC Transmission by S. Rao, Khanna Publishers-2009
2. M.S Naidu and V. Kamaraju, 'High-Voltage Engineering'. Tata McGraw Hill, 6th Edition 2015

Web links:

1. http://www.electricalquizzes.com/electric-transmissiondistribution/electric
2. www.electrical4u.com/corona-effect-in-power-system.html
3. www.electricaleasy.com/2016/07/corona-discharge.html

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PE3201.4	Special Electrical Machines **(Professional Elective-2)**	3:0:0	3

Course objectives:

- To describe the operation and characteristics of permanent magnet dc motor.
- To explain 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 Motors**.**
- To explain 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. Explain the working and control strategies of stepper motors (L2).
3. Explain the working and control strategies of switched reluctance motor (L2).
4. Explain the working of different types of BLDC motors. (L2)
5. Explain the concept of travelling magnetic field and working of linear motors (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-high temperature effects reversible losses-Irreversible losses-PMDC motor construction-Principle of operation-torque equation-Equivalent circuit-Application of permanent magnets in motors-Torque Speed Characteristics of PMDC Motor

Learning outcomes:

- Understand the Different permanent magnet materials and its usage in electrical machines (L2).
- Implement the electrical equivalent circuit of PMDC motor (L3).

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.

Learning outcomes:

- Understand the different types of stepper motors (L2).
- Discuss the open loop and closed loop control for different stepper motors (L2).

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.

Learning outcomes:

- Understand the principle operation and design of stator, rotor pole arc of switched reluctance motor (L2)
- Understand the rotor sensing mechanism and logic controller of switched reluctance motor (L2)

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.

Learning outcomes:

- Understand the construction and operation of Brushless DC Motor and its advantages. (L2)
- Explain the torque speed characteristics of square wave brushless DC motor. (L2)

UNIT –V

Linear Induction Motors (LIM): 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-equivalent circuit of LIM.

Learning outcomes:

- Understand the construction and operation of Linear Induction Motor (L2).
- List the application of Linear Induction Motors used (L1).

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,

Weblinks:

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

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20ECE-OE3201	Communication Systems **(Open Elective-2)**	3:0:0	3

Course Objective

- To expose on the analog and digital communication principles.
- To study the recent trends adopted in communication systems.

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

1. Explain the concept of amplitude and angle modulations(L2)
2. Understanding the concept of noise in communication systems(L2)
3. Describe various pulse communication schemes(L2)
4. Analyze various pulse transmission schemes(L4)
5. Explain the errors obtained in the communication system by using error Control coding techniques

UNIT I

Analog Communications: Introduction to Communication Systems: Modulation–Types Need for Modulation, Theory of Amplitude Modulation-Evolution and Description of SSB Techniques, Theory of Frequency and Phase Modulation,

Applications:

- Amplitude modulation is used in a variety of applications. Broadcast transmissions, Air band radio, single side band, quadrature amplitude modulation
- In order to transmit 2 channel stereo signals, DSB signals are used in Television and FM broadcasting.
- SSB-SC modulation techniques are used in mobile communication, telemetry, military communications, navigation and amateur radio.
- Frequency modulation is widely used for FM radio broadcasting, telemetry, radar, seismic prospecting, and monitoring newborns for seizures via EEG, two-way radio systems, sound synthesis, magnetic tape-recording systems and some video transmission systems.

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

- Understand the need for modulation, time domain and frequency domain representation (L2).
- Understand the different modulation techniques of AM, DSB-SC,SSB and FM (L2)

UNIT II

Noise: Noise: Source of Noise –External Noise –Internal Noise-Noise Calculation, Comparison of Various Analog Communication Systems (AM–FM–PM).

Applications:

- The noise calculation is used in all analog and digital communications systems, which limits the transmission distance.
- It is used to improve the quality of transmission and reduce the cost of the of system.

