B.TECH - ELECTRICAL & ELECTRONICS ENGINEERING

Course Structure R-22

SEMESTER V

S. No.	Class	Course Code	Name of the Subject	L	T	P	Credits
1	**PC**	D25PC15	Power Electronics	3	0	0	3
2	**PC**	D25PC16	Electrical Measurements and Instrumentation	3	0	0	3
3	**PE**	D25PE1	**Professional Elective-I** 1) IOT Applications in Electrical Engineering 2) High Voltage Engineering 3) Electrical Machine Design	3	0	0	3
4	**PC**	D25PC17	Digital signal processing	3	0	0	3
5	**OE**	D25OE1	**Open Elective-I** 1) Charging Infrastructure for Electric Vehicles 2) Electrical Engineering Materials 3) Nano Technology	3	0	0	3
6	**PC**	D25PC18	Digital signal processing Lab	0	0	2	1
7	**PC**	D25PC19	Power Electronics Lab	0	0	2	1
9	**HS**	D5HSE3	Advanced English Communication Skills Lab	0	0	4	2
8	**PC**	D25PC20	Electrical Measurements and Instrumentation Lab	0	0	2	1
10	MC	MC003	Intellectual property Rights	0	0	0	**S**
		Total Credits					20

Professional Elective-I
1) IOT Applications in Electrical Engineering
2) High Voltage Engineering
3) Electrical Machine Design

Open Elective-I
1) Charging Infrastructure for Electric Vehicles
2) Electrical Engineering Materials
3) Nano Technology

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

POWER ELECTRONICS (D25PC1)

B. Tech. V Sem **L/T/P/C**
3/0/0/3

Prerequisite: Analog Electronics, Digital Electronics

Course Objectives:

1. Understand the characteristics and performance of various power electronic devices.
2. Analyze single and three phase controlled rectifier circuits.
3. Understand choppers circuits and AC voltage controllers
4. Understand the performance of single phase and three phase inverter circuits.

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

1. Understand the characteristics and performance of various power electronic devices.
2. Analyze single and three phase controlled rectifier circuits.
3. Understand choppers circuits and AC voltage controllers
4. Understand the performance of single phase inverter circuits.
5. Analyse the operation of three phase voltage source inverters.

UNIT-I

Power switching devices: Diode, Thyristor, MOSFET, IGBT: static and dynamic Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

UNIT-II

Thyristor rectifiers: Single-phase half-wave, full-wave and semi controlled rectifiers with R-load and highly inductive load; Three-phase half wave, full wave and semi controlled bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

UNIT-III

DC-DC Converters: Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit and operation of buck, boost and buck-boost converters in continuous conduction mode, duty ratio control of output voltage.
AC-AC Converter: Power circuit and operation of single phase AC Voltage Controller with R & RL Load.

UNIT-IV

Single-phase inverter: Power circuit and operation of single-phase voltage source inverter in square wave mode, sinusoidal pulse width modulation (Unipolar and bi-polar), relation between modulation index and output voltage. Calculation of performance parameters of inverter.

UNIT-V

Three-phase inverter: Power circuit and operation of three-phase voltage source inverter in 180^0 and 120^0 modes, Bi-polar sinusoidal pulse width modulation, relation between modulation index and output voltage. Elementary operation of CSI, Comparison of Voltage Source Inverter and Current Source Inverter.

TEXTBOOKS:

1. M. H. Rashid, "*Power electronics: circuits, devices, and applications*", Pearson Education India,2009.

2.N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons,2007.

3.R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media,2007.

4.L. Umanand, "Power Electronics: Essentials and Applications", Wiley India,2009.

WEB LINK:

1. https://www.coursera.org/learn/power-electronics
2. https://nptel.ac.in/courses/108/102/108102145/

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION (D25PC16)

B. Tech. V Sem **L/T/P/C**
3/0/0/3

Pre-requisite: Basic Electrical Engineering, Electrical Circuit Analysis& Electromagnetic fields.

Course Objectives:

1. To introduce the basic principles of all measuring instruments
2. To deal with the measurement of voltage, current, Power factor, power, energy and magnetic measurements.

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

1. Understand different types of measuring instruments, their construction, operation and characteristics.
2. Identify the instruments suitable for typical measurements.
3. Analyze the measuring instruments for power and energy.
4. Design DC & AC bridges.
5. Apply the knowledge about transducers to use them effectively.

UNIT I

Introduction to Measuring Instruments: Classification – deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type instruments – expression for the deflecting torque and control torque – Errors and compensations, extension of range using shunts and series resistance. Electrostatic Voltmeters-electrometer type and attracted disc type – extension of range of E.S. Voltmeters.

UNIT II

Potentiometers & Instrument transformers: Principle and operation of D.C. Crompton's potentiometer – standardization – Measurement of unknown resistance, current, voltage. A.C. Potentiometers: polar and coordinate type's standardization – applications. CT and PT – Ratio and phase angle errors.

UNIT III

Measurement of Power & Energy: Single phase dynamometer wattmeter, LPF and UPF, Double element and three element dynamometer wattmeter, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems. Single phase induction type energy meter – driving and braking torques – errors and compensations – testing by phantom loading using R.S.S. meter. Three phase energy meter – tri-vector meter, maximum demand meters.

UNIT IV

DC & AC bridges: Method of measuring low, medium and high resistance – sensitivity of Wheat-stone's bridge – Carey Foster's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method. Measurement of inductance- Maxwell's bridge, Hay's bridge, Anderson's bridge - Owen's bridge.Measurement of capacitance and loss angle – Desaunty's Bridge - Wien's bridge – Schering Bridge.

UNIT V

Transducers: Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor, Thermistors, Thermocouples, Piezo electric transducers, photovoltaic, photo conductive cells, and photo diodes.

Measurement of Non-Electrical Quantities: Measurement of strain, Gauge sensitivity, Displacement, Velocity, Angular Velocity, Acceleration, Force, Torque, Temperature, Pressure, Vacuum, Flow and Liquid level.

TEXT BOOKS:

1. "G. K. Banerjee", "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd., 2 nd Edition, 2016
2. "S. C. Bhargava", "Electrical Measuring Instruments and Measurements", BS Publications, 2012.

REFERENCE BOOKS:

1. A. K. Sawhney, "Electrical & Electronic Measurement & Instruments", DhanpatRai& Co. Publications, 2005.
2. R. K. Rajput, "Electrical & Electronic Measurement & Instrumentation", S. Chand and Company Ltd., 2007.
3. Buckingham and Price, "Electrical Measurements", Prentice – Hall, 1988.
4. Reissland, M. U, "Electrical Measurements: Fundamentals, Concepts, Applications", New Age International (P) Limited Publishers, 1st Edition 2010.
5. E.W. Golding and F. C. Widdis, "Electrical Measurements and measuring Instruments", 5th Edition, Wheeler Publishing, 2011.

WEB LINK:

1. https://www.researchgate.net
2. https://nptel.ac.in/course

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R22
IOT APPLICATIONS IN ELECTRICAL ENGINEERING (D25PE1)
(Professional Elective-I)

B. Tech. V Sem **L/T/P/C**
3/0/0/3

Prerequisite: Programming, Digital Electronics

Course Objectives:

1. To learn about a few applications of Internet of Things and distinguish between motion less andmotion detectors as IoT applications
2. To know about Micro Electro Mechanical Systems (MEMS) fundamentals in design andfabrication process
3. To understand about applications of IoT in smart grid and new concept of IoE for variousapplications

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

1. To get exposed to recent trends in few applications of IoT in Electrical Engineering
2. To understand about usage of various types of motionless sensors and motion detectors
3. To get exposed to various applications of IoT in smart grid
4. To get exposed to future working environment with Energy internet

UNIT I

Sensors: Definitions, Terminology, Classification, Temperature sensors, Thermo resistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflect meter, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric.

