COURSE STRUCTURE AND DETAILED SYLLABI FOR M.TECH UNDER ACADEMIC REGULATIONS R20 FOR

M.Tech Regular (Full Time) Two Year Post Graduate Degree Programme

(For the Batches Admitted From 2020-2021)

POWER ELECTRONICS AND ELETRICAL DRIVES (PE&ED)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY

(AUTONOMOUS)

Accredited by NBA, New Delhi & NAAC, Bengaluru │Affiliated to JNTUA, Ananthapuramu, Recognized by the UGC under Section 12 (B) and 12 (F)│ Approved by AICTE, New Delhi.

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SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY

(AUTONOMOUS)

R.V.S. NAGAR, CHITTOOR-517127. A.P

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATIONS UNDER R20 REGULATIONS

I M. Tech, I Semester (PE & ED)

S.NO	SUBJECT CODE	SUBJECT	PERIODS			CREDITS	SCHEME OF EXAMINATION (MAXIMUM MARKS)		
			L	T	P		CIE	SEE	TOTAL
1	20BPE01	Analysis of Power Converters	3	0	0	3	40	60	100
2	20BPE02	Power Electronic Control of DC Drives	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE – I									
3	20BPE03	Modern Power Electronics	3	0	0	3	40	60	100
	20BPE04	Wind Energy Systems with Energy Storage							
	20BPE05	Solar Photovoltaic Systems With Battery Energy Storage							
PROFESSIONAL ELECTIVE – II									
4	20BPE06	PIC Controllers and their Applications	3	0	0	3	40	60	100
	20BPE07	Modeling and Analysis of Electrical Machines							
	20BPE08	Advanced Power Semiconductor Devices and Protection							
5	20BMB21	Research Methodology	2	0	0	2	40	60	100
6	20BPE09	Simulation of Power Electronic control and RES Lab	0	0	4	2	40	60	100
7	20BPE10	Integrated DC Drives Lab	0	0	4	2	40	60	100
8	20BPE11	Research paper Writing Methodology (Audit Course - I)	2	0	0	-	-	-	-
TOTAL			**16**	**0**	**8**	**18**	**280**	**420**	**700**

I M. Tech, II Semester (PE & ED)

S.NO	SUBJECT CODE	SUBJECT	PERIODS			CREDITS	SCHEME OF EXAMINATION (MAXIMUM MARKS)		
			L	T	P		CIE	SEE	TOTAL
1	20BPE12	Analysis of Inverters	3	0	0	3	40	60	100
2	20BPE13	Embedded System Design	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE – III									
3	20BPE14	Power Electronic Control of AC Drives	3	0	0	3	40	60	100
	20BPE15	Switched Mode and Resonant Converters for Power Supply Design							
	20BPE16	Integrated Design and Analysis of Electrical Machines							
PROFESSIONAL ELECTIVE – IV									
4	20BPE17	Power Electronics Applications in Power Systems	3	0	0	3	40	60	100
	20BPE18	Advanced Power System Operation & Control							
	20BPE19	System Identification and Adaptive Control							
5	20BPE20	Mini Project	0	0	4	2	100	00	100
6	20BPE21	Integrated A.C. Drives Lab	0	0	4	2	40	60	100
7	20BPE22	Embedded Systems Lab	0	0	4	2	40	60	100
8	20BPE23	Indian Constitution (Audit Course – II)	2	0	0	-	-	-	-
TOTAL			**14**	**0**	**12**	**18**	**340**	**360**	**700**

II M. Tech, III Semester (PE & ED)

S.NO	SUBJECT CODE	SUBJECT	PERIODS			CREDITS	SCHEME OF EXAMINATION (MAXIMUM MARKS)		
			L	T	P		CIE	SEE	TOTAL
PROFESSIONAL ELECTIVE – V									
1	20BPE24	Power Electronics for Renewable Energy Sources	3	0	0	3	40	60	100
	20BPE25	Electric and Hybrid Vehicles							
	20BPE26	Intelligent Control of Electrical Drives							
PROFESSIONAL ELECTIVE – VI									
2	20BPE27	Electrical Distribution and Automation.	3	0	0	3	40	60	100
	20BPE28	Distributed Generation and Micro- Grids							
	20BPE29	Advanced Digital Signal Processing							
3	20BPE30	DISSERTATION PHASE-I	-	-	20	10	40	60	100
TOTAL			**6**	**0**	**20**	**16**	**120**	**180**	**300**

II M. Tech, IV Semester (PE & ED)

S.NO	SUBJECT CODE	SUBJECT	PERIODS			CREDITS	SCHEME OF EXAMINATION (MAXIMUM MARKS)		
			L	T	P		CIE	SEE	TOTAL
1	20BPE31	DISSERTATION PHASE-II	-	-	32	16	120	180	300
TOTAL						**16**	**120**	**180**	**300**

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I M. Tech, I Semester (PE & ED)

L	T	P	C
3	0	0	3

20BPE01 ANALYSIS OF POWER CONVERTERS

Course Objectives:

The objectives of this course are to

1. To understand the operation and static & dynamic characteristics of all semiconductor devices.
2. To acquire knowledge about the operation and performance characteristics of single and three phase converters.
3. To study the principle and operation of DC and AC choppers.
4. To know the operation and performance characteristics of dual and cyclo-converters.

UNIT I

THREE-PHASE CONTROLLED RECTIFIERS: Three-phase controlled half wave, full bridge, Semi/Half rectifiers – Analysis of output and input parameters in detail-continuous and discontinuous mode of operation.

UNIT II

MULTI-PULSE RECTIFIERS – Analysis, PWM rectifiers - operation and control Evaluation of input power factor and harmonic factor and its analysis -Continuous and Discontinuous load current – Applications- Numerical problems

UNIT III

D.C. TO D.C CONVERTERS:

D.C. CHOPPERS: Analysis of step-down and step-up dc to dc converters with resistive and resistive –inductive loads.

Soft-switching DC - DC converters: Zero-voltage-switching converters, zero-current - Switching converters, Cascaded DC/DC converters – ripple reduction and its advantages

UNIT IV

THREE PHASE AC VOLTAGE CONTROLLERS: - Three Phase AC Voltage Controllers-Analysis of Controllers with star and delta connected R, RL loads-Effect of source and load inductances–Application- numerical problems.

UNIT V

DUAL CONVERTERS & CYCLOCONVERTERS: three phase dual converters-Principle of operation –control strategy - Power factor improvements-three phase PWM-twelve pulse converters–Application- Numerical problems- -Three phase to three phase cycloconverters-analysis of Midpoint and bridge configurations – Limitations – Advantages – Applications- Numerical problems.

Course Outcomes:

At end the course the student will be able to

1. Apply the knowledge about static and dynamic characteristics all semiconductor devices.
2. Design the single and three phase converters.
3. Design DC to DC converters and analyze the switched mode regulators.
4. Design and simulate about three phase AC voltage controllers, Cyclo-converters and dual converters.

Text Books:

1. Rashid M.H:"Power Electronics – Circuits, Devices & Applications", Prentice Hall of India, 3rd Edition, New Delhi, 2005.
2. P.S.Bimbra:"Power Electronics", Khanna Publishers, Eleventh Edition, 2003
3. Mohan. N, Undeland& Robbins:"Power Electronics – Converters, Application & Design", John Wiley & Sons, Inc,2nd Edition, NewYork, 2001.

Reference Books:

1. P.C Sen:"Modern Power Electronics", Wheeler publishing Co, First Edition, New Delhi, 1998.
2. Rashid M.H:"Hand book on Power Electronics", Academic Press, Imprint of Elesvier, California.
3. M.D. Singh & K.B. Khanchandani:"Power Electronics", Tata Mc Graw Hill Publishing Company Limited, 2nd Edition, Fourth Print 2009.
4. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Power%20Electronics/New_index1.html

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L	T	P	C
3	0	0	3

20BPE02 POWER ELECTRONIC CONTROL OF DC DRIVES

Course Objectives:

The objectives of this course are to

1. To study 1-φ & 3-φ controlled bridge rectifier with motor load on continuous and discontinuous modes of operation and effect of freewheeling diode on converter performance
2. To understand the operation of three phase naturally commutated bridge as a rectifier and inverter.
3. To study the steady state analysis of three phase converter controlled and chopper controlled DC motor drives and design of speed and current controller
4. To know the closed loop operation and dynamic simulation of DC motor drive system with current controller.

UNIT I

CONTROLLED BRIDGE RECTIFIER (1-Φ& 3-Φ) WITH DC MOTOR LOAD: Separately excited DC motors with rectified single-phase supply- single phase semi converter and single-phase full converter for continuous and discontinuous modes of operation – power and power factor - Three phase semi converter and three phase full converter for continuous and discontinuous modes of operation – power and power factor – Addition of Freewheeling diode – Three phase double converter.

UNIT II

THREE PHASE NATURALLY COMMUTATED BRIDGE CIRCUIT AS A RECTIFIER (OR) AS AN INVERTER: Three phase-controlled bridge rectifier with passive load impedance, resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase-controlled bridge rectifier inverter,

UNIT III

THREE PHASE CONTROLLED DC MOTOR DRIVES: Three phase-controlled converter, control circuit, control modeling of three phase converter – Steady state analysis of three phase converter control DC motor drive –Current and Speed controllers - current and speed feedback – Design of Current and Speed controllers – Motor equations – current reference generator – current controller and flow chart for simulation – Harmonics and associated problems – sixth harmonic torque.

UNIT IV

CHOPPER CONTROLLED DC MOTOR DRIVES: Principle of operation of the chopper – Four quadrant chopper circuit – Chopper for inversion – Chopper with other power devices – model of the chopper –input to the chopper – Steady state analysis of chopper-controlled DC motor drives – rating of the devices – Pulsating torque.

UNIT V

CLOSED LOOP OPERATION AND DYNAMIC SIMULATION OF DC MOTOR DRIVES: Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current Controller, Dynamic simulations of the speed-controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

Course Outcomes:

At end the course the student will be able to

1. Design the 1- φ & 3-φ controlled drive system for the specified load torque.
2. Analyze the performance parameters of three phase controlled converter on load side and supply side.
3. Design a chopper controlled DC drive for industrial application
4. Simulate the closed loop drive system to predetermine the design parameters of drive system for specific application.

Text Books:

1. Shepherd, Hulley Liang: Power Electronics and motor control,2nd Edition, CU Press
2. G. K. Dubey: Fundamentals of Electric Drives, Narosa Publications, 1995.
3. R. Krishnan: Electric motor drives modeling, Analysis and control,1st Edition, PHI.

Reference Books:

1. M.H.Rashid: Power Electronic Circuits, Devices and Applications, PHI, 1stEdition.
2. S.B. Dewan and A. Straughen: Power Semiconductor drives, 1975.
3. S.K.Pillai: First course on Electric drives, New age international publishers Ltd, 2012.

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L	T	P	C
3	0	0	3

20BPE03 MODERN POWER ELECTRONICS

(PROFESSIONAL ELECTIVE – I)

Course Objectives:

The objectives of this course are to

1. To know static and dynamic characteristics of modern power semiconductor devices.
2. To know design of resonant converters and its time and frequency responses.
3. To know the concept of multilevel inverter and its performances.
4. To know the principle and operation of AC and DC power supplies.