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

- Apply the noise theory on analog signals (L3)
- Apply the noise theory on modulation techniques(L3)

UNIT III

Pulse Communication: Pulse Communication: Pulse Amplitude Modulation (PAM) –Pulse Time Modulation (PTM)–Pulse Code Modulation (PCM), Comparison of Various Pulse Communication Systems (PAM–PTM –PCM).

Applications:

- Pulse and digital modulation techniques are used in Ethernet communication, many micro-controllers for generating control signals.
- These techniques are used in Photo-biology, an electronic driver for LED lighting.

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

- Compare various types of pulse communications systems(L2)
- Understand pulse digital modulation techniques. (L2)

UNIT IV

Digital Communication : Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Minimum Shift Keying (MSK) Phase Shift Keying (PSK) :BPSK–QPSK –8PSK, Quadrature Amplitude Modulation (QAM): 8QAM, Bandwidth Efficiency, Comparison of Various Digital Communication System (ASK–FSK–PSK–QAM).

Applications:

- Digital nodulation techniques are used in QPSK, CDMA, Cellular service, Wireless local loop, Digital video broadcasting-satellite.

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

- Understand the digital modulation and demodulation tecniques (L1)
- Calculate probability of error for ASK, FSK, BPSK, BFSK, QPSK (L3)

UNIT V

Source and Error Control coding: Entropy, Source Encoding Theorem-Shannon Fanon Coding-Huffman Coding, Mutual Information-Channel Capacity, Channel Coding Theorem, Error Control Coding-Linear Block Codes-Cyclic Codes-Convolution Codes.

Applications:

- Information theory is used in, Data compression, Error correcting and detecting codes, Cryptology.
- Shannon fano coding is used in digital communications, random variable sequence generator
- Huffman encoding is widely used in compression formats like GZIP, PKZIP (winzip) and BZIP2 ,Multimedia codec like JPEG, PNG and MP3

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

- Calculate entropy for different message signals. (L3).
- Analyze different coding techniques. (L3)

Text books

- Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons, 2004
- H.Taub, D L Schilling and G Saha, “Principles of Communication”, 3rd Edition, Pearson Education, 2007.
- B. P.Lathi, “Modern Analog and Digital Communication Systems”, 3rd Edition, Oxford

Reference books

- WayneTomasi,“AdvancedElectronicCommunicationSystems”,6thEdition,PearsonEducation,2009.
- RappaportT.S, "Wireless Communications: Principles and Practice", 2ndEdition,PearsonEducation,2007.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20CSE-OE3201	Data Structures **(Open Elective-2)**	3:0:0	3

Course Objectives:

- Describe to algorithmic complexities, recursive algorithms, searching and sorting techniques.
- Describe to list representation models in various types of applications
- Applying stack and queue techniques for logical operations
- Implementation of tree implementation in various forms
- Describe of orientation on graphs, representation of graphs, graph traversals, spanning trees

Course Outcomes:

- Analyze different searching and sorting Techniques.
- Apply concepts of linked lists and implementation of different Linked Lists
- Apply concepts of stacks and queues in different mathematical evaluations
- Understanding of non linear data structures like trees and binary search trees their operations
- Evaluating concepts of graphs and their applications.

Unit I:

Data structure- Definition, types of data structures Recursion: Definition, Design Methodology and Implementation of recursive algorithms, Linear and binary recursion, recursive algorithms for factorial function, GCD computation, Fibonacci sequence, Towers of Hanoi, Tail recursion

List Searches using Linear Search, Binary Search, Fibonacci Search

Sorting Techniques: Basic concepts, Sorting by : insertion (Insertion sort), selection heap sort), exchange (bubble sort, quick sort), distribution (radix sort) and merging (merge sort) Algorithms.

Learning Outcomes:

After completion of this unit, student will be able to

- Understand and remember algorithms and its analysis procedure(L2).
- Analyze sorting techniques (L4).
- Analysis procedure of search (L4).

