


ACADEMIC YEAR (2022-2023)						
		J.K.K.MUNIRAJAH COLLEGE OF TECHNOLOGY T.N.Palayam(po),Gobi(tk)-638506, Erode(dt).				Metric No 1.3.2
S.No	Name of the course	course code	programme offering	project work	internship	Number of students
<b>(2022-2023) Regulation-2021</b>						
1	Project Work Phase I	PX5311	POWER ELECTRONICS & DRIVES	✓		2
2	Project Work Phase II	PX5411	POWER ELECTRONICS & DRIVES	✓		
3	Power Semiconductor Devices	PX5101	POWER ELECTRONICS & DRIVES	✓		
4	Solar and Energy Conservation Systems	PS5092	POWER ELECTRONICS & DRIVES	✓		
5	Wind Energy Conservation Systems	PX5071	POWER ELECTRONICS & DRIVES	✓		
6	Solid State Drives	PX5202	POWER ELECTRONICS & DRIVES	✓		
7	Power Electronics for Renewable Energy Systems	PX5072	POWER ELECTRONICS & DRIVES	✓		

  
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PX5101

**POWER SEMICONDUCTOR DEVICES**

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**OBJECTIVES:**

- To improve power semiconductor device structures for adjustable speed motor control applications.
- To understand the static and dynamic characteristics of current controlled power semiconductor devices
- To understand the static and dynamic characteristics of voltage controlled power semiconductor devices
- To enable the students for the selection of devices for different power electronics applications
- To understand the control and firing circuit for different devices.

**UNIT I INTRODUCTION 9**

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

**UNIT II CURRENT CONTROLLED DEVICES 9**

BJT's – Construction, static characteristics, switching characteristics; Negative temperature coefficient and second breakdown; - Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT & Thyristor- Basics of GTO, MCT, FCT, RCT

**UNIT III VOLTAGE CONTROLLED DEVICES 9**

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs -and IGCT. New semiconductor materials for devices – Intelligent power modules- Integrated gate commutated thyristor (IGCT) - omparison of all power devices.

**UNIT IV FIRING AND PROTECTING CIRCUITS 9**

Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.

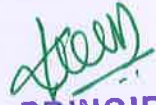
**UNIT V THERMAL PROTECTION 9**

Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance –Electrical analogy of thermal components, heat sink types and design – Mounting types- switching loss calculation for power device.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to determine the suitable device for the application.
- Ability to design of semiconductor device and its parameters.

  
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PS5092

**SOLAR AND ENERGY STORAGE SYSTEMS**

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**OBJECTIVES:**

- To Study about solar modules and PV system design and their applications
- To Deal with grid connected PV systems
- To Discuss about different energy storage systems

**UNIT I INTRODUCTION**

**9**

Characteristics of sunlight – semiconductors and P-N junctions –behavior of solar cells – cell properties – PV cell interconnection

**UNIT II STAND ALONE PV SYSTEM**

**9**

Solar modules – storage systems – power conditioning and regulation - MPPT- protection –stand alone PV systems design – sizing

**UNIT III GRID CONNECTED PV SYSTEMS**

**9**

PV systems in buildings – design issues for central power stations – safety – Economic aspect –Efficiency and performance - International PV programs

**UNIT IV ENERGY STORAGE SYSTEMS**

**9**

Impact of intermittent generation – Battery energy storage – solar thermal energy storage –pumped hydroelectric energy storage

**UNIT V APPLICATIONS**

**9**

Water pumping – battery chargers – solar car – direct-drive applications –Space – Telecommunications.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Students will develop more understanding on solar energy storage systems
- Students will develop basic knowledge on standalone PV system
- Students will understand the issues in grid connected PV systems



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PX5071

**WIND ENERGY CONVERSION SYSTEMS**

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**OBJECTIVES:**

- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed and variable speed, wind energy conversionsystems.
- To analyze the grid integration issues.

**UNIT I INTRODUCTION**

**9**

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory- Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine.