UNIT I

MODERN POWER SEMICONDUCTOR DEVICES: Modern power semiconductor devices- MOS Turn Off Thyristor (MTO) – Emitter Turn Off Thyristor (ETO) – Integrated Gate – Commutated thyristor (IGCTs) – MOS – controlled thyristors (MCTs) – Static induction Thyristors (SITHs) – Power integrated circuits (PICs) – Symbol, structure and equivalent circuit- comparison of their features.

UNIT II

RESONANT PULSE INVERTERS: Resonant pulse inverters – series resonant inverters- series resonant inverters with unidirectional switches – series resonant inverters with bidirectional switches- analysis of half bride resonant inverter- evaluation of currents and Voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverter- for series loaded inverter – for parallel resonant inverters – Voltage control of resonant inverters-class E resonant inverter – class E resonant rectifier- evaluation of values of C's and L's for class E inverter and Class E rectifier – numerical problems.

UNIT III

MULTILEVEL INVERTERS: Multilevel concept- Classification of multilevel inverters – Diode clamped Multilevel inverter- Principle of operation – main features- improved diode clamped inverter – principle of operation – Flying capacitors multilevel inverter – principle of operation – main features - Cascaded multilevel inverter – principle of operation – main features- multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives – switching device currents – dc link capacitor voltage balancing –features of Multilevel inverters – comparisons of multilevel converters.

UNIT IV

DC POWER SUPPLIES: DC power supplies – classification- switched mode dc power supplies – fly back Converter- forward converter- push –pull converter –half bridge converter –Full bridge converter – Resonant DC power supplies- bidirectional power supplies- Application.

UNIT V

AC POWER SUPPLIES: AC power supplies – classification – switched mode ac power supplies Resonant AC power supplies-bidirectional ac power supplies – multistage conversions- control circuits- UPS & applications.

Course Outcomes:

At end the course the student will be able to

1. Design the modern power semiconductor devices & static and dynamic characteristics of all modern power semiconductor devices.
2. Emphasize the different types of resonant pulse inverters and also know the time and frequency response.
3. Simulate and Design the operation of multi level inverters and its importance's.
4. Design the DC and AC power supplies using advanced techniques.

Text Books:

1. Mohammed H.Rashid: Power Electronics, Pearson Education- Third Edition –first Indian reprint – 2004.
2. Ned Mohan, Tore M.Undeland and William P.Robbind: Power Electronics, John wiley& Sons, 2nd Edition.
3. Jai P. Agarwal:Power Electronics Systems, Pearson Education, Second Edition, 2002

Reference Books:

1. L. Umanand:Power Electronics – Essentials & Applications, Wiley Publication,2009
2. http://freevideolectures.com/Course/3345/Pulse-width-Modulation-for-Power-Electronic-Converters/3
3. http://freevideolectures.com/Course/3345/Pulse-width-Modulation-for-Power-Electronic-Converters/4
4. http://freevideolectures.com/Course/3345/Pulse-width-Modulation-for-Power-Electronic-Converters/5

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I M.Tech, I Semester (PE & ED)

L	T	P	C
3	0	0	3

20BPE04 WIND ENERGY SYSTEMS WITH ENERGY STORAGE

(PROFESSIONAL ELECTIVE – I)

Course Objectives:

The objectives of this course are to

1. Understanding the basic advantages of wind energy potential and its utilization.
2. Examine the developments in the wind turbine technologies.
3. Importance of wind turbine siting issues for wind power generation feasibility.
4. Identify suitable power electronic converters for the wind turbine generator systems.
5. Necessity of wind energy storage systems.

UNIT-I: WIND ENERGY BASICS AND POWER POTENTIAL IN THE WIND

Introduction, Historical development and current status, Global circulations, Forces influencing Wind - Pressure gradient force and Coriolis force, Local and regional wind systems, Atmospheric boundary layer, Atmospheric Stability, Surface wind, Power extracted from wind - stream tube model, linear momentum theory, power coefficient, Betz limit, Gusty winds, Extreme winds calculation of theoretical power developed by the wind turbine, Long-term wind speed variations, Synoptic and diurnal variations.

UNIT-II: WIND TURBINE TECHNOLOGIES AND WIND SHEAR ANALYSIS

Introduction, Types, Rotor elements, Horizontal (onshore and offshore) and vertical axis wind turbines, Wind turbine towers and its foundation, Calculation of axial thrust and efficiency, Pitch and stall regulation, Lift and drag coefficients, thrust and torque calculations, Tip losses, Horizontal and vertical extrapolation of wind resource, Power law model, Logarithmic law model Deaves and Harris model, Wind shear exponent, Extrapolation of wind resource at the hub height, Roughness length, Roughness classes, Remote sensing techniques, Turbulence, Acceleration effects, Numerical wind flow modeling.

UNIT-III: WIND TURBINE SITING AND WIND ENERGY SYSTEMS ECONOMICS

Introduction, Basic approaches to siting, Siting in homogeneous terrain and on land and offshore micro siting, Characteristics of horizontal axis wind turbines and power curve, Wind turbine driven pumps, Matching of pump and turbine characteristics, Wind turbine energy production and Capacity factor, Wake effects, resource assessment, Wind turbine performance characteristics, IEC standards, Wind speed prediction and forecasting models (the international organizations such as: DARPA /NASA and NIWE in India).

UNIT-IV: POWER ELECTRONICS AND GENERATOR SYSTEMS FOR WIND TURBINES

Introduction, Small wind energy turbines Vs. Large wind turbine generators, Single and three phase AC voltage systems, Transformers, Fixed and variable speed wind turbine generators, Types:

PMSG, DFIG and SEIG, Power electronic converter topologies, Grid connection requirements and its challenges, Grid independent operation, Need for energy storage.

UNIT-V: BATTERY STORAGE

Introduction, Basics of electrochemical cell: operation and classification, Cell to battery, Battery parameters, Factors affecting battery performance: Life cycle, Depth of discharge, Temperature, Discharge rate, cut off voltage soc determination, batteries for WTGs / PV systems, Comparison of different types of batteries, Flywheels, Super capacitors.

Course Outcomes:

At end the course the student will be able to

1. Explore the various uncertainties involved in the wind turbine / wind farm siting.
2. Calculation of wind turbine power curve characteristics.
3. Maintain the operating limits of wind turbines generators to meet IEC standards.
4. Determination of available power that can be extracted from the wind turbine systems.
5. Dynamic characteristics of wind flow over the flat and complex terrains

Text books:

1. J. F. Manwell, J. G. McGowan, and A. L. Rogers, design and application, John Wiley & Sons, Amherst (USA), 2009. (Chapters 1, 2 and 3)
2. Alois Schaffarczyk, Understanding the Wind Power Technology: Theory, Deployment and Optimization, John Willy and Sons, Ltd., Kiel (Germany) 2014. (Chapters 3 and 4)
3. Siegfried Heier, Grid Integrated and sons Ltd., 2006. (Chapter 4)
4. Chetan Singh Solanki, Applications, 3rd Edition, PHI publications. (Chapter 5)

References Books:

1. F. Diaz-Gonzalez, A. Sumper, review of energy storage technologies for wind power applications," Renewable and Sustainable Energy Reviews, vol. 16, pp. 2154
2. K. S. R. Murthy and O. P. Rahi, "A Comprehensive Review Assessment," Renewable and Sustainable Energy Reviews May 2017. (Chapter 1-4)
3. Tony Burton, David Sharpe, Nick Jenkins and Ervin Bossanyi, Handbook, John Wiley and Son's Ltd. 2001. (Chapter 1
4. Michael C. Brower, Wind Resource Assessment: A Practical Guide to Developing a Wind Project, A John Wiley & Sons, Inc., Publication, 2012.

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	L	T	P	C
I M.Tech, I Semester (PE & ED)	**3**	**0**	**0**	**3**

20BPE05 SOLAR PHOTOVOLTAIC SYSTEMS WITH BATTERY ENERGY STORAGE

(PROFESSIONAL ELECTIVE –I)

Course Objectives:

At end the course the student will be able to

1. Analyze the generation of power from PV solar cell and its efficiency.
2. Illustrate the design considerations of solar PV array.
3. Know solar photovoltaic system for different applications.
4. Demonstrate different types of batteries and its performance parameters
5. Analyze solar energy for different domestic applications.

UNIT-I: AN INTRODUCTION TO SOLAR ENERGY, PV CELLS AND TECHNOLOGIES

Solar radiation: Extraterrestrial, Terrestrial, Spectral distribution, Motion of sun, Availability of solar radiation, Conversion of Solar energy into Electricity – Photovoltaic Effect, Equivalent Circuit of the Solar cell, solar cell parameters, Losses in solar cell, Analysis of PV Cells: I-V and P-V characteristics, Variation of efficiency with irradiation and temperature, Solar cell technologies, Spectral distribution of solar cell, Hi cells, Recent developments in Solar cells- Recent development in solar cells.

UNIT-II: POWER CONDITIONING FOR SOLAR PHOTOVOLTAIC SYSTEMS

Solar PV modules and array, Effects of mismatches in series and parallel connected modules, Effects of shading and module tilt, Photovoltaic system and its configuration Sub systems Battery storage, Charge controllers and monitoring system for batteries, DC – DC Converters for maximum Power Point Tracking, Inverters for stand alone and grid connected PV systems, Inverter principles, Power quality of Inverters, Safety Accepts with Grid connected Inverters.

UNIT-III: DESIGN OF SOLAR PHOTOVOLTAIC SYSTEM

Stand-alone PV systems: with DC load, with battery and DC load, with DC and AC loads- Hybrid PV systems, System sizing: power and energy estimates, battery sizing, PV array sizing, Grid-Connected systems: Interface requirements such as DC/AC inverter, synchronizing with grid, load transient, operating limit, stability issues Solar PV as Renewable Energy Source for Distributed power generation

UNIT-IV ENERGY STORAGE

Basics of electrochemical cell: operation and classification, Battery, Types of battery, Equivalent electrical circuit, Battery performance characteristics, Factors affecting battery performance: Life cycle, depth of discharge, temperature, discharge rate, cut off voltage SOC determination, Batteries for PV systems, Equivalent electrical circuit models for Lead acid and Lithium-Ion batteries, Super capacitors.

UNIT-V: PV ENERGY AND ECONOMIC ANALYSIS WITH CASE STUDIES

PV Economy: Energy delivery factor, Initial capital cost, Energy cost estimates, Profitability index, Life cycle conversion efficiency, Energy payback period, Impact of green power, marketing, Case studies: Energy analysis of roof top PV systems, Energy analysis of solar day lighting system

Course Outcomes:

At end the course the student will be able to

1. Illustrate energy metrics of solar PV systems.
2. Demonstrate the energy analysis of different PV systems.
3. Design Interface requirements of grid connected PV systems.
4. Design the DC-DC converters and inverters of PV system.

