Department of Electrical and Electronics

New course introduced

SL. NO.	COURSE CODE	COURSE OFFERED
1	SEEA3020	MODERN POWER CONVERTERS
2	SEEA3021	DISTRIBUTED GENERATION AND MICROGRID

SEEA3020	MODERN POWER CONVERTERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on different types of Switched mode power supplies.
- To study the operation, characteristics and performance parameters of Matrix Converter.
- To understand the operations of Soft switched converters.
- To get acquainted with the applications of modern power electronics converters.

UNIT I SWITCHED MODE POWER SUPPLIES (SMPS) **9 Hrs.**

DC Power supplies and Classification - Switched mode dc power supplies with and without isolation - single and multiple outputs - Closed loop control and regulation - Design examples on converter and closed loop performance.

UNIT II AC-DC CONVERTERS **9 Hrs.**

Switched mode AC-DC converters - Synchronous rectification - Single and three phase topologies - switching techniques - High input power factor - Reduced input current harmonic distortion - Improved efficiency - With and without input-output isolation - Performance indices design examples.

UNIT III DC-AC CONVERTERS **9 Hrs.** Multi-level Inversion – concept - classification of multilevel inverters - Principle of operation - Main features and analysis of Diode clamped - Flying capacitor and cascaded multilevel inverters - Modulation schemes.

UNIT IV AC-AC CONVERTERS WITH AND WITHOUT DC LINK **9 Hrs.**

Matrix converters - Basic topology of matrix converter - Commutation - current path - Modulation techniques - Scalar modulation - Indirect modulation - Matrix converter as only AC-DC converter - AC-AC converter with DC link - Topologies and operation - With and Without resonance link - Converter with DC link converter - Performance comparison with matrix converter with DC link converters.

UNIT V SOFT-SWITCHING POWER CONVERTERS **9 Hrs.**

Soft switching techniques - ZVS, ZCS, quasi resonance operation – Performance comparison hard switched and soft switched converters - AC-DC converter - DC-DC converter – DC-AC converter -Resonant DC power supplies.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the classification and operation of Switched Mode Power Supplies.

CO2 - Evaluate the various performance parameters of different converters.

CO3 - Analyze different types of multilevel inverters circuits.

CO4 - Design various converters based on real time applications.

CO5 - Analyze the AC-AC Converters with and without DC Link.

CO6 - Implement Power Electronic Converters to perform soft switching techniques.

TEXT / REFERENCE BOOKS

1. Power Electronics Handbook, M.H.Rashid, Academic press, New York, 2000.
2. Advanced DC/DC Converters, Fang Lin Luo and Fang Lin Luo, CRC Press, New York, 2005.
3. Power Electronic Circuits, Issa Batarseh, John Wiley and Sons, Inc.2006.
4. Krein Philip T, Elements of Power Electronics,Oxford University press, 2nd 2012.
5. Agarwal, Power Electronics: Converters, Applications, and Design, 4th edition, Jai P, Prentice Hall, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEA3021	DISTRIBUTED GENERATION AND MICROGRID	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge about distributed generation technologies
- To understand relevance of power electronics in DG
- Obtain knowledge of different energy storage devices
- To understand concept of microgrid

UNIT 1 INTRODUCTION TO DISTRIBUTED GENERATION **9 Hrs.**

Distributed generation (DG) overview and technology trend. Working principle, architecture and application of renewable DG technologies: Solar PV, bioenergy, wind energy, hydroelectricity, tidal power, wave energy, geothermal energy etc. Non-conventional technology based DGs: Fuel cells, CHP based microturbine, IC engines, etc. Storage based DGs: Storage technology: Battery, super capacitor, flywheel etc., Need for Distributed generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.

UNIT 2 INTERCONNECTION ISSUES AND STANDARDS OF DGs. **9 Hrs.**

Distributed energy resources (DERs), topologies, selection of source, dependence on storage facilities, regulatory standards/ framework, standards for interconnecting DGs to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Grid code and Islanding & non-islanding system.

UNIT 3 IMPACT OF GRID INTEGRATION **9 Hrs.**

Grid interconnection issues for grid connected operation of various types of DG systems. Constraints on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Reliability, stability and power quality issues involved in grid connected operation of various DGs.

UNIT 4 POWER ELECTRONICS AND DG SYSTEMS **9 Hrs.**

Relevance of power electronics in DG applications, Power quality requirements and source switching using SCR based static switches, Distribution system loading, line drop model, series voltage regulators and on-line tap changers, power converter topologies, model and specifications for DG applications, issues filter designs, harmonic reduction, Control of DG inverters, phase locked loops, current control and DC voltage control for stand-alone and grid parallel operations. Protection of converters, power quality implication, acceptable ranges of voltage and frequency, reactive power compensation and active filtering.

UNIT 5 OPERATION AND CONTROL OF MICROGRID **9 Hrs.**

Concept and definition of microgrid, review of sources of microgrids, typical structure and configuration of a microgrid, microgrid implementation in Indian and international scenario, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode operation, anti-islanding schemes. Control techniques for voltage, frequency, active and reactive power control of microgrid system.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the basic concepts of Distributed Generation
CO2 - Knowledge about the interconnection issues and standards of DGs.
CO3 - Analyze the impact of grid integration
CO4 - Design Power Electronics circuits for DG systems
CO5 - Analyze operation and control of microgrid.
CO6 - Develop the Control techniques for microgrid system

TEXT / REFERENCE BOOKS

1. Renewable Energy- Power for a sustainable future, third edition, Edited by Godfrey Boyle, Oxford University Press, 2013.
2. Amirnaser Yezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, IEEE John Wiley Publications, 2009.
3. Dorin Neacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006. New Delhi
4. J.F. Manwell, J.G “Wind Energy Explained, Theory Design and Applications,”. McGowan Wiley publication, 2nd Edition, 2009.
5. D. D. Hall and R. P. Grover, “Biomass Regenerable Energy”, John Wiley, New York, 1987.
6. John Twidell and Tony Weir, “Renewable Energy Resources”, Taylor and Francis Publications, Second Edition, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **ExamDuration:3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**