UNIT II

Occupancy and Motion detectors: Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors -Resistive microphones, Piezoelectric, Photo resistors.

UNIT III

MEMS: Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors.

UNIT IV

IoT for Smart grid: Driving factors, Generation level, Transmission level, and Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home.

UNIT V

Internet of Energy: Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid.

TEXT BOOKS:

1. 1.Jon S. Wilson, "Sensor Technology Hand book", Newnes Publisher, 2004
2. Tai Ran Hsu, "MEMS and Microsystems: Design and manufacture", 1st Edition, McGraw hillEducation, 2017
3. Ersan Kabalci and Yasin Kabalci, "From Smart grid to Internet of Energy", 1st Edition, AcademicPress, 2019.

REFERENCE BOOKS:

1. Raj Kumar Buyya and Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms",Kindle Edition, Morgan Kaufmann Publisher, 2016
2. Yen Kheng Tan and Mark Wong, "Energy Harvesting Systems for IoT Applications":Generation, Storage and Power Management, 1st Edition, CRC Press, 2019
3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, "Internet of Things",Wiley, 2019.

WEB LINK: https://archive.nptel.ac.in/courses/108/108/108108123/

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

HIGH VOLTAGE ENGINEERING (D25PE1)

(Professional Elective-I)

B. Tech. V Sem **L/T /P/C**
3/0/0 /3

Prerequisite: Power Systems – I, Electro Magnetic Fields

Course Objectives:

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

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

1. Understand the basic physics related to various breakdown processes in solid, liquid andgaseous insulating materials, generation and measurement of D. C., A.C., & Impulse voltages.
2. Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
3. Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

UNIT I

Breakdown In Gases: Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Breakdown In Liquid And Solid Insulating Materials: Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

UNIT II

Generation Of High Voltages: Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT III

Measurements Of High Voltages And Currents: Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

UNIT IV

Lightning And Switching Over-Voltages: Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching overvoltage's, Protection against over-voltages, Surge diverters, Surge modifiers.

UNIT V

High Voltage Testing Of Electrical Apparatus And High Voltage Laboratories Various standards for HV Testing of electrical apparatus, IS, IEC standards, testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

TEXT BOOKS:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.

REFERENCE BOOKS:

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

WEB LINK: https://archive.nptel.ac.in/courses/108/104/108104048/

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

ELECTRICAL MACHINE DESIGN (D25PE1)

(Professional Elective-I)

B. Tech V Sem **L/ T/P/ C**
3/0/0/3

Prerequisite: Electrical Machines-I, Electrical Machines-II

Course Objectives:

1. To know the major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings,
2. To analyze the thermal considerations, heat flow, temperature rise, rating of machines.
3. To understand the design of machines and CAD design concepts

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

1. Understand the construction and performance characteristics of electrical machines.
2. Understand the various factors which influence the design: electrical, magnetic and thermalloading of electrical machines
3. Understand the principles of electrical machine design and carry out a basic design of an acmachine using software tools.

UNIT I

Introduction: Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT II

Transformers: Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

UNIT III

Induction Motors: 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, circle diagram, operating characteristics.

UNIT IV

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 airgap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

UNIT V

Computer Aided Design (CAD): Limitations (assumptions) of traditional designs need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines- PMSMs, BLDCs, SRM and claw-pole machines.

TEXT BOOKS:

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

REFERENCE BOOKS:

1. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBHPublishing, 2006.
2. K. L. Narang, "A Text Book of Electrical Engineering Drawings", Satya Prakashan, 1969.
3. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book",New Age International, 1979.
4. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
5. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2Dmachine design package.

WEB LINK: https://onlinecourses.nptel.ac.in/noc24_ee50/preview

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

DIGITAL SIGNAL PROCESSING (D25PC17)

B. Tech. V Sem **L/T/P/C**
3/0/0/3

PREREQUISITES: To have knowledge of Signals and Systems.

Course Objectives: The objective of this subject is to

1. Provide background and fundamental material for the analysis and processing of digital signals.
2. Study fundamentals of time, frequency and Z plane analysis and to discuss the inter relationships of these analytic method.
3. Study the design and structures of digital filters from analysis to synthesis for a given specifications.
4. Acquaint in FFT algorithms, multi rate signal processing techniques and finite word length effects.

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

1. Acquire knowledge on various types of continuous and discrete time signals, solves linear constant coefficient difference equation also can realize digital filters.
2. Calculate time domain and frequency domain of signals using DFS,DFT and develop FFT Algorithm for faster realization of signals and systems
3. Design digital IIR filters from analog filters using various techniques.
4. Design digital FIR filters using Window techniques, Fourier methods and frequency sampling techniques.
5. Design Interpolator and Decimator, knows the impacts of Finite Word Length Effects in Filter design.

UNIT I

INTRODUCTION: Introduction to Digital Signal Processing, Applications, Discrete time signals & sequences, linear shift invariant systems, stability, and causality. Linear constant coefficient difference equations, Frequency domain representation of discrete time signals and systems.

Z-TRANSFORMS: Review of Z-transforms, Applications of Z – transforms, solution of difference equations of digital filters, system function, stability criterion, frequency response of stable systems.

UNIT II

DISCRETE FOURIER TRANSFORMS: Properties of discrete Fourier series, DFS representation of periodic sequences, Discrete Fourier transforms: Properties of DFT, linear convolution of sequences using DFT, Computation of DFT: Over-lap save, Over-lap add methods, Relation between DTFT,DFS and Z-transform.

FAST FOURIER TRANSFORMS: Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT, and FFT for composite N, Linear filtering approach for computing DFT.

UNIT III

IIR DIGITAL FILTERS: Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters-Backward difference algorithm, Step and Impulse invariant techniques, Bilinear transformation method, spectral transformations, Realization of IIR Digital filters, applications.

UNIT IV

FIR DIGITAL FILTERS: Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital Filters using Fourier series method, Window Techniques, Frequency Sampling technique, Realization of FIR Digital filters, Comparison of IIR & FIR filters.

UNIT V

MULTIRATE DIGITAL SIGNAL PROCESSING: Introduction, Down Sampling, Decimation, Up sampling, Interpolation, sampling rate conversion, Multistage implementation of Interpolator and Decimator, Applications.

Finite Word Length Effects: Limit cycles, Overflow oscillations, Round-off noise in IIR digital filters, computational output round off noise, Methods to prevent overflow. Trade off between round off and overflow noise, Dead band effects.

TEXT BOOKS:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing-A.V.Oppenheim and R.W.Schaffer, PHI,2009
3. Digital Signal processing –Tarun Kumar Rawat,Oxford University Press,2015

REFERENCE BOOKS:

1. Analog and Digital Signal Processingby Ashok Ambardar -2nd Edition, Brooks/Cole Publishing Company,2006
2. Digital Signal processing-S.Shalivahanan, A.Vallavaraj and C.Gnanapriya,TMH,2009.
3. Fundamentals of Digital Signal processing- LoneyLudeman, John Wiley,2009

WEB LINK: **https://nptel.ac.in/courses/117102060**

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

CHARGING INFRASTRUCTURE FOR ELECTRIC VEHICLES

(Open Elective-1) (D25OE1)

B. Tech. V-Sem **L/T/P/C**
3/0/0/3

Prerequisite: None, Interest in Electric Vehicles.

Course Objectives:

1. Gain understanding of the various components involved in an electric vehicle charging system.
2. Comprehend the different types of electric vehicle chargers, along with the applicable standards governing their design and operation.
3. Interpret the diverse communication protocols utilized in electric vehicle charging systems andstay familiar with the latest trends in this evolving field.

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

1. Understand the various components of Electric vehicle charging system
2. Comprehend the different types of Electric vehicle chargers and their standards
3. Interpret the various communication protocols and recent trends in Electric vehicle charging

UNIT I
Introduction to EV charging:
Electric Vehicle Charging; Charging Modes; Electric Vehicle Supply Equipment (EVSE): Types,Components of EV Battery Chargers; Challenges in Electric Vehicle Charging.