Application: Evaluating the Complex Mathematical Expressions

Unit II:

Linked Lists: Data structures-Linear and non linear data structures, ADT concept, Linear List ADT, Array representation, Linked representation, Vector representation, singly linked lists -insertion, deletion, search operations, applications of single linked list to represent polynomial expressions, doubly linked lists-insertion, deletion operations, circular lists. Sparse matrices and their representation.

Learning Outcomes:

After completion of this unit student will be able to

- Understand the linked list process(L2).
- Analyze operation on different Linked lists(L4).
- Apply linked list into polynomial expressions(L3).

Application: Data Storage Representations

Unit III:

Stacks and Queues: Basic Stack Operations, Representation of a Stack using Arrays, Stack Applications: Reversing list, Factorial Calculation, Infix to postfix Transformation, Evaluating Arithmetic Expressions.

Queues: Basic Queues Operations, Representation of a Queue using array, Implementation of Queue Operations using Stack, Applications of Queues-Round robin Algorithm, Circular Queues, Priority Queues.

Learning Outcomes:

After completion of this unit, student will be able to

- Understand working process of stack and Queue(L2)..
- Evaluating Arithmetic Expressions(L5)..
- Apply Transformation of infix to postfix conversion(L3).

Application: Evaluating the Complex Mathematical Expressions

Unit IV:

Trees: Basic tree concepts, Binary Trees: Properties, Representation of Binary Trees using arrays and linked lists, operations on a Binary tree , Binary Tree Traversals (recursive), Creation of binary tree from in, pre and post order traversals, Threaded Binary Trees. Binary search tree, Basic concepts, BinaryST operations: insertion, deletion

Learning Outcomes:

After completion of this unit student will be able to

- Create Binary Tree using linked list and Arrays(L6)..
- Create Binary tree from different Traversals(L6).
- Understand how Binary Search Tree works(L2).
- Analyze different Operation of Binary Search Tree operations(L4)..

Application: Computer Networks, Routing Protocols

Unit V:

Graphs: Basic concepts, Representations of Graphs: using Linked list and adjacency matrix, Graph algorithms ,Graph Traversals (BFS & DFS), applications: Dijkstra's shortest path, Transitive closure, Minimum Spanning Tree using Prim's Algorithm, warshall's Algorithm

Learning Outcomes:

After completion of this unit student will be able to

- Create the spanning tree from graphs(L6).
- Create minimal spanning tree by using different algorithms(L6).

Application: Communication networks,Routing Algorithms, Shortest Path, Network topologies

TEXT BOOKS:

1. Data Structure with C, Seymour Lipschutz, TMH
2. Fundamentals of Data Structures in C++, Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, 2nd Edition, Universities Press (India) Pvt. Ltd.
3. Data Structures using C,Reema Thareja, Oxford
4. Data Structures, 2/e, Richard F, Gilberg , Forouzan, Cengage
5. Data structures and algorithm analysis in C, 2nd ed, mark allen weiss

REFERENCE BOOKS:

1. Data Structures and Algorithms, 2008,G.A.V.Pai, TMH
2. Classic Data Structures, 2/e, Debasis ,Samanta,PHI,2009
3. Fundamentals of Data Structure in C, 2/e, Horowitz, Sahni, Anderson Freed, University Press.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20CSE-OE3202	Data Base Management System **(Open Elective-2)**	3:0:0	3

Course objectives:

- Learn the fundamental concepts of database systems.
- Enable students to design ER diagram for any customized applications
- Learn simple and Complex queries using SQL
- Learn schema refinement techniques (Normalization).
- Knowledge about transaction and recovery techniques.

Course Outcomes:

1. Understand File System Vs Databases.
2. Design and implement ER-model and Relational models.
3. Construct simple and Complex queries using SQL.
4. Analyze schema refinement techniques.
5. Design and build database system for a given real world problem

Unit-I

Introduction-Database system, Characteristics (Database Vs File System), Database Users (Actors on Scene, Workers behind the scene), and Advantages of Data base systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

Learning outcomes: Student will be able to

- Distinguish between Database System and File System (L2)
- Categorize different kinds of data models (L2)

Unit-II

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance , Relational algebra, Relational Calculus.