Text books:

1. Chetan Singh Solanki, Applications, 3rdEdition, PHI publications, 2015 (Unit
2. Mukund R Patel, Wind and Solar 2ndEdtion, Taylor Franscis, 2006 (Unit

Reference books:

1. Antonio Luque, Steven Hegedus, Wiley, 2011 (Unit-II, III)
2. S P Sukhatme, J K Nayak, Solar Energy roof-top PV systems, Energy analysis of solar roof-top PV systems
3. Solar Photovoltaics- Fundamentals, Technologies & Edition, Unit-I, II, III,V)
4. Power Systems- Design, Analysis & Operation Edtion, Unit- III, IV, V)

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	L	T	P	C
I M.Tech, I Semester (PE & ED)	**3**	**0**	**0**	**3**

20BPE06 PIC CONTROLLERS &THEIR APPLICATIONS

(PROFESSIONAL ELECTIVE –II)

Course Objectives:

The objectives of this course are to

1. To understand the review of basic models of 8-bit microcontrollers like MCS-51 and Atmel.
2. To know in detail the PIC microcontrollers.
3. To understand interface some of the peripheral devices with the microcontroller.
4. To study some Industrial applications of PIC Controllers.

UNIT I

INTRODUCTION TO MICROCONTROLLERS: 8-bit & 16-bit microcontrollers – CISC and RISC processors – Harvard and Van Neumann architecture –MCS-51 Architecture –MCS-51 Instruction Set-Simple Programs-ATMEL Microcontroller(89CXX and 89C20XX)-Architectural Overview of ATMEL 89C51 and ATMEL 89C2051-PIN Description of 89C51and 89C2051

UNIT II

PIC CONTROLLERS: Overview and Features – PIC 16C6X/7X – FSR (File Selection Register) [Indirect Data memory Address Pointer]- PIC Reset actions – PIC Oscillator connections - PIC Memory organization - PIC 16C6X/7X Instructions - Addressing modes – I/O Ports – Interrupts in PIC 16C61/71 – PIC 16C61/71 Timers

UNIT III

PIC 16F8XX FLASH MICROCONTROLLERS: Introduction - PIN diagram of 16F8XX – STATUS register – OPTION-REG register – Power control register – PIC 16F8XX Program memory – PIC 16F8XX Data memory, Data EEPROM and Flash program EEPROM - Interrupts in 16F877 – I/O Ports – Timers.

UNIT IV

INTERFACING AND MICROCONTROLLER APPLICATIONS: Introduction – Light Emitting Diodes (LEDs), Push buttons, Relays and Latch Connections - Key board interfacing – Interfacing 7-segment Displays – LCD Interfacing – ADC and DAC interfacing with 89C51 microcontrollers

UNIT V

INDUSTRIAL APPLICATIONS: Introduction – Measurement Applications – Sensing Robot Arm position –Linear Variable Differential Transformer (LVDT) – RPM meter – Digital Thermometer – Load cell. Automation and Control applications – Digital PID Controllers – Power controlling devices – Stepper motor drive

Course Outcomes:

At end the course the student will be able to

1. Distinguish between CISC and RISC processors
2. Design the concept of PIC Controllers and Flash microcontrollers
3. Implement the concept of connecting PIC controllers with various interfacing devices for several applications.
4. Utilize the knowledge of PIC controllers for various Industrial applications related with Electrical Engineering.

Text Books:

1. Ajay V Deshmukh: Microcontrollers – Theory and Applications, Mc Graw Hills.

References Books:

1. Kenneth J Aayala:8051 Microcontrollers Architecture, Programing and Applications, 2nd edition, Thomson Publishing
2. Prof C.R. Sarma: Microprocessor and Microcontrollers.
3. John B Peatman: Design with PIC Microcontrollers, Pearson Education Inc.

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L	T	P	C
3	0	0	3

20BPE07 MODELING AND ANALYSIS OF ELECTRICAL MACHINES

(PROFESSIONAL ELECTIVE –II)

Course Objectives:

The objectives of this course are to

1. To know the basic two-pole machine representation of commutator machines, kron'sprimitive machine and acquire the knowledge about mathematical model of DC machines.
2. To understand the transformation from three phase to two phase and vice-versa, rotating axes to stationery axes & vice-versa and application of generalized machine theory.
3. To impart knowledge of D-Q model of induction machines in various reference frames, per unit model and its dynamic simulation of induction machine
4. To emphasize the different models of synchronous machine and also mathematical modelings of various special machines and know about single phase motors.

UNIT I

BASIC CONCEPTS OF MACHINE MODELINGAND DC MACHINE: Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations. Mathematical model of separately excited D.C motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Transfer function of separately excited D.C Motor- Mathematical model of D.C Series motor, steady state analysis - Linearization Techniques for small perturbations

UNIT II

LINEAR TRANSFORMATION IN MACHINES: Transformation from Three phase to two phase and Vice Versa - Transformation from Rotating axes to stationary axes and vice versa – Park's Transformation and it's physical concepts – Transformer Impedance – How to apply generalized theory – Electrical Torque – Restriction Matrix.

UNIT III

THREE PHASE INDUCTION MACHINE: D-Q model of induction machine in Stator reference Frame, Rotor reference Frame and Synchronously rotating reference Frame -Small signal equations of induction machine-d-q flux linkages model derivation- Signal flow graph of the induction machine-Per unit model -Dynamic simulation of induction machine.

UNIT IV

SINGLE PHASE INDUCTION MOTORS& SYNCHRONOUS MACHINE: Comparison between single phase and poly-phase induction motors - Cross field theory - steady state analysis – steady state torque –Synchronous Machine/Synchronous machine inductances –The phase Co-ordinate model-The Space phasor (d-q) model-Steady state operation-Mathematical model of PM Synchronous motor.

UNIT V

SPECIAL MACHINES: Mathematical Modeling of Permanent Magnet Brushless DC Motor and Switched Reluctance Motor – Operating principle of PM Brushless DC motor-PMDC Motor Drive Scheme, -Operating principle of SRM -Construction and functional Aspects-Average torque and Energy Conversion Ratio-The Commutation windings-The flux current position curve fitting.

Course Outcomes:

At end the course the student will be able to

1. Design and simulate the modeling concepts of 3-phase synchronous machine and 3-phase Induction machine, Kron's primitive machine equations.
2. Analyze the mathematical model of separately excited D.C Motor, D.C Series & shunt motor and its steady state, transient state analysis.
3. Transforms from 3-phase to 2-phase, Park's transformation of Induction machine, signal flow graph of the Induction machine.
4. Design the modeling of 1-phase and poly phase Induction machine, cross field theory, modeling of synchronous machine**.**

Text Books:

1. P.S.Bimbhra: Generalized Theory of Electrical Machines, Khanna publications, 5thEdition,1995.
2. R.Krishnan: Electric Motor Drives Pearson Modeling, Analysis& control, 1st edition, 2002.
3. P.C.Krause:Analysis of Electrical Machinery,Tata McGraw Hill, 1980.

Reference Books:

1. C.V.jones, Butterworth:The Unified Theory of Electrical Machines, London, 1967
2. Boldea& S.A. Nasar:Electrical Drives-I,The Oxford Press Ltd.
3. D.P. Sengupta& J.B. Lynn:Electrical Machine Dynamics, The Macmillan Press
4. Woodson & Melcher:Electromechanical Dynamics, John Wiley & Sons

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I M. Tech, I Semester (PE & ED)	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

20BPE08 ADVANCED POWER SEMICONDUCTOR DEVICES AND PROTECTION
(PROFESSIONAL ELECTIVE –II)

Course Objectives:

The objectives of this course are to

1. To know various types of power semi conductor devices such as BJT, MOSFET, GTO, IGBT and their characteristics.
2. To obtain knowledge on various types of emerging power semi conductor devices such as power JFET and MOS controlled Thyristor.
3. To understand the Electromagnetic Interference due to switching in power electronic circuits.
4. To know the protection of power devices using snubber circuits.

UNIT I

Power Transistors: Construction, static characteristics, physics of operation, switching characteristics; Negative temperature co-efficient and secondary breakdown – Power Darlington- Safe operating regions. dynamic models of BJT **Power Thyristors:** concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types, steady state and dynamic models of Thyristor, comparison of BJT and Thyristor.

UNIT II

POWER MOSFET: Power MOSFET Introduction-basic structures-I-V characteristics-physics of device operation-switching characteristics-operation limitations and safe operating areas-design of gate drive circuits-snubber circuits.

UNIT III

INSULATED GATE BIPOLAR TRANSISTOR (IGBT):–IGBT Introduction-basic structures-I-V characteristics-physics of device operation-Latch in IGBTs-switching characteristics-Device limits and safe operating areas-drive and snubber circuits.

UNIT IV

EMERGING DEVICES: Basics of GTO, MCT, FCT, RCT and IGCT. Smart power devices, Intelligent Power Modules. Silicon Carbide Devices.

UNIT V

Gate Driving and Protection: Necessity of isolation, pulse transformer, opto-coupler – Gate drives circuit for MOSFETs and IGBTs; Design of snubbers–guidance for heat sink selection, heat sink types and design – Mounting types.

Course Outcomes:

At end the course the student will be able to

1. Analyze the characteristics and operation of power semi conductor devices.
2. Design the cross section and switching characteristics of semi conductor devices.
3. Identify the occurrence of noise and measurement of noise.
4. Design the protection of power device and transient in the power electronic circuits.

Text Books:

1. Mohan and Undeland: Power Electronics –Converters, Applications and Design, John Wiley&Sons
2. M.H.Rashid: Power Electronics Circuits, Devices and Applications, PHI-Publication
3. B.W Williams: Power Electronics Circuit Devices and Applications, New York, Halsted Press, 1987.

Reference Books:

1. Joseph Vithayathil: Power Electronics Circuits, 2nd Edition, Tata MC Graw Hill.
2. W.C. Lander:Power Electronics Circuits, 3rd Edition, Tata MC Graw Hill.
3. Loganathan Umanand: Power Electronics: Essentials and Applications, Wiley India Pvt. Ltd, 2009.
4. http://nptelonlinecourses.iitm.ac.in/courses/108104011/

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20BMB21 RESEARCH METHODOLOGY

(Common To All Branches)

Course objectives:

1. To introduce the students to concepts, objectives, and process of research.
2. To enable the students to formulate research problems and develop a coherent research design.
3. To introduce the students to instruments of data collection, tools for data analysis, and help them draw meaningful interpretations.
4. To enable the students to prepare research reports.

UNIT-I: RESEARCH

Research Meaning, Objective, Motivation in Research, Types of Research, Research Approaches, Research Process; Validity and Reliability in Research; Research Design: Features of Good Design, Types of Research Design, and Basic Principles of Experimental Design.

UNIT-II: SAMPLING DESIGN

Meaning,Steps in Sampling Design, Characteristics of a Good Sample Design, Random Samples and Random Sampling Design; Measurement and Scaling Techniques: Errors in Measurement, Tests of Sound Measurement, Scaling and Scale Construction techniques, Forecasting Techniques, Time Series Analysis, Interpolation and Extrapolation.