UNIT II
Charger sizing and standards:
Charger Classification; Slow Charging and Fast Charging; DC Charging and AC Charging; Selection and Sizing of Chargers: Charger Connectors and Cables; Charging Standards: Connectors, Supply Equipment; EMI/EMC; Testing Methods for Chargers and EVSE

UNIT III
EV charger communications protocols:
Open Charge Point Protocol (OCPP); Open System Interconnection Layer Model (OSI); Adapted PWM Signal based Low-level Communication; PLC based High-level Communication; CAN Communication;Billing and Authentication

UNIT IV
Public charging infrastructure:
Location, Planning and Implementation of Public Charging Stations; Components; Selection and Sizing - HT/LT Equipment & Cables; Protection; Safety Standards: Policy and Regulatory Aspects; EVCharging Station and their Business Models; Economic Aspects; Major Challenges

UNIT V

Future frontiers in EV charging:

Bulk Charging; Battery Swapping; Wireless Charging; EVs as Distributed Storage Resources: Grid to Vehicle (G2V) and Vehicle to Grid (V2G), V2X Concept, Integration of Charging Station with Renewable Sources and its Impact on the Grid

TEXT BOOKS:

1. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", 3rd Edition, CRC Press, 2021
2. Code of Practice for Electric Vehicle Charging Equipment Installation, 4th Edition, IET, 2020.

REFERENCE BOOKS:

1. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid
2. Electric Vehicles", 1st Edition, Springer, 2013.
3. Tom Denton, "Automotive Electrical and Electronic Systems", 5th Edition, Routledge, 2018.
4. Wolfhard Lawrenz, "CAN System Engineering: From Theory to Practical Applications", Springer, 2nd Edition, 2013.

WEB LINK: **https://www.udemy.com/course/charging-infrastructure-for-electric-vehicles/**

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B.TECH-ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

ELECTRICAL ENGINEERING MATERIALS-(D25OE1)

(Open Elective-1)

B.Tech. V Sem **L/T/P/C**
3/0/0/3

Course Objective: To understand the importance of various materials used in electrical engineering and obtain a qualitative analysis of their behavior and applications.

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

1. Understand various types of dielectric materials, their properties in various conditions.
2. Evaluate magnetic materials and their behavior.
3. Evaluate semiconductor materials and technologies.
4. Acquire Knowledge on Materials used in electrical engineering and applications.

UNIT I

Dielectric Materials: Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectricmaterials.

UNIT II

Magnetic Materials: Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and hysteresis

UNIT III

Semiconductor Materials: Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI).

UNIT IV

Materials for Electrical Applications: Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT – V

Special Purpose Materials: Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI.

TEXT BOOKS:

1. "R K Rajput", " A course in Electrical Engineering Materials", Laxmi Publications, 2009
2. "T K Basak", " A course in Electrical Engineering Materials", New Age Science Publications2009

REFERENCE BOOKS:

1. TTTI Madras, "Electrical Engineering Materials", McGraw Hill Education,2004.
2. "AdrianusJ.Dekker", Electrical Engineering Materials, PHI Publication,2006.

S. P. Seth, P. V. Gupta "A course in Electrical Engineering Materials", Dhanpat Rai & Sons,2011

WEB LINK: https://nptel.ac.in/courses/113104096

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
NANO TECHNOLOGY (D25OE1)
(Open Elective-1)

B. Tech. V Semester **L/T/P/C**
3/0/0/3

Course Objectives: Nano Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy, electronics, Biomedical Engg. Etc. Built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness, and efficiency. The objective here is imparting the basic knowledge in Nano Science and Technology.

Course Outcomes:
1. Introduction to Nano Technology" will give insight into many aspects of Nano science, technology
2. Applications in the prospective of materials science.

UNIT I

Introduction: History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges, and FutureProspects.

UNIT II

Unique Properties of Nanomaterial's: Microstructure and Defects in Nano crystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations,

Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility.

Magnetic Properties: Soft magnetic Nano crystalline alloy, Permanent magnetic Nano crystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties, and Mechanical Properties.

UNIT III

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

UNIT IV

Tools to Characterize nanomaterial's: X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope(STM),Field Ion Microscope (FEM), Three-dimensional Atom Probe(3DAP), Nano indentation.

UNIT V

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

TEXT BOOKS:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, UniversityPress-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, WleyIndia Edition,2012.

REFERENCES BOOKS:

1. Nano: The Essentials by T. Pradeep, Mc Graw- HillEducation.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L.Schodek.
3. Transport in Nano structures- David Ferry, Cambridge University press2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S., S. R. Kumar, J. H.Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J.O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, CambridgeUniversity press.

WEB LINK: https://nptel.ac.in/courses/118102003

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
DIGITAL SIGNAL PROCESSING LAB (D25PC18)

B. Tech. V Sem **L/T/P/C**
0/0/2/1

Pre-requisites: Digital Signal Processing

Course Objectives:

1. To implement Linear and Circular Convolution.
2. To implement FIR and IIR filter and architecture of DSP processor.
3. To demonstrate Finite word length effect.

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

1. Carry out simulation of DSP system and abilities towards DSP processor-based implementation of DSP systems.
2. Analyze Finite word length effect on DSP systems and applications of FFT to DSP.
3. Implement adaptive filters for various applications of DSP.

List of Experiments (programs/MATLAB):

1. Generation of Sinusoidal Waveform / Signal based on Recursive Difference Equations
2. To find DFT / IDFT of given DT Signal
3. To find Frequency Response of a given System given in Transfer Function/ Differential equationform.
4. Implementation of FFT of given Sequence
5. Determination of Power Spectrum of a given Signal(s).
6. Implementation of LP FIR Filter for a given Sequence/Signal.
7. Implementation of HP FIR Filter for a given Sequence/Signal
8. Implementation of LP IIR Filter for a given Sequence/Signal
9. Implementation of HP IIR Filter for a given Sequence/Signal
10. Generation of Sinusoidal Signal through Filtering
11. Generation of DTMF Signals
12. Implementation of Decimation Process
13. Implementation of Interpolation Process
14. Implementation of I/D Sampling Rate Converters
15. Impulse Response of First order and Second Order Systems.

TEXT BOOKS:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris
G. Manolakis, Pearson Education / PHI, 2007.

2. Discrete Time Signal Processing – A. V. Oppenheim and R.W. Schaffer, PHI, 2009.

REFERENCE BOOKS:

1. Fundamentals of Digital Signal Processing – Loney Ludeman, John Wiley, 2009
2. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008
3. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson, 2007
4. Digital Signal Processing - A Practical approach, Emmanuel C. If each orand Barrie W. Jervis, 2nd Edition, Pearson Education, 2009

ONLINE RESOURCES:

1. NPTEL DSP Course: Lectures, notes, and lab assignments for DSP (NPTEL DSP Course)
2. DSP Course on edX: Video lectures, lab assignments, and quizzes (DSP Course on edX)
3. https://sjce.ac.in/wp-content/uploads/2021/11/dsp-lab-manual-2021-22.pdf

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
POWER ELECTRONICS LAB (D25PC19)

B. Tech. V Sem **L/T/P/C**
0/0/2/1

Prerequisite: Power Electronics

COURSE OBJECTIVES:

1. Apply the concepts of power electronic converters for efficient conversion/control of power from source to load.
2. Design the power converter with suitable switches meeting a specific load requirement.