Entity Relationship Model:

Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

Learning Outcomes: Student Will Be Able To

- Develop E-R model for the given problem (L6)
- Knowledge about integrity constraints in relational model (L1)

Unit-III

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency(1NF, 2NF and 3NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF).

Learning Outcomes: Student will be able to

- Differentiate between various normal forms based on functional dependency (L2)
- Apply Normalization techniques to eliminate redundancy (L3)

Unit-IV

Transaction and Recovery:

Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Deadlocks in transactions, Recoverability, Implementation of Isolation, Testingfor Serializability, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

Learning Outcomes: Student will be able to

- Summarize transaction properties and recoverability (L2)

UNIT-V

File Organization and Indexing, File Types, File Operations ,Cluster Indexes, Primary and Secondary Indexes , Index data Structures, Hash Based Indexing: Tree based Indexing, Indexes and Performance Tuning

Learning Outcomes: Student will be able to

- Understand basic concepts of File Organization and Indexing (L2)

Text Books:

1. Database Management Systems, 3/e, Raghurama Krishnan, Johannes Gehrke,TMH
2. Database System Concepts,5/e, Silberschatz, Korth, TMH
3. Introduction to Database Systems, 8/e C J Date, PEA..

Reference Books:

1. Database Management System, 6/e Ramez Elmasri, Shamkant B. Navathe, PEA
2. Database Principles Fundamentals of Design Implementation and Management, Carlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20CSE-OE3203	OOPS Through JAVA **(Open Elective-2)**	3:0:0	3

Course Objectives:

- To understand the structure and environment of Java.
- To implement the relationship between objects.
- To apply data hiding strategy in objects.
- To implement text processing and error handling.
- To organize data using different data structures.
- To create multi threaded graphical user interface applications.

Course Outcomes:

1. Understand the environment of JRE and Control Statements.
2. Implement real world objects using class Hierarchy.
3. Implement generic data structures for iterating distinct objects.
4. Implement error handling through exceptions and file handling through streams.
5. Design thread-safe GUI applications for data communication between objects.

Unit I:

Java Environment and Program Structure: 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

- Understand architecture of Java Virtual Machine.(L2)
- Understand the structure of java program and its environment. (L2)

Unit II:

Class Hierarchy & Data Hiding: 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

- Understand the class hierarchy and their scope. (L2)
- Implement relationship between objects. (L3)
- Understand data hiding and nested classes. (L2)
- Implement data type casting and cloning of objects. (L3)

Unit III:

Strings and Collections :

String: Methods, String Buffer and String Builder, String Tokenizer,

Collections: Exploring java.util.*, Scanner, Iterable, Collection Hierarchy, Set, List, Queue and Map, Comparable and Comparator, Iterators: for each, Enumeration, Iterator and List Iterator.

Learning Outcomes: Student will be able to

- Understand the usage of String and its properties and methods.(L2)
- Understand data structures and Iterators. (L2)
- Create the data structures and implement different utility classes. (L3)

Unit IV:

IO and Error Handling:

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

- Understand character and byte streams. (L2)
- Understand the hierarchy of errors and exceptions. (L2)
- Implement data streams and exception handlers. (L3)

Unit V:

Threads and GUI:

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, Menu Bar, Menu Item.

Learning Outcomes: Student will be able to

- Understand the Thread Life Cycle and its scheduling.(L2)
- Implement the synchronization of threads. (L2)
- Create graphical components using Abstract window toolkit. (L3)

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 in
2. Swings, JList and JScrollPane, Split Pane, JTabbedPane, JTree, JTable, Dialog Box.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PC3204	Power Systems & Simulation Lab	0:0:3	1.5

Course Objectives:

- To evaluate the Sequence Impedance of Transformer and Alternator.
- To determine ABCD Parameters of Transmission line.
- To analyze of Load Frequency Controllers & Load Flow Studies of Power System Network.
- To analyze Transient Response of RLC circuits using Simulation
- To design of Single Phase Full Converter & Voltage Controller in Simulation.