UNIT-III: METHODS OF DATA COLLECTION

Primary Data, Questionnaire and Interviews, Collection of Secondary Data, Cases and Schedules. Professional Attitude and Goals, Concept of Research Excellence, Ethics in Science and Engineering, Frauds in Science and Research.

UNIT-IV: CORRELATION AND REGRESSION ANALYSIS

Method of Least Squares, Regression Vs. Correlation, Correlation Vs. Determination, Types of Correlation and Their Specific Applications; Statistical Interference: Tests of Hypothesis, Parametric Vs. Non-Parametric Tests, Procedure for Testing Hypothesis, Use Statistical Techniques for Testing Hypothesis, Sampling Distribution, Sampling T Chi-Square Test, Analysis of Variance and Covariance, Multivariable Analysis

UNIT V: INTERPRETATION OF DATA AND REPORT WRITING

Layout of a Research Paper, Techniques of Interpretation, Making Scientific Presentation at Conferences and Popular Lectures to Semi Technical Audience, Participating in Public Debates on Scientific Issues.

Course outcomes*:*

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

1.Explain the concepts, objectives, and process of research (Understanding).

2. Formulate the research problem and develop a sufficiently coherent research design (Creating).

3. Identify the measuring and scaling procedure used in research (Applying).

4. Use statistical tools for descriptive and inferential analysis (Applying).

5. Outline the key elements of report writing (Remembering).

TEXT BOOKS :

1. Garg, C. K. (2019). Research Methodology: Methods And Techniques (4 ed.). New Delhi: New Age International Publisher.
2. Bhattacharyya, D. K. (2006). Research Methodology (2 ed.). New Delhi: Excel Books.
3. O.R.Krishnaswamy and D.Obul Reddy,(2009),Research Methodology and Statistical Analysis, Himalaya Publication,(2nd Edition)

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20BPE09 SIMULATION OF POWER ELECTRONIC CONTROL AND RES LAB

Course Objectives:

The objectives of this course are to

1. To know PSPICE Coding and Simulate single phase converters with RLE load.
2. To write PSPICE coding and simulate single phase two & three level inverters and Buck – Boost converters.
3. To understand speed control of DC motor using MATLAB SIMULINK.
4. To know the performance of PMSM and induction motor using MATLAB SIMULINK**.**

LIST OF EXPERIMENTS

Any Ten of the following experiments are to be conducted as compulsory experiments

1. PSPICE simulation of single phase Semi & full converter using R-L-E load
2. PSPICE simulation of single phase AC voltage controller using R-L-E load
3. PSPICE simulation of Three phase Semi & Full converter using R-L-E load
4. PSPICE simulation of single phase inverter with Two Level PWM control
5. PSPICE simulation of single phase inverter with Three Level PWM control
6. PSPICE simulation of Buck, Boost & Buck-Boost Converters
7. Simulation of Open Loop Control of PMSM Using MATLAB Simulink
8. Simulation of speed control of separately excited DC Motor using MATLAB Simulink
9. Simulation of induction motor with indirect vector control using MATLAB Simulink
10. Simulation of induction motor with Closed loop constant V/F control using MATLAB Simulink
11. Simulation of Four Quadrant Chopper fed DC motor drive
12. Simulation of Three Phase AC Voltage controller (Matrix Converter)

Course Outcomes:

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

1. Apply PSPICE in Simulation of Single phase semi & full converters, AC voltage and 3 phase semi & full & DC to DC converters.
2. Design the Single phase Two and Three level inverters.
3. Apply PSPICE in Simulation of Buck, Boost and Buck –Boost converters.
4. Design and Simulate DC & AC Drives.

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20BPE10 INTEGRATED D.C DRIVES LAB

Course Objectives:

The objectives of this course are to

1. To determine the performance parameters of half and fully controlled bridges with RL Loads.
2. To conduct experiment on closed loop speed control of PMDC motor.
3. To know the performance of chopper fed DC motor
4. To obtain speed control of four quadrant chopper fed PMDC motor.

LIST OF EXPERIMENTS

Any Ten of the following experiments are to be conducted as compulsory experiments

1. Single phase half wave controlled converter fed DC motor drive with continuous and discontinuous mode
2. Single phase fully controlled converter fed DC motor drive with continuous and discontinuous mode
3. Thyristorised drive for PMDC motor with speed measurement & closed loop control
4. Speed measurement of PMDC motor with closed loop control
5. IGBT using single 4 quadrant chopper drive for PMDC motor with speed measurement and closed loop and control
6. Thyristorised drive for dc motor with closed loop control
7. Three phase input thyristorised drive 3hp dc motor with closed loop control
8. Three phase input IGBT drive for 4 quadrant chopper of 3HP dc motor with closed loop control
9. Operation of 3- phase Full controlled Converter with R-L& R-L-E load
10. Performance & speed control of D.C. drive using 3-phase full Converter
11. Operation of Single Phase Dual Converter with RL Load
12. Operation of Single Phase Full bridge controlled converter with DC Motor Load

Course Outcomes:

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

1. Know the concept of Single phase AC to DC converters.
2. Design speed control of PMDC motor.
3. Design the concept of 4 quadrant chopper and Thyristorised drives.
4. Design and Simulate the operation of 3 phase full converter on R & RL loads.

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20BPE11 RESEARCH PAPER WRITING METHODOLOGY

(AUDIT COURSE I)

Course Objectives:

1. Demonstrate writing meaningful sentences and coherent paragraphs
2. Show conciseness, clarity and avoid redundancy in writing
3. Summarize, evaluate literature, and write methodology, results and conclusion
4. Describe how to develop title, write an abstract and introduction
5. Apply correct style of referencing and use punctuation appropriately

UNIT I:

Planning and preparation, word order & breaking up long sentences, structuring sentences and paragraphs

UNIT II:

Being concise, avoiding redundancy, ambiguity and vagueness, literature survey - highlighting your findings, hedging, paraphrasing and plagiarism

UNIT III:

Sections of a paper – abstract, introduction, etc. review of the literature, writing - methods, results, discussion, conclusions and final check

UNIT IV:

Writing – Title, Abstract and Introduction, Review of Literature and Methods

UNIT V:

Useful phrases and punctuation, in-text citation and bibliography – MLA/APA styles

Course Outcomes:

1. Demonstrate writing coherent paragraphs and sentences
2. Describe the process of literature survey
3. Discuss how to write methodology, discussions, results and conclusion
4. Summarize and evaluate literature
5. Apply correct style(s) of in-text citation and bibliography

TEXT BOOKS :

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht
2. Heidelberg, London, 2018
3. Day R. How to Write and Publish a Scientific Paper, Cambridge University Press, 2019

REFERENCE BOOKS

1. Goldbort R. Writing for Science, Yale University Press, 2006.
2. Highman N. Handbook book, 1998.

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I M. Tech, II Semester (PE & ED)

20BPE12 ANALYSIS OF INVERTERS

Course Objectives:

The objectives of this course are to

1. To study the operation of single phase and three phase inverters and different pulse width modulation techniques for voltage control of inverters.
2. To know various harmonic reduction techniques and principles of operation of current source inverter.
3. To understand the multilevel concept of inverters and types of multilevel inverters and their applications.
4. To know the operation of different types of resonant inverters.

UNIT I

PULSE WIDTH MODULATED INVERTERS (SINGLE PHASE INVERTER): Introduction-Principle of operation – Performance parameters- Single phase half bridge inverter-evaluation of output voltage and current with resistive, inductive and capacitive loads - Voltage control of single phase inverters - Single PWM, Multiple PWM, Sinusoidal PWM, modified PWM-phase displacement control – numerical problems, Advanced Modulation techniques for improved performance, Trapezoidal, staircase, stepped, harmonic injection and delta modulation – Advantages– Applications - numerical problems.

UNIT II

PULSE WIDTH MODULATED INVERTERS (THREE PHASE INVERTER): Three Phase inverters-analysis of 180 degree condition of output voltage and current with resistive, inductive loads-analysis of 120 degree conduction-Voltage control of three phase inverters - sinusoidal PWM, third harmonic PWM, 60 degree PWM, Space vector modulation-Comparison of PWM techniques-Variable dc link inverter –boost inverters- buck and boost inverter – inverter circuit design – Advantages –Applications - numerical problems.

UNIT III

HARMONIC REDUCTION & ANALYSIS AND CURRENT SOURCE INVERTERS: Third harmonic PWM-60-degree PWM- Phase displacement-Bipolar output voltage notches, Uni-polar output voltage notches-Transformer connections-Design of C filter to eliminate harmonics-numerical problems, Current Source inverter – inverter operation modes – load commutated inverters –comparison of current source inverter and voltage source inverters.

UNIT IV

MULTILEVEL INVERTER: Introduction –Types of Multilevel Inverters - Multilevel concept – Diode clamped, Flying capacitor & Cascade –Principle of operation – Features – Reactive power

compensation, Back-to-Back Inverter – adjustable speed driver - Comparison of multilevel Inverters – Applications.

UNIT V

RESONANT INVERTERS: Introduction – Series resonant Inverters with unidirectional and Bidirectional switches – Parallel resonant Inverters – Class E resonant Inverter - Zero current switching – Resonant Converter– Zero voltage switching resonant converter – Two quadrant ZVS resonant converter – Resonant DC link Inverter.

Course Outcomes:

At end the course the student will be able to

1. Design and simulate the single phase and three phase inverters with pulse width modulation techniques for voltage control for speed control of induction motor.
2. Design filters circuit to minimize harmonics and know the principle of operation of current source inverter.
3. Design the various types of multilevel inverters.
4. Apply the concept of various types of resonant inverters.

Text Books:

1. Rashid M.H:“Power Electronics – Circuits, Devices & Applications”, Prentice Hall of India, 3rd Edition, New Delhi, 2005.
2. P.S.Bimbra:"Power Electronics”, Khanna Publishers, Eleventh Edition, 2003
3. M.D. Singh & K.B. Khanchandani:“Power Electronics”, Tata Mc Graw Hill Publishing Company Limited, 2nd Edition, Fourth Print 2009

Reference Books:

1. Mohan .N, Undeland& Robbins:“Power Electronics – Converters, Application & Design”, John Wiley & Sons, Inc,2nd Edition, New york, 2001.
2. P.C Sen:"Modern Power Electronics", Wheeler publishing Co, First Edition, New Delhi-1998.
3. Rashid M.H:“Hand book on Power Electronics”, Academic Press, Imprint ofElesvier, California
4. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Power%20Electronics/New_index1.html

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I M. Tech, II Semester (PE & ED)

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3	0	0	3

20BPE13 EMBEDDED SYSTEM DESIGN

Course Objectives:

The objectives of this course are to

1. To study the 8051 micro controller architecture and addressing modes.
2. To know the assembly instructions and development of embedded system programming.
3. To acquire knowledge about embedded peripherals and interfacing.
4. To know the importance of CISC & RISC controllers and also know the operation of distributed embedded system.