COURSE OUTCOMES: After completion of this course, the student is able to

1. Understand the operating principles of various power electronic converters.
2. Use power electronic simulation packages& hardware to develop the power Converters.
3. Analyze and choose the appropriate converters for various applications

Any eight experiments should be conducted

1. Study of Characteristics of SCR, MOSFET & IGBT,
2. Gate firing circuits for SCR's
3. Gate firing circuits for MOSFET, IGBT
4. Single Phase half controlled bridge converter with R and RL loads
5. Single Phase Fully controlled bridge converter with R and RL loads
6. Forced Commutation circuits (Class A, Class B, Class C, Class D & Class E)
7. Single Phase series and parallel inverter with R and RL loads
8. Operation of MOSFET based chopper.
9. Three Phase half controlled bridge converter with R-load
10. Single phase cyclo converter with R and RL loads

Any two experiments should be conducted

1. DC Jones chopper with R and RL Loads
2. Single Phase AC Voltage Controller with R and RL Loads
3. Three Phase fully controlled bridge converter with R-load
4. Single Phase dual converter with RL loads
5. (a) Simulation of single-phase Half wave converter using R and RL loads
   (b) Simulation of single-phase full converter using R, RL and RLE loads
   (c) Simulation of single-phase Semi converter using R, RL and RLE loads
6. Simulation single phase inverter with SPWM.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

WEB LINK: https://nptel.ac.in/courses/108105066

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
ADVANCED ENGLISH COMMUNICATION SKILLS LAB (D5HSE3)

B. Tech. V Sem **L/T/P/C**
0/0/4/2

1. Introduction

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

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

1. Gathering ideas and information to organise ideas relevantly and coherently.
2. Making oral presentations.
3. Writing formal letters.
4. Transferring information from non-verbal to verbal texts and vice-versa.
5. Writing project/research reports/technical reports.
6. Participating in group discussions.
7. Engaging in debates.
8. Facing interviews.

Taking part in social and professional communication

2. Objectives:

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

- To improve the students' fluency in English, with a focus on vocabulary
- To enable them to listen to English spoken at normal conversational speed by educated English speakers
- To respond appropriately in different socio-cultural and professional contexts
- To communicate their ideas relevantly and coherently in writing
- To prepare the students for placements.

3. Syllabus:

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

1. **Activities on Listening and Reading Comprehension:** Active Listening – Development of Listening Skills Through Audio clips - Benefits of Reading – Methods and Techniques of Reading – Basic Steps to Effective Reading – Common Obstacles – Discourse Markers or Linkers - Sub-skills

of reading - Reading for facts, negative facts and Specific Details- Guessing Meanings from Context, Inferring Meaning - Critical Reading — Reading Comprehension – Exercises for Practice.

2. **Activities on Writing Skills**: Vocabulary for Competitive Examinations - Planning for Writing – Improving Writing Skills - Structure and presentation of different types of writing – Free Writing and Structured Writing - Letter Writing –Writing a Letter of Application –Resume vs. Curriculum Vitae – Writing a Résumé – Styles of Résumé - e-Correspondence – Emails – Blog Writing - (N)etiquette – Report Writing – Importance of Reports – Types and Formats of Reports– Technical Report Writing– Exercises for Practice.
3. **Activities on Presentation Skills -** Starting a conversation – responding appropriately and relevantly – using the right language and body language – Role Play in different situations including Seeking Clarification, Making a Request, Asking for and Refusing Permission, Participating in a Small Talk – Oral presentations (individual and group) through JAM sessions- PPTs – Importance of Presentation Skills – Planning, Preparing, Rehearsing and Making a Presentation – Dealing with Glossophobia or Stage Fear – Understanding Nuances of Delivery - Presentations through Posters/Projects/Reports – Checklist for Making a Presentation and Rubrics of Evaluation
4. **Activities on Group Discussion (GD):** Types of GD and GD as a part of a Selection Procedure - Dynamics of Group Discussion- Myths of GD - Intervention, Summarizing - Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas – Do's and Don'ts - GD Strategies – Exercises for Practice.
5. **Interview Skills**: Concept and Process - Interview Preparation Techniques - Types of Interview Questions – Pre-interview Planning, Opening Strategies, Answering Strategies - Interview Through Tele-conference & Video-conference - Mock Interviews.

4. Minimum Requirement:

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

- **Spacious room with appropriate acoustics**
- **Round Tables with movable chairs**
- **Audio-visual aids**
- **LCD Projector**
- **Public Address system**
- **One PC with latest configuration for the teacher**
- **T. V, a digital stereo & Camcorder**
- **Headphones of High quality**

5. Suggested Software:

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

- **TOEFL & GRE**(KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **Oxford Advanced Learner's Dictionary**, 10th Edition
- **Cambridge Advanced Learner's Dictionary**
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **Lingua TOEFL CBT Insider**, by Dreamtech

6. Books Recommended:

1. Rizvi, M. Ashraf (2018). *Effective Technical Communication*. (2nd ed.). McGraw Hill Education (India) Pvt. Ltd.
2. Suresh Kumar, E. (2015). *Engineering English.* Orient BlackSwan Pvt. Ltd.
3. Bailey, Stephen. (2018). Academic *Writing: A Handbook for International Students.* (5th Edition). Routledge.
4. Koneru, Aruna. (2016). *Professional Communication.* McGraw Hill Education (India) Pvt. Ltd.
5. Raman, Meenakshi & Sharma, Sangeeta. (2022). *Technical Communication, Principles and Practice.* (4TH Edition) Oxford University Press.
6. Anderson, Paul V. (2007). *Technical Communication***.** Cengage Learning Pvt. Ltd. New Delhi.
7. McCarthy, Michael; O'Dell, Felicity & Redman, Stuart. (2017). *English Vocabulary in Use* Series. Cambridge University Press
8. Sen, Leela. (2009). *Communication Skills.* PHI Learning Pvt Ltd., New Delhi.
9. Elbow, Peter. (1998). *Writing with Power.* Oxford University Press.
10. Goleman, Daniel. (2013). *Emotional Intelligence*: *Why it can matter more than IQ.* Bloomsbury Publishing.

WEB LINK: https://nptel.ac.in/courses/109104031

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

ELECTRICAL MESEARUEMENTS AND INSTRUMENTATION LAB (D25PC20)

B. Tech. V Sem **L/T/P/C**
0/0/2/1

COURSE OBJECTIVES:

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

COURSE OUTCOMES: After completion of this course, the students will be able to

1. Design and validate DC and AC bridges.
2. Analyze the dynamic response and the calibration of few instruments.
3. Learn about various measurement devices, their characteristics, their operation and their limitations.
4. Understand statistical data analysis.
5. Understand computerized data acquisition.

Any 10 of the following experiments are required to be conducted

1. Calibration and Testing of single phase energy Meter.
2. Calibration of dynamometer power factor meter.
3. Crompton D.C. Potentiometer – Calibration of PMMC ammeter and PMMC voltmeter.
4. Kelvin's double Bridge – Measurement of resistance – Determination of Tolerance.
5. Dielectric oil testing using H.T. testing Kit.
6. Schering bridge& Anderson bridge.
7. Measurement of 3 – Phase reactive power with single-phase wattmeter.
8. Measurement of displacement with the help of LVDT. In addition to the above eight experiments, at least any two of the experiments from the following list are required to be conducted
9. Calibration LPF wattmeter – by Phantom testing.
10. Measurement of 3-phase power with single watt meter and two CTs.
11. C.T. testing using mutual Inductor – Measurement of % ratio error and phase angle of given CT by Null method.

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

TEXT BOOKS

1. "G. K. Banerjee", "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd., 2 nd Edition, 2016
2. "S. C. Bhargava", "Electrical Measuring Instruments and Measurements", BS Publications, 2012.

REFERENCE BOOKS

1. A. K. Sawhney, "Electrical & Electronic Measurement & Instruments", DhanpatRai& Co. Publications, 2005.
2. R. K. Rajput, "Electrical & Electronic Measurement & Instrumentation", S. Chand and Company Ltd., 2007.
3. Buckingham and Price, "Electrical Measurements", Prentice – Hall, 1988.
4. Reissland, M. U, "Electrical Measurements: Fundamentals, Concepts, Applications", New Age International (P) Limited Publishers, 1st Edition 2010.
5. E.W. Golding and F. C. Widdis, "Electrical Measurements and measuring Instruments", 5th Edition, Wheeler Publishing, 2011.