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

1. Determine the Sequence Impedance of Alternator and Transformer (L3)
2. Determine the Transmission Line Parameters and study the Ferranti Effect (L2)
3. Design & Simulation of Load Frequency Controllers and Load Flow Studies of Power System Network (L5)
4. Simulation of Transient Response of RLC circuits (L4)
5. Simulation of Single Phase Full Converter & Voltage Controller (L4)

Any 10 of the Following Experiments are to be conducted:

1. Sequence Impedances of 3 Phase Transformer.
2. Sequence Impedances of 3 Phase Alternator by Fault Analysis.
3. Sequence Impedances of 3 Phase Alternator by Direct method.
4. ABCD parameters of Transmission line.
5. Load flow studies using Gauss-Seidel method
6. Load Flow Studies using N-R method.
7. Load Frequency Control of Two Area with & without control
8. Economic Load Dispatch with & without Losses
9. Transient analysis of Single Machine Connected to Infinite Bus (SMIB).
10. Modelling of Transformer and simulation of Lossy Transmission Line.
11. Simulation of Transient Response of RLC circuits.
    a. Response to Pulse Input.
    b. Response to Step Input.
    c. Response to Sinusoidal Input.
12. Simulation of Single Phase Full Converter using RLE Loads and Single Phase AC
    a. Voltage Controller using RL Loads.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PC3205	Electrical Engineering Virtual Lab	0:0:3	1.5

Course objectives:

- To verify the Network Theorems.
- To Control the Speed of the DC Motors & Induction Motor.
- To Evaluate the Performance of DC Machines & Transformer.
- To Obtain Equivalent circuit parameters of Induction Motor
- To Assess the V & Inverted V Curves of Three Phase Synchronous Motor.

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

1. Analyze Basic Network Theorems. (L2)
2. Analyze the performance and characteristics of DC Machine & Transformer. (L3)
3. Obtain Equivalent circuit parameters of Induction Motor. (L3)
4. Control the Speed of Induction Motor. (L2)
5. Develop the V & Inverted V Curves of Three Phase Synchronous Motor. (L4)

Any 10 of the Following Experiments are to be conducted:

1. Verification of Superposition Theorem.
2. Verification of Thevenin‘s Theorem.
3. Verification and Norton‘s Theorem.
4. Magnetization characteristics of DC Shunt Generator. Determination of Critical Field. Resistance and Critical Speed.
5. Load test on DC Shunt Generator.
6. Speed control of DC Shunt motor by Field and Armature Control.
7. Equivalent circuit of Three Phase Induction Motor.
8. Speed control of Slip ring Induction Motor.
9. OC & SC Test on Single Phase Transformer.
10. V and Inverted V curves of a Three Phase Synchronous Motor.

Web links:

1. https://www.vlab.co.in/broad-area-electrical-engineering.

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PC3206	Microprocessors and 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 strings, branching and process control instructions for implementation of 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. Develop programming skills for data operations and different interfacing circuits of microprocessor and microcontrollers.
2. Develop 8086 Assembly language programs to demonstrate the arithmetic operations of binary, BCD, ASCII, logical operations and standard DOS functions to display message on screen, reading keys from keyboard with and without echo.
3. Examine different string, branch and process control-based operations in assembly language such as moving string, finding length of string, reverse of string, insertion, deletion, sorting.
4. Demonstrate the process of interfacing 8086 microprocessor with peripheral control ICs like 8255 and 8259.
5. Develop assembly language programs to make use of parallel ports, timers and serial port of 8051 microcontroller.