UNIT I

THE 8051 MICROCONTROLLERS ARCHITECTURE: Architecture of 8051 microcontroller - Memory Organization - Addressing Modes - Assembly Language Instructions -Embedded system concepts – Embedded Hardware devices – Introduction to 8051 microcontroller – 8051 Derivatives

UNIT II

EMBEDDED SYSTEM PROGRAMMING: Embedded Software Tools - Assembler - Compiler - Simulator – Debugger – Incircuit Simulator – Integrator Development Environment (IDE) - Introduction to Embedded 'C' Programming - Programming in Embedded Controllers.

UNIT III

EMBEDDED PERIPHERALS & INTERFACING: Embedded Peripherals - General Purpose I/O - Timer - Counter - UART/USART-Interrupts - ADC-DAC – Parallel Port - Peripheral Interfacing with input/output devices - LED-LCD – Keyboard - ADC - DAC.

UNIT IV

RISC EMBEDDED CONTROLLERS: Comparison of CISC and RISC Controllers - Pipelining Architecture - Introduction to PIC Microcontrollers - PIC16F877 Architecture - Memory Organization - Addressing Modes - Assembly Language Instructions – Embedded programming with PIC16F877.

UNIT V

DISTRIBUTED EMBEDDED SYSTEM DESIGN: Distributed Embedded System – Embedded Networking - RS232-RS485 - Inter-Integrated Circuit (I2 C) – Serial Peripheral Interface (SPI) – Universal Serial Bus (USB) - Controller Area Network (CAN) - Embedded Networking using Ethernet devices.

Course Outcomes:

At end the course the student will be able to

1. Apply the concept of 8051 microcontrollers.
2. Know the concept of embedded system programming and peripherals.
3. Design the concept of interfacing, RISC Embedded controllers.
4. Design and control the distributed embedded system and controllers.

Text Books:

1. Kenneth J. Ayala:"The 8051 Microcontroller Architecture Programming &Applications", Thomson Publications.
2. Mahammedali, “8051Microcontrolled based Embedded systems”

References Books:

1. MykePredko, "Programming & Customizing PIC Microcontrollers".
2. ZdravkoKarakehayov "Embedded System Design with 8051 Microcontrollers**".**

Websites:

1. www.raisonance.com
2. www.ccsinfo.com
3. www.micrchip.com
4. www.atmel.com

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20BPE14 POWER ELECTRONIC CONTROL OF AC DRIVES

(PROFESSIONAL ELECTIVE –III)

Course Objectives:

The objectives of this course are to

1. To study motor drives torque, control and its characteristics of AC and DC drives.
2. To design the different types of motor control and slip power recovery drives.
3. To know importance of power factor control and slip –Torque-power recovery systems.
4. To acquire knowledge about constant torque, flux weakening controllers, variable reluctance motor and brushless DC motor drives.

UNIT I

INTRODUCTION TO AC DRIVES: Introduction to motor drives-torque production- Equivalent circuit analysis-Speed-Torque characteristics with variable voltage operation, variable frequency operation, constant v/f operation-Induction motor characteristics in constant torque and field weakening regions

UNIT II

CONTROL OF INDUCTION MOTOR DRIVES: Scalar control-Voltage fed inverter control-Open loop volts/Hz Control-Speed control slip regulation- Speed control with torque and flux control-Current controlled voltage fed inverter drive-Current fed inverter control-Independent current and frequency control-Speed and flux control in current fed inverter drive-Volts/Hertz Control current fed-Inverter drive-Efficiency optimization control by flux program. Slip power recovery drives-Static Kramer Drive-Phasor diagram-Torque expression-Speed control of Kramer Drive-Static Scheribus Drive- Modes of operation

UNITIII

CONTROL OF SYNCHRONOUS MOTOR DRIVES: Synchronous motor and its characteristics – control strategies – constant torque angle control-Unity power factor control-Constant mutual flux linkage control.

UNIT IV

CONTROLLERS: Flux weakening operation- Maximum speed-Direct flux weakening algorithm – Constant torque mode controller- Flux Weakening controller- Indirect flux weakening – Maximum permissible torque-Speed control scheme- Implementation strategy – Speed controller design.

UNIT V

VARIABLE RELUCTANCE MOTOR DRIVE AND BRUSHLESS DC MOTOR DRIVES:

Variable reluctance motor drives- Torque Production in the variable reluctance motor- Drive characteristics and control principles- Current control variable reluctance servo drive. Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor-Current controlled Brushless dc servo drives

Outcomes:

Course Outcomes:

At end the course the student will be able to

1. Apply the concept AC drives and speed torque characteristics.
2. Gain knowledge about slip regulation, speed, flux control and optimization control.
3. Know the concept slip power recovery drives, vector control methods and UPF.
4. Design and simulate the knowledge about brushless DC motor drives and reluctance servo drives.

Text Books:

1. R.Krishnan: Electric Motor Drives Pearson modeling, analysis and control, prentice hall Publication, 1st Edition, 2018.
2. B.K Bose: Modern Power Electronics and AC drives, 1st Edition, Pearson Publication.
3. G. K. Dubey: Power Semiconductors Drives, Narosa Publications, 2015

Reference Books:

1. MD Murphy & FG Turn Bull Pergman Press: Power Electronic Control of AC motors, 1st Edition.
2. M.H Rashid:Power Electronics Circuits, Devices and Application, PHI Publications, 2015.
3. GK Dubey: Fundamentals of Electric Drives, Narora Publications, 2015.
4. B.K.Bose: Power Electronics and Variable Frequency drives, IEEE press-Standard publication, 4th Edition, 2018.

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	3	**0**	**0**	**3**

20BPE15 SWITCHED MODE AND RESONANT CONVERTERS FOR POWER
(PROFESSIONAL ELECTIVE –III)

Course Objectives:

The objectives of this course are to

1. Explain the principles of operation of non converters
2. Illustrate various loss components in a switched mode converter and choice of switching frequency with a view towards design of such converters
3. Describe slope criteria for a stable circuit and describe the transfer functions and design error amplifiers in the feedback loop.
4. Analyze and Calculation of Inductors and Chokes for Buck and Boost Converters.
5. Analyze Resonant Converters and classify them.

UNIT-I: FUNDAMENTALS OF SWITCHING REGULATORS

Buck, Boost, Buck-Boost SMPS Topologies. Basic Operation – Waveforms – modes of operation switching stresses - switching and conduction losses –optimum switching frequency - practical voltage, current and power limits -design relations – voltage mode -control principles. (Abraham I Pressman)

UNIT-II: PUSH-PULL AND FORWARD CONVERTER TOPOLOGIES 10 Lectures

Push-Pull and Forward Converter Topologies Basic operation. Waveforms – Flux imbalance Problem and Solutions - Transformer Design Output filter design – Switching stresses and Losses – Forward Converter Magnetics – Voltage mode control.

Half Bridge & Full Bridge Converters:

Basic operation and waveforms – Magnetics Output Filter Calculations. Blocking Capacitor to avoid Flux Imbalance, Power Limits. Flyback Converter discontinuous mode operation. Waveform. Magnetics Disadvantages – Continuous Mode Operation – Waveforms, control relation (Abraham I Pressman)

UNIT-III: FEEDBACK LOOP STABILIZATION

Mechanism of Loop Oscillations gain criteria for a stable circuit, Gain slop criteria for a stable circuit, Pulse Width Modulator gain, shaping the Error amplifier gain Vs frequency stable circuit, Characteristics. Error amplifier transfer function, poles and zeros, Design example stabilizing a forward converter feedback loop with a type – 2 error amplifier, trans-conductance error amplifier

UNIT-IV: INDUCTORS & CHOKES IN SWITCHED MODE POWER SUPPLIES

Inductors & Chokes in SMPS Design: Simple Inductor, Common mode line filter inductors design example of a common mode line filter inductor (using a ferrite E core and a graphical Design Graphical Design Method). Calculating Inductance (for Common Ferrite E Cores).Series-Mode Line Design Example of Chokes for Buck and Boost converters

UNIT-V: RESONANT CONVERTERS

Introduction to Resonant Converters Classification of resonant converters basic resonant Circuit Concepts - Load Resonant Converter, Resonant Switch Converter and zero voltage – Switching clamped Voltage Topologies - Switching Resonant DC link inverters with zero voltage switching - High Frequency Link Integral Half Cycle Converter.

Course Outcomes:

At end the course the student will be able to

1. Design Transfer Function of Error Amplifier in a feedback loop and Trans-conductance Error Amplifiers
2. Design of Inductors for SMPS and choke for buck and boost converter.
3. Know principles of operation of non converters and switching and conduction losses
4. Illustrate various loss components in a switched mode converter and choice switching frequency with a view towards design of converters

Text books:

1. Abraham I Pressman, "Switching Power Supply Design". McGraw Hill Publishing Company, 2001.
2. Ned Mohan, Tore M Undeland, William P Robbins, "Power Electronics," John Wiley and Sons 2006.
3. Keith H Billings "Handbook of Switched Mode Power Supplies", McGraw Hill Publishing Company, 1989.

Reference books:

1. Daniel M Mitchell, "DCCompany- 1988.
2. OtmarKilgenstein, "Switched Mode Power Supplies in Practice", John Wiley and Sons,1994.
3. Mark J Nave, "Power Line Filter Design for Switched Nostrand Reinhold, New York, 1991.

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20BPE16 INTEGRATED DESIGN AND ANALYSIS OF ELECTRICAL MACHIENES
(PROFESSIONAL ELECTIVE –III)

Course Objectives:

The objectives of this course are to

1. Understand the importance of computer aided design method and basic concepts of design.
2. Analyzing the basic design concepts of Induction motor.
3. Evaluate the performance of Brushless DC Motors and Permanents Magnet Synchronous Motors.
4. Analyze the performance of Switched Reluctance Motor (SRM)
5. Applying the Finite Element Method applications for designing the electrical machines.

UNIT-I: BASIC CONCEPTS OF DESIGN

Computer-Aided Design and Explanation about the details of flow chart, Specification, Electrical Materials, General Procedure for Calculation of Magnetic circuits , Heating and Cooling, Standard Ratings of Electrical Machines, Ventilation schemes, general design Procedure, Steps to Get Optimal Design.

UNIT-II: INDUCTION MOTOR DESIGN SPECIFICATIONS

Introduction, design factors, design features, typical load shaft torque/speed envelopes. Induction Motor design and constant Voltage and frequency, design specifications by example, algorithm. Design for variable speed, optimization design.

UNIT-III: BRUSHLESS DC MOTORS & PERMANENT MAGNET SYNCHRONOUS MOTORS:

Constructional features, Principle of operation, commutation in DC motor difference between mechanical and electronic Commutators, Types of BLDC motors, Torque - Speed characteristics, Microprocessor based - DSP based speed control BLDC. Comparisons of conventional and PM synchronous motor, construction details, principles of operation, Torque speed characteristics, Transfer function of PMSM, Microprocessor based, DSP based control of PMSM, Basic design approaches.

UNIT-IV: SWITCHED RELUCTANCE MOTOR (SRM) 1

Constructional features, Principle of operation. Torque equation, Characteristics, Power converter circuit for SRM, Control schemes for SRM, rotor positions sensor, current regulators, speed control of SRM drive, Basic design approaches for Switched Reluctance Motor.

UNIT-V: APPLICATION OF FINITE ELEMENT METHOD IN DESIGN

Introduction; Basics of Finite element, Shape functions, Single element computation. Assembly of elemental coefficient matrix, Global coefficient matrix, Application of FEM for design problems. Use of open source FEM software for 2D design of small transformers and choke coils.

Course Outcomes:

1. Understanding the Constructional features and Principle of operation for SRM.
2. Analyze the different control schemes for SRM.
3. Develop the Basic design approaches for Switched Reluctance Motor.
4. Understanding the basics design concepts of Induction Motor.

Text books:

1. K M Vishnu Murthy, Computer aided design of electrical machines First edition 2008.
2. K.Venkataratnam, Special Electrical Machines Limited, Hyderabad, First

Reference Books

1. Maurya, Jallan, Shukla, publication, First edition, reprinted in 2014.
2. Boldea I., Nasar S.A., The Induction Machines Design Handbook, CRC Press, Taylor & Francis Group, 2010.
3. E.G. Janardanan, Special Electrical Machines Edition reprinted in 2014.
4. R.S. Krishnan, Switched Reluctance Motor Drives: Modeling Simulation Analysis, Design and Application, CRC press 200
5. TJE Miller. Electronic Control of Switched Reluctance Machines Electronics and Electric Drives Laboratory, University of Glasgow, First Edition reprinted on 2001.

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I M.Tech, II Semester

L	T	P	C
3	0	0	3

20BPE17 POWER ELECTRONICS APPLICATIONS IN POWER SYSTEMS
(PROFESSIONAL ELECTIVE –IV)

Course Objectives:

The objectives of this course are to

1. To acquire requisite knowledge on basic concepts of voltage regulation and power factor correction and stability aspects of Transmission lines.
2. To understand the different methods of employing commutation.
3. To analyze harmonic control, power factor improvement in different types of converters and to know working principles of various voltage regulators.
4. To gain adequate knowledge on switched mode power supply and to analyze HVDC converters and its control characteristics**.**

UNIT I

LOAD COMPENSATION IN POWER SYSTEMS AND UNCOMPENSATED TRANSMISSION LINES: Introduction – Voltage Regulation – Power Factor Correction – Phase Balancing and power Factor Correction of Unsymmetrical Loads - Uncompensated electrical parameters-Transmission line equation-Solution of transmission line wave equation-Surge impedance and natural loading – Uncompensated on open circuit - voltage and current profile-Uncompensated under load conditions-Maximum and stability consideration-effect of generator reactance**.**

UNIT II

STATIC COMPENSATION CONTROL AND COMMUTATION METHODS FOR CONTROLLED CONVERTERS: Shunt – Series Compensation, Compensation by Sectioning – Property of Static Compensation – Thyristor Controlled Reactor (TCR) – Thyristor Switched Capacitor – Saturated Reactor Compensators -Methods of employing natural commutation – Methods of employing forced commutation and implementation of forced commutation.

UNIT III

HARMONICS CONTROL & POWER FACTOR IMPROVEMENT AND VOLTAGE REGULATORS: Reactive Power Variation for Fully Controlled Converter – Half Controlled Converter – Fully Controlled Converter with controlled freewheeling -Introduction to voltage regulators – Manually Controlled voltage regulator (Conventional methods) - Static tap changer using Thyristors– Different control schemes.

UNIT IV

SWITCH MODE POWER SUPLLY (SMPS): Introduction to Switch Mode Power Supply (SMPS) – Switched mode DC power supply – Fly back converter- Forward converter-Push pull Converter-Resonant DC power supply- Switched mode AC Power supply-Resonant AC Power supply-Bidirectional power Supply.

UNIT V

HIGH VOLTAGE DC TRANSMISSION:

Analysis of HVDC Converters: Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuit – Converter bridge characteristics.

Converted and HVDC system control: Principles of DC link control – Converter control characteristics – System control hierarchy – firing control – current and extinction angle control – starting and stopping of DC link power control.

Course Outcomes:

At end the course the student will be able to

1. Analyze the Transmission lines with Unsymmetrical loads with and without compensation.
2. Apply the compensation techniques in the analysis of transmission lines.
3. Analyze the harmonics in different types of Converters.
4. Design the Switched mode power supplies and Thyristor Converters used in HVDC Transmission.

Text Books:

1. Miller.T.J.E:"Reactive Power Control in Electric Systems", Wiley-Inter science, New York, 1982.
2. G.K.Dubey:"Thyristorised power controllers", New Age International Publishers, 1st Edition.
3. K.R.Padiyar: HVDC power transmission systems – Technology & system interaction, Published by WE limited, 1990.

References Books:

1.P.C.Sen:"Power Electronics", Tata Mc Graw Hill, 2008.

2.M.H.Rashid: "Power Electronics: Circuits, Devices and Applications", Pearson Education India, 3rd Edition.

3.Dr.P.S.Bimbhra:"Power Electronics", Khanna Publishers, 3rd Edition, 2003.

4. Dr. S. N. Singh, "High Voltage DC Transmission", National Programme on Technology Enhanced Learning (NPTEL) Web Course Series.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I M. Tech, II Semester (PE & ED)

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3	0	0	3

20BPE18 ADVANCED POWER SYSTEM OPERATION AND CONTROL

(PROFESSIONAL ELECTIVE –IV)

Course Objectives:

The objectives of this course are to

1. To Study economic dispatch, Unit commitment solution and hydrothermal scheduling problem by various methods.
2. To understand the load frequency control and economic dispatch control with different control techniques.
3. To know the concept of Economic interchange between interconnected utilities, power pools and power flow methods.
4. To understand the reactive power control, methods of voltage control and computer control of power systems.

UNIT I

ECONOMIC OPERATION & UNIT COMMITMENT PROBLEM IN POWER SYSTEMS: Concept of Economic operation- Load forecasting - Unit commitment – Economic dispatch problem of thermal units – Gradient method- Newton's method –Introduction to UCP, constraints in Unit commitment - unit commitment problem solution by priority list scheme method and Dynamic programming Approach. Advantages of DP method over priority list scheme, forward DP approach and their flow charts solution UCP using Dynamic program method.

UNIT II

LOAD FREQUENCY CONTROL& PROPORTIONAL PLUS INTEGRAL CONTROL: Necessity of keeping frequency constant. Definition of control area, single area control, Block diagram representation of an isolated power system, steady state analysis, and Dynamic response-Uncontrolled case. Load frequency control of 2-area system: uncontrolled case and controlled case. Tie-line bias control. Proportional plus integral control of single area and its block diagram representation, steady state response, load frequency control, Economic dispatch control, optimal LF control- steady state representation, performance index and optimal parameter adjustment.

UNIT III

INTERCHANGE OF POWER BETWEEN INTER CONNECTED SYSTEM & POWER SYSTEM SECURITY & CONTINGENCY ANALYSIS: Interchange of Power & Energy: Economic interchange between interconnected utilities – Inter utility energy evaluation – Power pools – Transmission effects and issues: Limitations – Wheeling-Power system security-Contingency analysis – linear sensitivity factors – AC power flow methods – contingency selection – concentric relaxation – bounding-security constrained optimal power flow-Interior point algorithm-Bus incremental costs.

UNIT IV

REACTIVE POWER – VOLTAGE CONTROL: Reactive power control, excitation systems – modelling, static and dynamic analysis, stability compensation, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, method of voltage control, tap changing transformers, tap setting of OLTC transformer and MVAR injection of switched capacitors.

UNIT V

COMPUTER CONTROL OF POWER SYSTEMS: Need of computer control of power systems, concept of energy control center (or) load dispatch center and the functions, system monitoring, data acquisition and control, system hardware configuration, SCADA and EMS functions, network topology, state estimation, security analysis and control, operating states.

Course Outcomes:

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

1. Apply the concepts of economic dispatch and solve unit commitment problems with various constraints using conventional optimization techniques.
2. Able to Solve AGC problems using heuristic techniques.
3. Able to know the interchange of power & energy, power pools and power flow methods.
4. Analyze reactive power control, methods of voltage control and computer control of power systems.

Text Books:

1. O.I. Elgerd:"Electric Energy System Theory - an Introduction", Tata McGraw Hill, New Delhi, 2002.
2. AllenJ .Wood and Bruce.F. Wollenberg: "Power Generation Operation and Control', John Wiley & Sons, New York, 1996.
3. A.K.Mahalanabis, D.P.Kothari and S.I.Ahson:"Computer Aided Power System Analysis and Control",Tata McGraw Hill publishing Ltd, 1984.

References Books:

1. P.Kundur:"Power System Stability and Control", EPRI Publications, California 1994.
2. Nagrath, I.J. and Kothari D.P: 'Modern Power System Analysis', TMH, New Delhi, 1980.
3. D.P.Kothari&J.S.Dhillon: Power System Optimization, PHI,2004.

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I M. Tech, II Semester (PE & ED)

L	T	P	C
3	0	0	3

20BPE19 SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

(PROFESSIONAL ELECTIVE –IV)

Course Objectives:

The objectives of this course are to

1. Acquire knowledge about linear and non linear models
2. Understand the non parametric and parametric identification for linear and non linear systems.
3. Study non linear identification using neural network and fuzzy logic systems.
4. Know the operation of Auto tuning, self tuning regulators and adaptive control with different types of applications like heat exchanger. Ship steering control and etc.

Course Outcomes:

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

1. Gain the knowledge about design of linear and non linear models.
2. Analyze the non parametric and parametric identification with different instrumental systems.
3. Acquire the knowledge about Wiener models
4. Emphasize the adaptive control and different tuning models with applications

UNIT I

MODELS FOR INDENTIFICATION: Models of LTI systems: Linear Models-State space Models-OE model- Model sets, Structures and Identifiability-Models with Nonlinearities – Non-linear state-space models-Black box models, Fuzzy models'.

UNIT II

NON-PARAMETRIC AND PARAMETRIC IDENTIFICATON: Transient response and Correlation Analysis – Frequency response analysis – Spectral Analysis – Least Square – Recursive Least Square –Forgetting factor- Maximum Likelihood – Instrumental Variable methods. Open and closed loop identification: Approaches – Direct and indirect identification – Joint input-output identification – Non-linear system identification

UNIT III

WIENER MODELS: Power series expansions - State estimation techniques – Non linear identification using Neural Network and Fuzzy Logic.

UNIT IV

ADAPTIVE COTROL AND ADAPTATION TECHNIQUES: Introduction – Uses – Auto tuning – Self Tuning Regulators (STR) – Model Reference Adaptive Control (MRAC) – Types of STR and MRAC

UNIT V

DIFFERENT APPROACHES TO SELF TUNING REGULATORS: Different Approaches to Self Tuning Regulators-Stochastic Adaptive control – Gain Scheduling -Inverted Pendulum, Robot arm, process control application: heat exchanger, Distillation column, application to power system, Ship steering control.

Text Books:

1. Ljung,"System Identification Theory for the User", PHI, 2019
2. TorstenSoderstrom, PetreStoica:"System Identification", prentice Hall ` International (UK) Ltd,2019.

Reference Books:

1. Astrom and Wittenmark:"Adaptive Control", PHI
2. William S. Levine: "Control Hand Book".

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	L	T	P	C
I M. Tech, II Semester (PE & ED)	**0**	**0**	**4**	**2**

20BPE20 MINI PROJECT

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I M.Tech, II Semester (PE & ED)	**L**	**T**	**P**	**C**
	0	**0**	**4**	**2**

20BPE21 INTEGRATED A.C. DRIVES LAB

Course Objectives:

The objectives of this course are to

1. To know performance of three phase induction motor using AC voltage controllers and cycloconverters.
2. To understand operation of three phase IGBT based PWM inverter with R & RL load.
3. To acquire knowledge on use of PIC Microcontrollers for generation of pulses.
4. To understand the fundamentals of DSP and its use in motor control circuits.

LIST OF EXPERIMENTS

Any Ten of the following experiments are to be conducted as compulsory experiments

1. Performance & speed control of 3 phase slip ring Induction motor by Static Rotor Resistance controller
2. Single phase cyclo converter based ac induction motor controller
3. Performance & Operation of a 3-phase A.C. Voltage controller on motor load.
4. Single phase half wave controlled AC voltage controller with resistive-inductive load
5. Single phase fully controlled AC voltage controller with resistive-inductive load
6. Single Phase IGBT based PWM Inverter on R & R-L load
7. Operation of 3-phase IGBT based PWM Inverter on R & R-L load
8. Three phase PWM Pulse generation using PIC Micro controller
9. PIC Microcontroller based speed control of three phase Induction Motor
10. DSP based V/F Control of 3 phase Induction motor

11. Simulation of three phase cycloconverter based three phase induction motor drive
12. Simulation of GTO based PWM inverter with RLE load

Course Outcomes:

At end the course the student will be able to

1. Analyze the speed control of 3 phase slip ring induction motor.
2. Design the IGBT based PWM inverter with RL load.
3. Know the concept of PIC microcontroller based speed control of three phase induction motor.
4. Gain the knowledge about operation of 3 phase PWM inverters, cycloconverter and AC voltage controllers

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0	0	4	2

20BPE22 EMBEDDED SYSTEMS LAB

Course Objectives:

The objectives of this course are to

1. To understand the fundamentals of 8051 and its use in conducting experiments motor control circuit.
2. To know the arithmetic operation and addressing modes.
3. To obtain speed control of DC motor using ALS89C51ED2.
4. To understand the interfacing of electro mechanic relay, stepper motor and elevator**.**

LIST OF EXPERIMENTS

Any Ten of the following experiments are to be conducted as compulsory experiments

1. a. Arithmetic operations manipulation for 8051

   b. Arithmetic operations with the stack for 8051.

2. a. Direct Bank Addressing.

   b. Indirect Addressing.

3. Accessing Scratchpad RAM.
4. Creating Variable Arrays.
5. Speed Control of DC Motor using ALS89C51ED2.
6. Interfacing of Button and LED to ALS89C51ED2.
7. Interfacing of an Electro Mechanical Relay.
8. Interfacing of Stepper Motor to ALS89C51ED2
9. Study on PWM generation using Timer 1, 2, 3 using ALS89C51ED2.
10. Interfacing of Keyboard and Elevator using ALS89C51ED2
11. Stack of LED 7 Segment and LCD Display
12. Interfacing of RS232 and RS485

Course Outcomes:

At end the course the student will be able to

1. Know the concept of Arithmetic operations manipulation for 8051
2. Design the stack, direct and indirect addressing
3. Know the concept of Interfacing of LED, Electro Mechanical relay and stepper motor to 89C51
4. Gain the knowledge about PWM generation using Timer 1,2,3

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	L	T	P	C
I M. Tech, II Semester (PE & ED)	**2**	**0**	**0**	**0**

20BPE23 INDIAN CONSTITUTION

(AUDIT COURSE II)

Course Objectives:

The objectives of this course are to

1. Describe historical background of the constitution making and its importance for building democratic India.
2. Explain the functioning of three wings of the government ie., executive, legislative and judiciary.
3. Explain the value of the fundamental rights and duties for becoming good citizens of India.
4. Analyse the decentralisation of power between central, state and local self-government.
5. Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

UNIT-I

Introduction to Indian Constitution: Constitution' meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre-State relationship, President: Role, power and position, PM and Council of Ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and Powers and Functions;

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions the High Court:

UNIT-IV

Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation Pachayati Raj: Functions PRI: Zilla Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass-root democracy

UNIT-V

Election Commission: Role of Chief Election Commissioner and Election Commission; State Election Commission: Functions of Commissions for the welfare of SC/ST/OBC and women

Course Outcomes:

1. Contrast and compare the role of Chief Election commissioner and Commissioner
2. Describe the structure of state government
3. Differentiate between the state and central government
4. Apply the knowledge on directive principle of state policy

Text Books:

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

Reference Books:

1. H.M. Sreevai, Constitutional Law of India, 4th edition in 3 volumes Publication)
2. J.C. Johari, Indian Government andPolitics Hans
3. J. Raj IndianGovernment and Politics

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

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II M. Tech, III Semester (PE & ED)

L	T	P	C
3	0	0	3

20BPE24 POWER ELECTRONICS FOR RENEWABLE ENERGY SOURCES (PROFESSIONAL ELECTIVE –V)

Course Objectives:

The objectives of this course are to

1. To provide knowledge about environmental impact of renewable energy resources.
2. To analyze and comprehend the various operating modes of wind electrical generators and solar energy systems.
3. To design different power converters namely AC to DC, DC to DC and AC to AC Converters for renewable energy systems.
4. To provide knowledge about the stand alone, grid connected and develops maximum Power point tracking Algorithms for renewable energy systems

UNIT I

INTRODUCTION AND QUALITATIVE STUDY OF DIFFERENT RENEWABLE ENERGY RESOURCES: Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission), Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II

ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION: Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III

POWER CONVERTERS AND THREE PHASE AC VOLTAGE CONTROLLERS: Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, and array sizing Wind, AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV

ANALYSIS OF WIND AND PV SYSTEMS AND GRID CONNECTION ISSUES: Stand alone operation of fixed and variable speed wind energy conversion systems and solar system, Grid integrated PMSG and SCIG Based WECS Grid Integrated solar system

UNIT V

HYBRID RENEWABLE ENERGY SYSTEMS: Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

Course Outcomes:

At end the course the student will be able to

1. Analyze the impacts of renewable energy generation on environment.
2. Know the importance and qualitative analysis of different renewable energy Sources.
3. Apply the principle of operation of electrical machines for renewable energy conversion and their performance characteristics.
4. Design the solar photo voltaic systems and power converters for Inversion mode and boost mode in PV system.

Text Books:

1. Rashid .M. H:"power electronics Hand book", Academic press, 2018.
2. Rai. G.D:"Non conventional energy sources", Khanna publishes, 2019.
3. Ewald F.Fuchs, Mohammad A.S. Masoum: power conversion of Renewable Energy Systems, Springer, 2018.

Reference Books:

1. Rai. G.D:"Solar energy utilization", Khanna publishes, 2019.
2. Gray, L. Johnson:"Wind energy system", prentice hall linc, 2020.
3. B.H.Khan: "Non-conventional Energy sources", Tata McGraw-hill PublishingCompany, New Delhi**.**
4. **http://freevideolectures.com/Course/2352/Power-System-Generation-Transmission-and-Distribution/6**

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3	0	0	3

20BPE25 ELECTRIC AND HYBRID VEHICLES

(PROFESSIONAL ELECTIVE –V)

Course Objectives:

The objectives of this course are to

1. Analyze the components of an EV and identify the importance of EVs in recent issues related to air pollution and Electric mobility policies in india coupled with energy costs.
2. Differentiate the characteristics of series and parallel HEV.
3. Analyze the characteristics of various electric motor drive systems for HEVs and identify a suitable motor drive system for HEVs.
4. Analyze the characteristics of various energy storage systems and identify a energy storage system for a Hybrid Electric Vehicle.

UNIT-I: EV SYSTEM

Components of EV systems. History of EVs and HEVs (Recent EVs and HEVs). EV advantages: Efficiency comparison, Pollution comparison, Capital and operating cost comparison. Configuration of EVs, Performance of Electric Vehicles: Traction motor characteristics, Tractive effort and transmission requirement, Vehicle performance; Tractive effort during normal driving.

UNIT-II: HYBRID ELECTRIC VEHICLES

Types of Hybrids: Series and Parallel HEVs, Advantages and disadvantages. Design of an HEV: Hybrid drive train, sizing of components: Rated vehicle velocity, initial acceleration, Maximum velocity, Maximum grade ability

UNIT-III: ELECTRIC VEHICLE MODELING

Introduction, Tractive Effort: Introduction, Rolling Resistance force Aerodynamic Drag,Hill-climbing Force, Acceleration Force, Total Tractive Effort ; Modeling Vehicle Acceleration: Acceleration performance parameters, Modeling the acceleration of an electric scooter, Modeling the acceleration of a small car; M Driving cycles, Range modeling of battery EV, constant velocity range modeling of battery EV, Constant velocity range modeling .

UNIT-IV: ELECTRIC PROPULSION SYSTEMS: INTRODUCTION TO ELECTRIC COMPONENTS USED IN ELECTRIC VEHICLES:

Configuration and control of Induction Motor drives – Configuration and control of Permanent Magnet Motor drives – Configuration and control of switched reluctance motor drives.

UNIT-V: ENERGY STORAGE

Introduction to Energy Storage Requirements in Electric Vehicles- Battery based energy storage and its analysis - Fuel Cell based energy storage and its analysis – Super capacitor based energy storage and its analysis – Flywheel based energy storage and analysis -Hybridization of different energy storages.

Course Outcomes:

At end the course the student will be able to

1. Analyze the configuration and characteristics of DC motor Drives.
2. Analyze the configuration and characteristics of Induction motor and the configuration and characteristics of switched reluctance motor Drives.
3. Distinguish between series and parallel HEVs and Compare the performance characteristics of EVs with conventional vehicles.
4. Analyze the characteristics of battery based energy storage systems for an HEV.

Text books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2018.
2. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design 2017.

References Books:

1. James Larminie, John Lowry,

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L	T	P	C
3	0	0	3

20BPE26 INTELLIGENT CONTROL OF ELECTRICAL DRIVES

(PROFESSIONAL ELECTIVE –V)

Course Objectives:

The objectives of this course are to

1. To develop the BNN and ANN models
2. To know the concept of genetic algorithms using MATLAB
3. To study the operation and reasoning of fuzzy logic system
4. To develop the fuzzy logic controllers for DC and AC electrical drives

UNIT I

INTRODUCTION: Approaches to intelligent control - Architecture for intelligent control - Symbolic reasoning system – rule based systems - AI approach - Knowledge representation - Expert systems.

UNIT II

ARTIFICIAL NEURAL NETWORKS: Concept of Artificial Neural Networks and its basic mathematical model – McCulloch Pitts neuron model - simple perceptron - Adaline and Madaline - Feed-forward Multilayer Perceptron - Learning and Training the neural network - Principal - Component analysis and wavelet transformations - Design of logic using all algorithms - Neural Network based controller with any application.

UNIT III

GENETIC ALGORITHM: Concept of Genetic algorithm and detail algorithmic steps - Genetic operators - Solution of typical control problems using genetic algorithm-Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems -Case studies: Speed control of Induction motor using MATLAB - Neural Network toolbox - simple feed-forward network programs.

UNIT IV

FUZZY LOGIC SYSTEM: Introduction to crisp sets and fuzzy sets - basic fuzzy set operation and approximate reasoning - Introduction to fuzzy logic modeling and control – Fuzzification – inferencing Defuzzification - Fuzzy knowledge and rule bases - Fuzzy modeling and control schemes for nonlinear systems - Self-organizing fuzzy logic control - Implementation of fuzzy logic controller using MATLAB fuzzy-logic toolbox -Stability analysis of fuzzy control systems.

UNIT V

FUZZY LOGIC & NEURAL NETWORK APPLICATIONS TO DRIVES:

Fuzzy logic applications: Design of Fuzzy PI controller for speed control of DC motor-Flux programming efficiency improvement of three phase induction motor-Induction motor speed control-Slip gain tuning of indirect vector control of induction motor-stator resistance estimation.

Neural network applications: PWM Controller-Selected harmonic elimination PWM-Space vector PWM-Vector controlled drive-feedback signal estimation-speed estimation and flux estimation of induction motor.

Course Outcomes:

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

1. Apply the concept of about ANN and BNN models
2. Design the genetic algorithms using MATLAB.
3. Emphasize the fuzzy logic system and fuzzy logic control electrical drives.
4. Estimate the harmonics in PWM control, space vector PWM and speed and flux estimation of induction motor.

Text Books:

1. S.N.Sivanandam, S.Sumathi and S.N.Deepa:"Introduction to Neural Networks using MATLAB 6.0", Mc Graw Hill Publishing companies Limited, 3rd Edition 2018.
2. Lawrence V.Fansett:"Fundamentals of Neural Networks: Architectures, Algorithums & Applications", Prentice Hall, 2017
3. S.N.Sivanandam & S.N.Deepa:"Introduction to genetic Algorithams",Spinger Publications 2007.

Reference Books:

1. SimopnS.Haykin:"Neural Networks: A Comprehensive Foundation", Macmillan,2008.
2. S.Rajasekaran, G.A.VijayalakashmiPai:"Neural Networks, Fuzzy Logic & GeneticAlgorithams: Synthesis & Applications", PHI, 3rd Edition 2014.
3. John Yen and Reza Langari:Fuzzy logic Intelligence, Control, and Information,Pearson Education, Indian Edition, 2010.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II M. Tech, III Semester (PE & ED)

L	T	P	C
3	0	0	3

20BPE27 ELECTRICAL DISTRIBUTION AND AUTOMATION

(PROFESSIONAL ELECTIVE –VI)

Course Objectives:

The objectives of this course are to

1. To understand the overall distribution network systems and system analysis.
2. To acquire knowledge about distribution transformer and substation.
3. To acquire knowledge about protective devices and various faults.
4. To acquire knowledge about capacitive compensation for power factor control.

UNIT I

GENERAL: Introduction to Distribution systems, an overview of the role of computers in distribution system planning-Load modeling and characteristics: definition of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor-Relationship between the load factor and loss factor - Classification of loads (Residential, Commercial, Agricultural and Industrial) and their characteristics.

UNIT II

DISTRIBUTION FEEDERS AND SUBSTATIONS: Design consideration of Distribution feeders: Radial and loop types of primary feeders, voltage levels, feeder loading -Design practice of the secondary distribution system.

SUBSTATIONS: Location - Rating of a Distribution Substation, service area with primary feeders. Benefits derived through optimal location of substations.

UNIT III:

SYSTEM ANALYSIS: Voltage drop and power loss calculations: Derivation for volt-drop and power loss in lines, manual methods of solution for radial networks, three-phase balanced primary lines, non-three-phase primary lines.

UNIT IV

PROTECTIVE DEVICES AND COORDINATION: Objectives of distribution system protection, types of common faults and procedure for fault calculation - Principle of operation of fuses, circuit reclosers, line sectionalizer and circuit breakers - Coordination of protective devices: General coordination procedure.

UNIT V

CAPACITIVE COMPENSATION FOR POWER FACTOR CONTROL: Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched) power factor correction, capacitor location. Economic justification. Procedure to determine the best capacitor location.

VOLTAGE CONTROL: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation.

Course Outcomes:

At end the course the student will be able to

1. Design the necessary accessories for distribution network.
2. Design the overview of distribution transformers and substations.
3. Design the concept of capacitive compensation for power factor control and its application.
4. Know the concept of protective devices, types of common faults and its protection.

Text Books:

1. TuranGonen:"Electric Power Distribution System Engineering", Mc. Graw-Hill Book Company,2012

References Books:

1. A.S.Pabla: Electric Power Distribution, Tata Mc Graw-Hill Publishing Company, 8th Edition, 2013

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY

(AUTONOMOUS)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II M. Tech, III Semester (PE & ED)

L	T	P	C
3	0	0	3

20BPE28 DISTRIBUTED GENERATION AND MICRO- GRIDS
(PROFESSIONAL ELECTIVE –VI)

Course Objectives:

The objectives of this course are to

1. Understand the current scenario of Distributed Generation and the need to implement DG Sources.
2. Investigate the different types of interfaces for Grid integration of DGs.
3. Understand the Battery management system and its performance characteristics.
4. Associate different types of micro
5. Analyze control methods and stability systems in DC Micro

UNIT-I : INTRODUCTION TO DISTRIBUTED GENERATION

Introduction - Distributed Vs Central station Generation system traditional Power systems – T & D system costs-power from Grid as a target for DG – DG Planning and comparison; Types of DG planning methods- comparison of various types DG systems

UNIT-II: TYPES OF DG's

Renewable resource Distributed Generators – Solar thermal power generation - wind power generation - Fuel Cell powered DG –Gas turbine powered DG – Grid interconnection options – Types of grid interconnections.

UNIT-III: ENERGY STORAGE

Introduction-Energy Storage Systems – Battery storage – super conducting magnetic energy storage (SMES) - Capacitor storage – Mechanical storage – comparison energy storage technologies

UNIT-IV: MICRO-GRIDS-I

Introduction to micro-grids – Types of micro grids – Autonomous non autonomous grids – Sizing of micro-grids – AC & DC Micro Grids - Comparison micro-grids and interfacing with power electronics interfacing units DG micro grid topologies.

UNIT-V: MICRO-GRIDS-II

DC Power source components, application of DC Micro-grids – DC micro grids operations, Some Standards related with DC Power Circuit – control methods in DC Micro grid – linear and nonlinear Stability system in DC Micro grid.

Course Outcomes:

At end the course the student will be able to

1. Summarize different types of Micro and AC & DC Micro grids
2. Interface Micro-Grid with power electronic units &Non-conventional Distributed generators
3. Differentiate Distributed and Traditional central station power generation of DGs (L2)

Text books:

1. H. Lee Willis, Walter G. Scott, *Evaluation*, Marcel Decker Press.(unit
2. Robert Lasseter, Paolo Piagi, Micro 2014.

References Books

1. F. Katiraei, M.R. Iravani, "Transients of a Micro Distributed Energy Resources" International Conference on Power Systems Transients (IPST-05) in Montreal, Canada on June 19
2. Z.Ye R. Walling, N.Miller, P.Du.K.Nelson,"FacilityMicrogrids, General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2015.

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L	T	P	C
3	0	0	3

20BPE29 ADVANCED DIGITAL SIGNAL PROCESSING

(PROFESSIONAL ELECTIVE –VI)

Course Objectives:

The objectives of this course are to

1. Describe the time domain and frequency domain representations and illustrate discrete time signals and systems.
2. Demonstrate the realization of different structures of IIR and FIR Filters.
3. Design different IIR and FIR filters digital filters and compare.
4. Explain about the finite word length effects in implementation of digital filters.
5. Analyze power spectrum of stationary random signals and describe DSP processor.

UNIT-I: FUNDAMENTALS OF DISCRETE

Discrete time signals, Linear shift invariant systems, Stability and causality, Sampling of continuous time signals, Discrete Fourier transform, linear convolution using DFT, Z transform-Properties.

UNIT-II: DIGITAL FILTER STRUCTURES 10 Lectures

Block diagram representation, Basic IIR digital filter Structures, IIR tapped cascaded Lattice Structure Basic FIR digital Filter Structures, FIR cascaded Lattice Structures, Computational complexity of digital filter structures.

UNIT-III: DIGITAL FILTER DESIGN 10 Lectures

IIR DIGITAL FILTER DESIGN: Preliminary Considerations – bilinear Transformations Method of IIR filter design-design of Low pass, high pass, Band pass, and Band stop

FIR DIGITAL FILTER DESIGN: FIR filter design – based on windowed Fourier series Computer aided design of Equi ripple Linear Phase FIR filters, Comparison of IIR and FIR digital filters.

UNIT-IV: DSP ALGORITHM AND FINITE WORD LENGTH EFFECTS:

Number representation, Arithmetic Operations, The Quantization process and errors Quantization of fixed -point and floating Quantization effects – A/D conversion noise, Analysis of Arithmetic Round Dynamic range scaling, -Limit cycles in IIR digital filters.

UNIT-V: POWER SPECTRUM ESTIMATION & DSP PROCESSOR

Power spectrum estimation- Spectral analysis of deterministic signals. Estimation of power spectrum of stationary random signals Period program-The Blackman - Tukey Method. **Applications:** Introduction, Application of TMS 320 LF 2812 DSP processor, digital I/O to suit control requirements of power converters, generation of basic PWM signals, Implementation of sine triangle PWM scheme.

Course Outcomes:

At end the course the student will be able to

1. Discuss the arithmetic operations and quantization process.
2. Describe the analog to digital conversion process and Explain Limit cycles in IIR digital filters. (L2)
3. Discuss the basic discrete time signals and systems and Summarize Computational complexity of digital filter structures

Text books :

1. Sanjit K. Mitra ,Digital signal processing TMH, 2017 (UNITS – I, II, III, IV)
2. Dimitris G .Manolakis, Vinay Adaptive Signal Processing

Reference Books:

1. Sen M Kuo and Bob H Lee, Sons, 2010. Lourens R. Rabinar& Bernard Golbal Processing, 4th Edition, TMH, 2013
2. John G. Proakis, Digital Signal Processing principles, algorithms and Applications 5th Edn. PHI, 2015.
3. Dimitris G. Manolakis, Vinay K Ingle, Practice, Cambridge University Press, 2016.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

	L	T	P	C
II M. Tech, III Semester (PE & ED)	**0**	**0**	**20**	**10**

20BPE30 DISSERTATION PHASE – I

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	L	T	P	C
II M. Tech, IV Semester (PE & ED)	**0**	**0**	**32**	**16**

20BPE31 DISSERTATION PHASE – II