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

INTELLECTUAL PROPERTY RIGHTS –MC004

B. Tech. V Sem **L/T/P/C**
3/0/0/0

Course Objectives:

1.Significance of intellectual property and its protection
2.Introduce various forms of intellectual property

Course Outcomes:

1.Distinguish and Explain various forms of IPRs.
2.Identify criteria to fit one's own intellectual work in particular form of IPRs.
3.Apply statutory provisions to protect particular form of IPRs.
4.Appraise new developments in IPR laws at national and international level

UNIT – I

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III

Law of copyrights: Fundamental of copyright law, originality of material, rights of reproduction, rights to perform the work publicly, copyright ownership issues, copyright registration, notice of copyright, International copyright law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV

Trade Secrets: Trade secret law, determination of trade secret status, liability for misappropriations oftrade secrets, protection for submission, trade secret litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V

New development of intellectual property: new developments in trade mark law; copyright law, patent law, intellectual property audits.

International overview on intellectual property, international — trade mark law, copyright law, international patent law, and international development in trade secrets law.

TEXT BOOK:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.

REFERENCE BOOK:

1. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

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B. TECH ELECTRICAL & ELECTRONICS ENGINEERING (R22)

Course Structure R-22

SEMESTER VI

S. No.	Class	Course Code	Name of the Subject	L	T	P	Credits
1	**HS**	D6HSBF	Business Economics and Financial Analysis	3	0	0	3
2	**PC**	D26PC21	Power System Protection	3	0	0	3
3	**PC**	D26PC22	Power System Operation and Control	3	0	0	3
4	**PC**	D26PC23	Microprocessors & Microcontrollers	3	0	0	3
5	**PE**	D26PE2	Professional Elective-II	3	0	0	3
6	**OE**	D26OE2	Open Elective-II	3	0	0	3
7	**PC**	D26PC24	Power System Lab	0	0	2	1
8	**PC**	D26PC25	Microprocessors & Microcontrollers Lab	0	0	2	1
		Total Credits					20

Professional Elective-II
1) Cyber-Physical Systems
2) Industrial Electrical Systems
3) Utilization of Electrical Energy

Open Elective-II
1) Fundamentals of Electric Vehicles
2) Optimization Techniques
3) Renewable Energy Sources

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

BUSINESS ECONOMICS AND FINANCIAL ANALYSIS (D6HSBF)

B.Tech. VI Sem **L/T/P/C**
3/0/0/3

Course Objectives:

1. To learn the basic business type of the organization.
2. To acquire the knowledge and impact of the economy on business firms.
3. To analyze the business from the financial perspective.
4. To know the financial position of the company.
5. To predict the future of business

Course Outcomes:

1. Analyze the total structure of the business and able to identify and classify the Different types of business entities.
2. Asses the demand and supply analyses with the help of various measures and types of Elasticity of demand.
3. Infer the knowledge about production and cost analysis for product and services.
4. Interpret the fundamental concepts related to financial accounting.
5. Predict the financial position by analyzing the financial statement of the company Through various ratios.

UNIT – I

Introduction to Business and Economics:

Business: Define Business, characteristics of business, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company.

Economics: Significance of Economics, Micro and Macro Economic Concepts, and Importance of National Income, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist,

UNIT – II

Demand Analysis:

Elasticity of Demand: Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Steps in Demand Forecasting, Methods of Demand Forecasting.

UNIT- III

Production, Cost, Market Structures & Pricing:

Production Analysis: production function, Law of returns to scale, Internal and External Economies of Scale.

Cost analysis: Cost concepts, Types of Costs. Break-even Analysis (BEA)

Pricing: Types of Pricing, product life cycle, **GST** (**Goods & service Tax**)

Market Structures- Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition, oligopoly.

UNIT - IV

Financial Accounting: Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, and Preparation of Final Accounts.

UNIT - V

Financial Analysis through Ratios: Concept of Ratio Analysis, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios (simple problems).

TEXT BOOKS:

1. D. D. Chaturvedi, S. L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata McGraw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.
4. Rakesh garg,sandeepgarg,Hand book of GST in India
5. A.R. Aryasri (2011), Managerial Economics and Financial Analysis, TMH, India.

REFERENCES:

1. Paresh Shah, Financial Accounting for Management 2e, Oxford Press, 2015.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

POWER SYSTEM PROTECTION (D26PC21)

B.Tech. VI Sem **L/T/P/C**

3/0/0/3

PREREQUISITE: Power Systems - I & Power Systems - II

Course Objectives:

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

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

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

UNTI I

PROTECTIVE RELAYS

Introduction, Need for power system protection, effects of faults, evolution of protective relays, zones of protection, primary and backup protection, essential qualities of protection, classification of protective relays and schemes, current transformers, potential transformers, basic relay terminology.

OPERATING PRINCIPLES AND RELAY CONSTRUCTION: Electromagnetic relays, thermal relays, static relays, microprocessor based protective relays.

UNTI II

OVER-CURRENT PROTECTION

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

DISTANCE PROTECTION: Impedance relay, reactance relay, MHO relay, input quantities for various types of distance relays, Effect of arc resistance, Effect of power swings, effect of line length and source impedance on the performance of distance relays, selection of distance relays, MHO relay with blinders, Reduction of measuring units, switched distance schemes, auto re-closing.

UNTI III

PILOT RELAYING SCHEMES

Wire Pilot protection, Carrier current protection.

AC MACHINES AND BUS ZONE PROTECTION: Protection of Generators, Protection of transformers, Bus-zone protection, frame leakage protection.

UNTI IV

STATIC RELAYS

Amplitude and Phase comparators, Duality between AC and PC, Static amplitude comparator, integrating and instantaneous comparators, static phase comparators, coincidence type of phase comparator, static over current relays, static directional relay, static differential relay, static distance relays, Multi input comparators, concept of Quadrilateral and Elliptical relay characteristics.

MICROPROCESSOR BASED RELAYS: Advantages, over current relays, directional relays, distance relays.

UNIT V

CIRCUIT BREAKERS

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

FUSES: Introduction, fuse characteristics, types of fuses, application of HRC fuses, discrimination

TEXTBOOKS:

1.Badriram and DN vishwakarma,"power system protection and switch gear" Tata McGraw-Hill Education, 01-Apr-2001

2. TS madhava rao ,power system protection Tata McGraw-Hill Education

REFERENCE BOOKS:

1. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.

2.. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.

3. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

4. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
POWER SYSTEM OPERATION AND CONTROL (D26PC22)

B.Tech. VI Sem **L/T/P/C**
3/0/0/3

Course Objectives:

1. To have an overview of power system operation and control.
2. Economic operation of Power Systems, Hydrothermal scheduling and modeling of turbines, generators and automatic controllers
3. To model power-frequency dynamics and to design power-frequency controller.
4. To model reactive power-voltage interaction and t-he control actions to be implemented for maintaining the voltage profile against varying system load.
5. To study the economic operation of power system.
6. To teach about SCADA and its application for real time operation and control of power systems.

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

1. Understand the economic load dispatch
2. Analyze the unit commitment problems, constraints and hydrothermal scheduling of power plants
3. Analyze the load frequency control
4. Understand reactive power and voltage control of a power system
5. Apply the computer control techniques for the power systems.

UNIT I
Load Flow Studies
Introduction, Bus classification -Nodal admittance matrix - Load flow equations - Iterative methods -Gauss and Gauss Seidel Methods, Newton-Raphson Method-Fast Decoupled method-Merits and demerits of the above methods-System data for load flow study

UNIT II
Power System Stability
The stability problem-Steady state stability, transient stability and Dynamic stability-Swing equation. Equal area criterion of stability-Applications of Equal area criterion, Step by step solution of swing equation-Factors affecting transient stability, Methods to improve steady state and Transient stability, Introduction to voltage stability

UNIT III
Single Area & Two Area Load Frequency Control: Necessity of keeping frequency constant, Definitions of Control area Single area control Block diagram representation of an isolated power system — Steady state analysis Dynamic response — Uncontrolled case,
Load frequency control of area system: Uncontrolled case and controlled case, tie1ine bias control.
Load Frequency Controllers: Proportional plus Integral control of single area and its block diagram representation, steady state response — Load Frequency Control and Economic dispatch control.