List of Experiments:
Intel 8086 (16-bit Micro Processor)-
assembly language programming

1. Perform simple arithmetic operations.
2. Sort an array of binary numbers.
3. Code Conversion (Eg. ASCII to Packed BCD form).
4. Addition of an array of BCD numbers stored in packed form.
5. Finding the reverse of a string.
6. Multiplying two 3x3 matrices.
7. Generation of Prime numbers.
8. Identification & displaying the activated key using DOS & BIOS function calls.
9. Interface a stepper motor to 8086 through 8255.
10. Interfacing with a 8259 interrupt controller.

Intel 8051 (8-bit Microcontroller)-
assembly language and C programming experiments in 8051 using keil.

1. Detection of key closure (connected to a port line) by polling technique.
2. Delay generation using i) Nested loop & ii) Timers.
3. Counting of external event occurrence through port line.
4. 8051 serial communication interfaces with PC.
5. Develop a embedded C program to interface seven segment display to port1 and port2 and display the count from 00 to FFH.
6. Implement the functionality of traffic signal controller using 8051 microcontrollers.
7. Develop an embedded C program to display the given string on LCD.

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 Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-SC3201	Electric Vehicle Technology **(Skill Oriented Course-4)**	1:0:2	2

Course Objectives:

- To study the working principle of electric vehicles and fundamentals.
- To study electric vehicle architecture design.
- To study different types of motors used in electric vehicle and controller
- Analyze the necessity of battery management system (BMS) in electric vehicle
- Demonstrate different configurations of electric vehicles and charging techniques

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

1. Explain about working principle of electric vehicles and fundamentals (L2).
2. Explain the design and architecture of electric vehicle (L2).
3. Explain the construction and working principle of various motors used in electric vehicles. (L2).
4. Analyze the importance of battery management system (BMS) in electric vehicle (L4).
5. Understand the control and configurations of EV charging stations.(L2)

UNIT–I:

Introduction to electric vehicle: History-Components of Electric Vehicle-Comparison with Internal combustion Engine: Technology, Benefits and Challenges-EV classification and their electrification levels-advantages & disadvantages of EV - EV Terminology

Learning Outcomes: The students are able to

- Understand the basic components of electric vehicles (L2)
- Understand the advantages & disadvantages of EV(L2)

UNIT–II:

Electric Vehicle Architecture Design: Types of Electric Vehicle and components-Electrical protection and system requirement-Photovoltaic solar based EV design-Battery Electric vehicle (BEV)-Hybrid electric vehicle (HEV)-Plug-in hybrid vehicle (PHEV-Fuel cell electric vehicle (FCEV)-Electrification Level of EV-Comparison of fuel vs. Electric and solar power-Solar Power operated Electric vehicles

Learning Outcomes: The students are able to

- Understand the different designs in electric vehicle (L2)

UNIT–III:

Electric Drive and Controller: Types of Motors-Selection and sizing of Motor-RPM and Torque calculation of motor-comparison of all motors - Motor Controllers-Component-sizing-Physical Locations-Mechanical connection of motor-Electrical connection of motor

Learning Outcomes: The students are able to

- Explain the different motors used in electric vehicle (L2)
- Understand the use of controller in electric vehicle (L2)

UNIT–IV: Battery Management System (BMS): Need of BMS-Rule based control and optimization-based control-Software-based high-level supervisory control-Mode of power-Behaviour of motor-Advance Features

Learning Outcomes: The students are able to

- Analyze the role of battery management system (BMS) in EV(L4)

UNIT–V:

EV Charging Technologies: Classification of different charging technology for EV charging station - introduction to Grid-to-Vehicle(G2V) - Vehicle to Grid (V2G) - Vehicle to

Buildings (V2B) - Vehicle to Home (V2H) operations - bi-directional EV charging systems - energy management strategies used in hybrid and electric vehicle - Wireless power transfer (WPT) technique for EV charging.