**UNIT II WIND TURBINES**

**9**

HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations- Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control- stall control-Schemes for maximum power extraction.

**UNIT III FIXED SPEED SYSTEMS**

**9**

Generating Systems- Constant speed constant frequency systems -Choice of Generators- Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.

**UNIT IV VARIABLE SPEED SYSTEMS**

**9**

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modeling  
- Variable speed variable frequency schemes.

**UNIT V GRID CONNECTED SYSTEMS**


**9**

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Acquire knowledge on the basic concepts of Wind energy conversion system.
- Understand the mathematical modeling and control of the Wind turbine

  
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PX5202

**SOLID STATE DRIVES**

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**OBJECTIVES:**

- To study and analyze the operation of the converter / chopper fed DC drives, both qualitatively and quantitatively.
- To familiarize the students on the operation of VSI and CSI fed induction motor drives.
- To understand the field oriented control of induction machines.
- To impart knowledge on the control of synchronous motor drives

**UNIT I RECTIFIER CONTROL OF DC DRIVES**

9

Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Implementation of braking schemes; Drive employing dual converter.

**UNIT II CHOPPER CONTROL OF DC DRIVES**

9

Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control - Chopper based implementation of braking schemes; Multi-phase chopper; Related problems.

**UNIT III CONTROL OF INDUCTION MOTOR DRIVES- STATOR**

**SIDE AND ROTOR SIDE**

9

AC voltage controller circuit – six step inverter voltage control-closed loop variable frequency PWM inverter with dynamic braking-CSI fed variable frequency drives – comparison Static rotor resistance control - injection of voltage in the rotor circuit – static Scherbius drives - power factor considerations – modified Kramer drives

**UNIT IV FIELD ORIENTED CONTROL OF INDUCTION MOTOR DRIVES**

9

Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.

**UNIT V SYNCHRONOUS MOTOR DRIVES**

9


Wound field cylindrical rotor motor – Equivalent circuits – performance equations for operation from a voltage source – starting and braking - V curves - Self control-margin angle control-torque control-power factor control-Brushless excitation systems

**TOTAL : 45+30 = 75 PERIODS**

**OUTCOMES:**

Students,

- Will be able to formulate, design and analyze power supplies for generic loads and machine loads.
- Will acquire knowledge on the operation of VSI and CSI fed induction motor drives.

  
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**OBJECTIVES:**

- To provide knowledge about the stand alone and grid connected renewable energysystems.
- To equip with required skills to derive the criteria for the design of power converters forrenewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generatorsand solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to ACconverters for renewable energy systems.
- To develop maximum power point tracking algorithms

**UNIT I INTRODUCTION**

9

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) -Qualitative study of different renewable energy resources ocean, Biomass, Hydrogen energy systems : operating principles and characteristics of: Solar PV, Fuel cells, wind electrical systems-control strategy, operating area.

**UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION**

9

Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

**UNIT III POWER ELECTRONICS FOR SOLAR**

9

Block diagram of solar photo voltaic system : line commutated converters (inversion-mode) - Boost and buck-boost converters-selection of inverter, battery sizing, array sizing- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

**UNIT IV POWER ELECTRONICS FOR WIND**

9

Three phase AC voltage controllers-AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, matrix converters- Stand alone operation of fixed and variable speed wind energy conversion systems- Grid connection Issues -Grid integrated PMSG and SCIG Based WECS.

**UNIT V HYBRID RENEWABLE ENERGY SYSTEMS**

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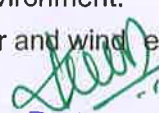
Need for Hybrid Systems -Range and type of Hybrid systems-Case studies of Wind-PV- Maximum Power Point Tracking (MPPT).

TOTAL : 45 PERIODS

**COURSE OUTCOMES**

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

- Analyze the impacts of renewable energy generation on environment.
- Understand the importance and qualitative analysis of solar and wind energy sources.

  
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