UNIT IV

Reactive Power Control: Overview of Reactive Power control — Reactive Power compensation in transmission systems — advantages and disadvantages of different types of compensating equipment for transmission systems. Load compensation: Specifications of load compensator, Uncompensated and compensated transmission lines: shunt and Series Compensation. (Qualitative treatment)

UNIT V

Computer control of Power System: Need for computer control of power systems - concept of energy control centre - functions - system monitoring - data acquisition and control - system hardware configuration – SCADA and EMS functions - network topology - state estimation – WLSE - Contingency Analysis - state transition diagram showing various state transitions and control strategies.

TEXT BOOKS:

1. Operation and Control in Power Systems, PSR Murthy, BS Publications.
2. Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition, 2011.

REFERENCE BOOKS:

1. Power systems stability and control, PrabhaKundur, The McGraw — Hill companies.
2. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
3. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2003.
4. AbhijitChakrabarti, SunitaHalder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
MICROPROCESSORS & MICROCONTROLLERS–(D26PC23)

B.Tech. VI Sem **L/T/P/C**
3/0/0/3

Prerequisite: Digital logic Design

Course Objectives:

1. To familiarize the architecture of microprocessors and microcontrollers
2. To provide the knowledge about interfacing techniques of bus & memory.
3. To understand the concepts of ARM architecture
4. To study the basic concepts of Advanced ARM processors

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

1. Apply knowledge of the internal architecture and organization of the 8086 microprocessor, and develop assembly language programs.
2. Analyse internal architecture, memory organization of 8051 controller and can develop programming
3. Construct interfacing techniques to 8086 and 8051 and define various serial communication standards.
4. Understand the internal architecture and organization of ARM processors/controllers, and apply assembly language programs for design.
5. Build the knowledge of the internal architecture and organization of advanced ARM Processors.

UNIT–I

8086Architecture: 8086 Architecture-Functional diagram, Register Organization, 8086 Flag register, Memory Segmentation, Physical Memory organization, Pin diagram of 8086,Signal description of 8086-Common function signals, Minimum and Maximum mode signals, addressing modes, Instruction set, Assembler directives, Programming.

UNIT–II

Introduction to Microcontrollers: Overview of 8051 microcontroller, Architecture, I/O ports, Memory Organization, Addressing modes, Instruction set of 8051.

8051 Real Time Control: Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the serial communication Interrupts, Programming 8051 Timers and Counter

UNIT–III

I/O And Memory Interface: 8255 PPI, stepper motor interfacing to 8086,LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

Serial Communication and Bus Interface: Serial Communication standards, Serial data transfer schemes, On board Communication Interfaces-I2CBus, SPI Bus,UART; External Communication Interfaces-RS-232,USB.

UNIT–IV

ARM Architecture: ARM Processor Fundamentals, Processor modes, ARM Architecture-Register, CPSR, Pipeline, exception and interrupts, Interrupt vector table, ARM instruction set-Data processing, Branch Instructions, load store instructions, Software interrupt instructions, Program Status register instructions, loading constants, Conditional execution, Simple programs, Introduction to Thumb Instructions.

UNIT-V

Advanced ARM Processors: Introduction to CORTEX Processor, features, applications and its architecture, Registers, Pipeline, interrupts, OMAP Processor and its Architecture.

TEXT BOOKS:

1. A.K.Ray and K Bhurchandani "Advanced Microprocessors and peripherals", , MHE.2ND Edition 2006.
2. Kenneth. J. Ayala "The 8051 Microcontroller", Cengage Learning., 3rdEd.
3. Andrew NSLOSS, "Dominic SYMES, Chris WRIGHT" ARM system Developers guide, Elsevier,2012.

REFERENCE BOOKS:

1. D.V.Hall," Microprocessor and Interfacing", MGH, 2nd Edition2006.
2. Shibu K.V "Introduction to Embedded Systems", MHE, 2009.
3. K.Uma Rao, Anhe Pallavi, "The 8051 Microcontrollers Architecture and Programming and Applications"–, Pearson, 2009.
4. Donald Reay. "Digital Signal Processing and Applications with the OMAP-L138 Experimenter",WILEY2012

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
CYBER-PHYSICAL SYSTEMS (D26PE2)
(Professional Elective II)

B. Tech. VI Sem **L/T/P/C**
3/0/0/3

Pre-requisites: None; Interest in cyber-physical systems

Course Objectives:

1. To gain insight into the seamless integration of computational algorithms and physicalprocesses within cyber-physical systems.
2. To develop proficiency in analyzing and managing the dynamic interactions between the cyberand physical components in diverse applications.
3. To explore practical applications, focusing on the design, implementation, and optimization ofcyber-physical systems for real-world

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

1. Achieve a thorough understanding of the core principles that form the foundation of Cyber-Physical Systems.
2. Apply the knowledge to successfully identify safety specifications and critical properties crucial for ensuring the safety of CPS.
3. Develop proficiency in utilizing abstraction techniques for system designs, and effectivelyexpress pre- and post-conditions as well as invariants for CPS models.

UNIT I

Introduction to Cyber-Physical Systems (CPS): Cyber-Physical Systems in the real world, Basic principles of design and validation of CPS, Industry 4.0 and its implications, Auto SAR and IIOT (Industrial Internet of Things), Applications in Building Automation and Medical CPS.

UNIT II

CPS Platform Components: CPS Hardware platforms: Processors, Sensors, Actuators, CPS Network: Wireless Hart, CAN, Automotive Ethernet, CPS Software stack: Real-Time Operating Systems (RTOS), Scheduling, Overview of CPS Software components and their mapping to ElectronicControl Units (ECUs).

UNIT III

Principles of Automated Control Design: Dynamical Systems and Stability, Controller Design Techniques, Stability Analysis using Common Lyapunov Functions (CLFs) and Multiple Lyapunov Functions (MLFs), Performance analysis under Packet drop and Noise.

UNIT IV

CPS Implementation and Performance Analysis: Translating features into software components, Mapping software components to ECUs, Performance Analysis of CPS, considering scheduling, bus latency, and faults, Network congestion and its impact on control performance.

UNIT V

Formal Methods, Software Analysis, and Secure Deployment: Advanced Automata-based modeling and analysis, Timed and Hybrid Automata for CPS, Formal Analysis techniques: Flow pipe construction, reachability analysis, Analysis of CPS Software: Weakest Pre-conditions, Bounded Model Checking, Frama-C, CBMC, Secure Deployment of CPS: Attack models, Secure Task mapping, and Partitioning, State estimation for attack detection. **Case Studies in CPS Automotive Case Study:** Vehicle ABS hacking, **Power Distribution Case Study:** Attacks on Smart Grids

TEXT BOOKS:

1. Raj Rajkumar, Dionisio De Niz, and Mark Klein, *Cyber-Physical Systems*, ddison-WesleyProfessional
2. Rajeev Alur, *Principles of Cyber-Physical Systems*, MIT Press, 2015.

REFERENCE BOOKS:

1. André Platzer, Logical Analysis of Hybrid Systems: Proving Theorems for Complex Dynamics.,Springer, 2010. 426 pages, ISBN 978-3-642-14508-7.
2. Jean J. Labrosse, Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C, The publisher, Paul Temme, 2011.
3. Introduction to Embedded Systems - A Cyber-Physical Systems Approach, by E. A. Lee and S.
   A. Seshia, 2014. The book is available in two forms: a free PDF download and low-costpaperback.

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
INDUSTRIAL ELECTRICAL SYSTEMS (D26PE2)
(Professional Elective-II)

B. Tech. VI Sem **L/T/P/C**
3/0/0/3

Course Objectives:

1. Illustrate different electrical system components
2. Explain illumination systems
3. To solve industrial electrical systems

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the electrical wiring systems for residential, commercial and industrial
2. Consumers, representing the systems with standard symbols and drawings, SLD.
3. Understand various components of industrial electrical systems.
4. Analyze and selectthe proper size of various electrical system components.

UNIT I
Electrical System Components
LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

UNIT II
Residential and Commercial Electrical Systems
Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT III
Illumination Systems
Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

UNIT IV
Industrial Electrical Systems I
HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC,MCC panels. Specifications of LT Breakers, MCB and other LT panelV components.

UNIT V

Industrial Electrical Systems II

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Industrial Electrical System Automation

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation

TEXT BOOKS:

1. "G K Dubey", Fundamentals of Electric Drives, CRC Press, 2002.
2. "Vedam Subramanyam", Thyristor Control of Electric drives, Tata McGraw Hill Publications, 1987.

REFERENCE BOOKS:

1. "S K Pillai", A First course on Electrical Drives, New Age International (P) Ltd. 2nd Edition. 1989
2. "P. C. Sen", Thyristor DC Drives, Wiley-Blackwell, 1981
3. "B. K. Bose", Modern Power Electronics, and AC Drives, Pearson 2015.
4. "R. Krishnan", Electric motor drives - modelling, Analysis and control, Prentice Hall PTR, 2001

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
UTILIZATION OF ELECTRICAL ENERGY (D26PE2)
(Professional Elective II)

B. Tech. VI Sem **L/T/P/C**
3/0/0/3

Pre-requisites: Electrical Machines-I and Electrical Machines-II

PREREQUISITE: Electrical Machines-I & Electrical Machines-II

Course Objectives:

1. To understand the fundamentals of illumination and good lighting practices
2. To understand the methods of electric heating and welding.
3. To understand the concepts of electric drives and their application to electrical traction systems.

Course Outcomes:

After completion of this course, the students will be able to

1. Understand the electric drives and types of loads.
2. Understands the concepts and methods of electric heating and welding.
3. Analyze the various illumination methods.
4. Apply the electric drives to electric traction applications.
5. Analyze various calculations involved in electric traction.

UNIT – I:
Electric Drives: Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

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

UNIT – III:
Illumination: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light.
Various Illumination Methods: Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

UNIT – IV:

Electric Traction – I: System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking-plugging rheostat braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves.

UNIT – V:

Electric Traction-II: Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and coefficient of adhesion.

TEXT BOOKS:

1. H. Partab: Modern Electric Traction, Dhanpat Rai & Co, 2007.
2. E. Openshaw Taylor: Utilisation of Electric Energy, Orient Longman, 2010.

REFERENCE BOOKS:

1. H. Partab: Art & Science of Utilization of Electric Energy, Dhanpat Rai & Sons, 1998.
2. N.V. Suryanarayana: Utilization of Electrical power including Electric drives and Electric Traction, New Age Publishers, 1997.

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
FUNDAMENTALS OF ELECTRIC VEHICLES (D26OE2)
(Open Elective – II)

B. Tech VI Sem **L/T/P/C**
3/0/0/3

Pre-requisites: None; Interest in electric Vehicles

Course Objectives:

1. To understand the fundamentals of Electric Vehicles (EVs), especially in Indian Context.
2. To examine technology associated with each element of EV drive-train;
3. To get into the economics of EVs in India vis-à-vis petrol vehicles.

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

1. Understand the fundamentals of Electric Vehicles.
2. Design of batteries, EV motors and Power electronic controllers for EV systems.
3. Analyze the economics of EV market and EV data using Analytical tools.

UNIT I
Introduction
Overview of Electric Vehicles in India, India's EV program, Charging and Swapping Infrastructure, briefintroduction of batteries, EV Subsystems, Loop travels.

UNIT II
Vehicle Dynamics: Forces acting when a vehicle move, Aerodynamic drag, Rolling Resistance and Uphill Resistance, Power and Torque to accelerate. **Drive Cycle:** Concept of Drive Cycle, Drive Cyclesand Energy used per km.

UNIT III
EV Powertrain: Design of EV Drive Train, Introduction to Battery Parameters, Why Lithium Ion Battery? Batteries in Future, Li-Ion Battery Cells, SoH and SoC estimation and Self Discharge, Battery Pack Development, Computation of Effective cost of battery, Charging Batteries.
Fundamentals of EV Battery Pack design: Mechanical, Thermal and Electrical Design, BMS Designof Electric Vehicle.

UNIT IV
EV Motors and Controllers: Fundamentals and Design, Understanding Flow of Electricity, Magnetism and Heat, Power and Efficiency, Torque Production, Speed and Back EMF, the d-q Equivalent circuit, Field-oriented Control, Understanding Three phase AC and DC to AC conversion systems, Understanding the thermal design of the motors, Engineering Considerations, Future Frontiers.

UNIT V

EV Charging: Introduction, Slow or Fast EV Chargers, Battery Swapping, Standardization and On board Chargers, Public Chargers, Bulk Chargers/Swap Stations, Economics of Public Chargers in context, Analytics and Tools for EV systems.

TEXT BOOKS:

1. Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuelcell vehicles by John G. Hayes and A. Goodarzi, Wiley Publication
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric andFuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004
3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003

REFERENCE BOOKS:

1. James Larminie, John Lowry, *Electric Vehicle Technology Explained*, Wiley, 2003
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, *Hybrid Electric Vehicles: Principles andApplications with Practical Perspectives*, John Wiley & Sons Ltd., 2011

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
OPTIMIZATION TECHNIQUES (D26OE2)
(OPEN ELECTIVE – II)

B. Tech VI Sem **L/T/P/C**
3/0/0/3

Pre-requisites: None; Interest in electric Vehicles

Course Objectives:

1. To introduce various optimization techniques in classical, linear programming, transportation problem, simplex algorithm, dynamic programming
2. Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.
3. To explain the concept of Dynamic programming and its applications to project implementation.

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

1. Explain the need of optimization of engineering systems
2. Understand optimization of electrical and electronics engineering problems
3. Apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
4. Apply unconstrained optimization and constrained non-linear programming and dynamic programming
5. Formulate optimization problems.

UNIT I
INTRODUCTION AND CLASSICALOPTIMIZATIONTECHNIQUES

Statement of an Optimization problem – design vector – design constraints – constraint surface –objective function–objective function surfaces–classification of Optimization problems.

CLASSICAL OPTIMIZATIONTECHNIQUES:
Single variable Optimization–multivariable Optimization without constraints–necessary and sufficient conditions for minimum/maximum– multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers–Multivariable Optimization with inequality constraints– Kuhn–Tucker conditions.

UNIT II
LINEAR PROGRAMMING

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems–solution of a system of linear simultaneous equations– pivotal reduction of a general system of equations–motivation to the simplex method– simplex algorithm.

TRANSPORTATIONPROBLEM: Finding initial basic feasible solution by north–west corner rule, least cost method and Vogel's approximation method–testing for optimality of balanced transportation problems.

UNIT III

UNCONSTRAINED NON LINEAR PROGRAMMING

One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method

UNCONSTRAINED OPTIMIZATION TECHNIQUES: Uni-variant method, Powell's method and steepest descent method.

UNIT IV

CONSTRAINEDNONLINEARPROGRAMMING

Characteristics of a constrained problem-classification-Basic approach of Penalty Function method- Basic approach of Penalty Function method- Basic approaches of Interior and Exterior penalty function methods-Introduction to convex programming problem.

UNIT V

DYNAMIC PROGRAMMING

Dynamic programming multistage decision processes –types –concept of sub optimization and the principle of optimality–computational procedure in dynamic programming–examples illustrating the calculus method of solution- examples illustrating the tabular method of solution.

TEXT BOOKS:

1. SingiresuS.Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4thedition, 2009.
2. H.S. Kasene &K. D.Kumar, Introductory Operations Research, Springer (India),Pvt.Ltd., 2004

REFERENCE BOOKS:

1. George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in operationsresearch3rd edition,2003.
2. H.A.Taha, "Operations Research: An Introduction",8th Edition, Pearson/PrenticeHall,2007.
3. Kalyanmoy Deb, "Optimization for Engineering Design – Algorithms and Examples", PHI Learning Pvt.Ltd, New Delhi, 2005

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B.TECH – ELECTRICAL & ELECTRONICS ENGINEERING (R22)
RENEWABLE ENERGY SOURCES (D26OE2)
(OPEN ELECTIVE – II)

B. Tech VI Sem **L/T/P/C**
3/0/0/3

Pre-requisites: None

Course Objectives:

- To recognize the awareness of energy conservation in students
- To identify the use of renewable energy sources for electrical power generation
- To collect different energy storage methods
- To detect about environmental effects of energy conversion

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

- Understand the principles of wind power and solar photovoltaic power generation, fuel cells.
- Assess the cost of generation for conventional and renewable energy plants
- Design suitable power controller for wind and solar applications
- Analyze the issues involved in the integration of renewable energy sources to the grid

UNIT I
Introduction
Renewable Sources of Energy-Grid-Supplied Electricity-Distributed Generation-Renewable Energy. Economics- Calculation of Electricity Generation Costs –Demand side Management Options – Supply side Management Options-Modern Electronic Controls of Power Systems.

Wind Power Plants
Appropriate Location -Evaluation of Wind Intensity -Topography -Purpose of the Energy Generated -General Classification of Wind Turbines-Rotor Turbines-Multiple-Blade Turbines Drag Turbines – Lifting Turbines-Generators and Speed Control used in Wind Power Energy Analysis of Small Generating Systems.

UNIT II
Photovoltaic Power Plants
Solar Energy-Generation of Electricity by Photovoltaic Effect -Dependence of a PV Cell Characteristic on Temperature-Solar cell Output Characteristics-Equivalent Models and Parameters for Photovoltaic Panels-Photovoltaic Systems-Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy.

Fuel Cells: The Fuel Cell-Low and High Temperature Fuel Cells-Commercial and Manufacturing Issues Constructional Features of Proton Exchange-Membrane Fuel Cells –Reformers-Electro-lyzer Systems and Related Precautions-Advantages and Disadvantages of Fuel Cells-Fuel Cell Equivalent Circuit Practical Determination of the Equivalent Model Parameters -Aspects of Hydrogen as Fuel.

UNIT III

Induction Generators

Principles of Operation- Representation of Steady-State Operation-Power and Losses Generated-Self Excited Induction Generator-Magnetizing Curves and Self-Excitation Mathematical Description of the Self-Excitation Process- Interconnected and Stand-alone operation -Speed and Voltage Control - Economical Aspects.

UNIT IV

Storage Systems

Energy Storage Parameters-Lead–Acid Batteries-Ultra Capacitors-Flywheels –Superconducting Magnetic Storage System-Pumped Hydroelectric Energy Storage - Compressed Air Energy Storage - Storage Heat -Energy Storage as an Economic Resource.

UNIT V

Integration of Alternative Sources of Energy

Principles of Power Injection-Instantaneous Active and Reactive Power Control Approach Integration of Multiple Renewable Energy Sources-Islanding and Interconnection Control-DG Control and Power Injection.

Interconnection of Alternative Energy Sources with the Grid:

Interconnection Technologies –Standards and Codes for Interconnection – Interconnection Considerations - Interconnection Examples for Alternative Energy Sources.

TEXT BOOKS:

1. Felix A. Farret, M. Godoy Simoes, "Integration of Alternative Sources of Energy", John Wiley& Sons, 2006.

2. Solanki: Renewable Energy Technologies: Practical Guide for Beginners, PHI Learning Pvt. Ltd., 2008.

REFERENCE BOOKS:

1. D. Mukherjee: Fundamentals of Renewable Energy Systems, New Age International publishers, 2007.

2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez: Grid Converters for Photovoltaic and Wind Power Systems, John Wiley & Sons, 2011.

3. Gilbert M. Masters: Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

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(Sponsored by TKR Educational Society, Approved by AICTE, Affiliated to JNTU H)
Medbowli, Meerpet, Balapur, Hyderabad, Telangana – 500 097
Phone: 9100377790, email: info@tkrcet.ac.in, web site: www.tkrcet.ac.in

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
POWER SYSTEM LAB (D26PC24)

B. Tech. VI Sem **L/T/P/C**
0/0/2/1

Prerequisite: Power System-I, Power System-II, Power System Protection, Power System Operationand Control, Electrical Machines

Course Objectives:

- To perform testing of CT, PT's and Insulator strings
- To find sequence impedances of 3-Φ synchronous machine and Transformer
- To perform fault analysis on Transmission line models and Generators.

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

- Perform various load flow techniques
- Understand Different protection methods
- Analyse the experimental data and draw the conclusions**.**

The following experiments are required to be conducted as compulsory experiments:
Part - A

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

In addition to the above six experiments, at least any four of the experiments from thefollowing list are required to be conducted.
Part - B

1. Formation of YBUS.
2. Load Flow Analysis using Gauss Seidel (GS) Method.
3. Load Flow Analysis using Fast Decoupled (FD) Method.
4. Formation of ZBUS.
5. Simulation of Compensated Line

TEXT BOOKS:

1. C.L. Wadhwa: Electrical Power Systems –Third Edition, New Age International Pub. Co., 2001.
2. Hadi Sadat: Power System Analysis –Tata Mc Graw Hill Pub. Co. 2002.

REFERENCE BOOK:

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

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
MICROPROCESSORS AND MICROCONTROLLERS LAB (D26PC25)

B. Tech. VI Sem **L/T/P/C**
0/0/2/1

Pre-Requisite: Digital logic Design Lab

Course Objectives:

1. To develop an understanding of the operations of microprocessors and microcontrollers using machine language programming and interfacing techniques.

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

1. Apply the fundamentals of assembly level programming for microprocessors/ microcontrollers
2. Analyse the instruction set of 8086 and use it to develop programs.
3. Analyse the instruction set of 8051 and use it to develop programs.
4. Analyse different I/O devices which can be interfaced to microprocessor and microcontroller.
5. Analyse the instruction set of ARM and use it to develop programs.

The following programs/experiments are to be written for assembler and to be executed the same with8086 and 8051 kits.

List of Experiments:

Note:-Minimum of 12 experiments to be conducted.

1. Programs for 16 bit arithmetic operations 8086 (using various addressing modes)
2. Programs for sorting an array for 8086.
3. Programs for searching for a number of characters in a string for 8086.
4. Programs for string manipulation for 8086.
5. Parallel communication between two microprocessor kits using 8255.
6. Serial communication between two microprocessor kits using 8251.
7. Interfacing to 8086 and programming to control stepper motor.
8. Programming using arithmetic, logical and bit manipulation instructions of 8051.
9. Program and verify Timer/Counter in 8051.
10. Program and verify interrupt handling in 8051.
11. UART operation in 8051.
12. Communication between 8051 kit and PC.
13. Interfacing LCD to 8051
14. Programs for arithmetic operations using ARM7.
15. Program for Digital output (blink LEDs) using ARM7.
16. Program to display message on LCD using ARM7.
17. Interfacing seven segment display to ARM7.

TEXT BOOKS:

1. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2nd Edition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed.

REFERENCE BOOKS:

1. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012
2. Microprocessors and Interfacing, D. V. Hall, MGH, 2nd Edition 2006.
3. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
4. The 8051 Microcontrollers, Architecture and Programming and Applications -K.Uma Rao, Andhe Pallavi, Pearson, 2009.