Learning Outcomes: The students are able to

- Explain the different charging technologies to charge the EV (L2)
- Understand the concept of Bi-Directional charging system (L2)

Text Books:

1. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis - second edition, 2013.

Reference Books:

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2. Hybrid Electric Vehicles – Teresa Donateo, Published by ExLi4EvA, 2017
3. Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Mehrdad Ehsani Yimin Gao Stefano Longo Kambiz M. Ebrahimi, Taylor & Francis Group, LLC, 2018.
5. Hybrid, Electric & Fuel-Cell Vehicles Jack Erjavec, Delmar, Cengage Learning.
6. Electric and Hybrid Vehicles, Tom Denton, Taylor & Francis, 2018.

Web links:

1. https://nptel.ac.in/courses/108106170

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20BSH-MC3201	Constitution of India **(Mandatory Course)**	2:0:0	0

Course Objectives:

- Comprehend the awareness of history of India and importance of constitution.(L2)
- Inculcate the basic knowledge of structure of union government and roles and responsibilities executive bodies.(L2)
- Know the structure of state government and its administration in various levels.(L1)
- Examine the local government structure and roles of the authorized bodies from the grass roots of democracy.(L3)
- Identify the importance of election commissions and other welfare commissions in the state as well union governments. (L1)

Course Outcomes: At the end of the semester/course, the student will be able to have a clear knowledge on the following:

1. Know the sources, features and principles of Indian Constitution.(L1)
2. Learn about Union Government role and responsibilities and its structure(L2)
3. Comprehend the state government and its administration.(L2)
4. Get acquainted with Local administration and PachayatiRaj.(L2)
5. Gain knowledge on roles and functioning of Election Commission(L1)

UNIT-I

Introduction to Indian Constitution: Indian Constitution meaning, features and Sources - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Learning Outcomes:

After completion of this unit student will be able to

- Understand the concept of Indian constitution (L2)
- Apply the knowledge on directive principle of state policy (L3)
- Analyze the History, features of Indian constitution (L3)
- Evaluate Preamble Fundamental Rights and Duties (L2)

Application:

Application of the fundamental rights and fundamental duties in present scenario.

UNIT-II

Union Government and its Administration: Structure of the Indian Union: Federalism, President: Role, power and position, PM and Council of ministers, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions;

Learning Outcomes:-

After completion of this unit student will be able to

- Understand the structure of Indian government (L2)
- Differentiate between the state and central government (L2)
- Know the Structure of supreme court and High court (L2)

Application: Role play mock parliament in the class room to understand LokSabha and RajyaSabha.

UNIT-III

State Government and its Administration: Governor - Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions

Learning Outcomes:-

After completion of this unit student will be able to

- Understand the structure of state government (L2)

- Analyze the role Governor and Chief Minister(L3)
- Explain the role of state Secretariat (L2)
- Differentiate between structure and functions of state secretariat (L3)

Application:

- Study the lien of the hierarchy of ministries and list-out current ministers.

UNIT-IV

A Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - PachayatiRaj: Functions PRI: Zilla Panchayat, Block level Organizational Hierarchy - Village level - Importance of grass root democracy

Learning Outcomes:-

After completion of this unit student will be able to

- Understand the local Administration (L2)
- Compare and contrast district administration role and importance (L2)
- Analyze the role of Mayor and elected representatives of Municipalities (L2)
- Evaluate Zilla panchayat block level organization (L3)

Application:

- Compare and contrast the functionalities of two mayors of two Municipal Corporations.

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner - State Election Commission.

Learning Outcomes:-

After completion of this unit student will be able to

- Know the role of Election Commission apply knowledge (L3)
- Analyze role of Central and state election commission (L3)

Application:

- Make a survey of the voters for local elections in your area.

Text Books:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics

References:

1. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
2. J.C. Johari, Indian Government and Politics Hans
3. J. Raj Indian Government and Politics
4. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
5. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

E-Resources:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution