ACADEMIC YEAR (2021-2022)						
		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
(2021-2022) Regulation-2021						
1	Project work.	PX 5411	POWER ELECTRONICS & DRIVES	✓		1
2	Power semiconductor devices	PX 5101	POWER ELECTRONICS & DRIVES	✓		
3	Analysis of Electrical machines	PX 5151	POWER ELECTRONICS & DRIVES	✓		
4	Analysis and design of power converters	PX 5152	POWER ELECTRONICS & DRIVES	✓		
5	Wind energy conversion systems	PX 5071	POWER ELECTRONICS & DRIVES	✓		
6	Solar and Energy storage system	PS 5092	POWER ELECTRONICS & DRIVES	✓		

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

MASTER OF ENGINEERING

POWER ELECTRONICS AND DRIVES

2021-2022

S.NO	REG.NO	STUDENT NAME	PROJECT
1	731220415001	VIJAYAPRABAKARAN.S	✓

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

S.No	Name of the Course that include experiential learning through Project Work/Internship/Field Visit
1	Project work
2	Power semiconductor devices
3	Analysis of Electrical machines
4	Analysis and design of power converters
5	Wind energy conversion systems
6	Solar and Energy storage system

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PROJECT WORK

PX5101 **POWER SEMICONDUCTOR DEVICES**

L	T	P	C
3	0	0	3

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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PX5151 **ANALYSIS OF ELECTRICAL MACHINES**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide knowledge about the fundamentals of magnetic circuits, energy, force and torque of multi-excited systems.
- To analyze the steady state and dynamic state operation of DC machine through mathematical modeling and simulation in digital computer.
- To provide the knowledge of theory of transformation of three phase variables to two phase variables.
- To analyze the steady state and dynamic state operation of three-phase induction machines using transformation theory based mathematical modeling and digital computer simulation.

UNIT I PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 9

Magnetic circuits, permanent magnet, stored magnetic energy, co-energy - force and torque in singly and doubly excited systems – machine windings and air gap mmf - winding inductances and voltage equations.

UNIT II DC MACHINES 9

Elementary DC machine and analysis of steady state operation - Voltage and torque equations – dynamic characteristics of permanent magnet and shunt d.c. motors – Time domain block diagrams - solution of dynamic characteristic by Laplace transformation – digital computer simulation of permanent magnet and shunt D.C. machines.

UNIT III REFERENCE FRAME THEORY 9

Historical background – phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame - variables observed from several frames of reference.

UNIT IV INDUCTION MACHINES 9

Three phase induction machine, equivalent circuit and analysis of steady state operation – free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – analysis of dynamic performance for load torque variations – digital computer simulation.

UNIT V SYNCHRONOUS MACHINES 9

Three phase synchronous machine and analysis of steady state operation - voltage and torque equations in machine variables and rotor reference frame variables (Park's equations) –analysis of dynamic performance for load torque variations – Generalized theory of rotating electrical machine and Krons primitive machine.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand the various electrical parameters in mathematical form.
- Ability to understand the different types of reference frame theories and transformation relationships.

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PX5152 ANALYSIS AND DESIGN OF POWER CONVERTERS L T P C
3 0 0 3

OBJECTIVES:

- To determine the operationand characteristics of controlled rectifiers.
- To apply switching techniques and basic topologies of DC-DC switching regulators.
- To introduce the design of power converter components.
- To provide an in depth knowledge about resonant converters.
- To comprehend the conceptsof AC-AC power converters and their applications.

UNIT I SINGLE PHASE & THREE PHASE CONVERTERS 9

Principle of phase controlled converter operation – single-phase full converter and semi- converter (RL,RLE load)- single phase dual converter – Three phase operation full converter and semi-converter (R,RL,RLE load) – reactive power – power factor improvement techniques –PWM rectifiers.

UNIT II DC-DC CONVERTERS 9

Limitations of linear power supplies, switched mode power conversion, Non-isolated DC- DC converters: operation and analysis of Buck, Boost, Buck-Boost, Cuk& SEPIC – under continuous and discontinuous operation – Isolated converters: basic operation of Flyback, Forward and Push-pull topologies.

UNIT III DESIGN OF POWER CONVERTER COMPONENTS 9

Introduction to magnetic materials- hard and soft magnetic materials –types of cores , copper windings – Design of transformer –Inductor design equations – Examples of inductor design for buck/flyback converter-selection of output filter capacitors – selection ofratings for devices – input filter design.

UNIT IV RESONANT DC-DC CONVERTERS 9

Switching loss, hard switching, and basic principles of soft switching- classification of resonant converters- load resonant converters – series and parallel – resonant switch converters – operation and analysis of ZVS, ZCS converters comparison of ZCS/ZVS- Introduction to ZVT/ZCT PWM converters.

UNIT V AC-AC CONVERTERS 9

Principle of on-off and phase angle control – single phase ac voltage controller – analysis with R & RL load – Three phase ac voltage controller – principle of operation of cyclo converter – single phase and three phase cyclo converters – Introduction to matrix converters.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Analyze various single phase and three phase power converters
- Select and design dc-dc converter topologies for a broad range of power conversionapplications.

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PX5071 **WIND ENERGY CONVERSION SYSTEMS**

L	T	P	C
3	0	0	3

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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PS5092	SOLAR AND ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

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 – cellproperties – 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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WIND AND SOLAR INTEGRATION AND POWER SYSTEM RELIABILITY FOR AI BASED LOAD RESPONSE

A THESIS

Submitted by

VIJAYAPRABAKARAN S

(731220415001)

In partial fulfillment for the award of the

degree of

MASTER OF ENGINEERING

POWER ELECTRONICS AND DRIVES

J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

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SEPTEMBER-2022

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BONAFIDE CERTIFICATE

Certified that this project report **"WIND AND SOLAR INTEGRATION AND POWER SYSTEM RELIABLITY AI BASED LOAD RESPONSE"** is the bonafide work of **VIJAYAPRABAKARAN.S (Reg. no: 731220415001)** who carried out the Project work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate

5/9/22

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INTERNALEXAMINER

05/09/22

EXTERNALEXAMINER

ABSTRACT

The current and typical solution of smoothing renewable power generation fluctuations in power system. A BES based Solar and wind power systems had a suitable control strategy that can effectively utilize the Maximum Power Point Techniques (MPPT) output from the DC to DC converter. As like split battery the output Inverter also classified in to two ratings that is called as load response inverter.

Smart grid is considered as an attractive technology for monitoring and management of grid connected renewable energy plants due to its flexibility, network architecture and communication between providers and consumers. Smart grid has been deployed with renewable energy resources to be securely connected to the grid. Indeed, this technology aims to complement the demand for power generation and distributed storage. For this reason, a system powered by a photovoltaic (PV) has been chosen as an interesting solution due to its competitive cost and technical structure.

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CHAPTER 7

CONCLUSION

The proposed system has been analyzed in the steady and dynamic state with the performance of the micro-grid integrated hybrid solar system with has been analysed by considering variable load demand. The impact of SMES of operation of the hybrid solar system has carried out. To improve the system's operation, the proposed system is necessary to share the load supply with the battery especially when the wind speed or photovoltaic power drops or the load increases. Also, the battery selection for applications is highly important in order to overcome the problems of dynamic instability of the electrical network based on such an energy storage system.. For the future works, a larger power network could be developed using same technologies. To get more flexible results, fuzzy logic rules could be modified. The capacity of the battery could be increased with respect to the network load demand.

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