SANKALCHAND PATEL UNIVERSITY
।। अथातो ज्ञानजिज्ञासा ।।

# Ph. D. Program
# (July-2019 Batch)

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| **Subject Code:** 1RI3000102 | **Subject Title:** Essentials of Disciplinary Research Subject-1<br>**Subject Sub-Title:** Advance Power Electronics |
| **Pre-requisite Subject** | Fundamentals of Power Electronics |

**Objectives of course**:

- This course is intended to provide a comprehensive treatment towards understanding of the new dimensions associated with deregulation of the power system.

**Learning outcomes:**

- The course will bring out the differences between the conventional power system operation and the restructured one. The course will prepare a background with fundamentals of microeconomics.

| Teaching Scheme ( Credit Distribution) | | | | Assessment Scheme (Weightage) | |
|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Hall Exam | Continuous Evaluation |
| 4 | -- | -- | 4 | 60% | 40% |

Continuous evaluation is based on assignments/quiz/presentation/small projects as per the supervisor instructions.

| Subject Contents | | | |
|---|---|---|---|
| **Sr. No.** | **Topic** | **Total Hours** | **Weight (%)** |
| 1 | **AC to DC Converters (Rectifiers):**<br>Introduction, Single phase and three phase half wave and full wave, 1-phase and 3- phase half controlled and fully controlled converters, Analysis with R & RL load, Performance parameters for converters,, Operation in continuous and dis- continuous mode, Operation in conversion and inversion mode, Effect of source inductance. | 8 | 20 |
| 2 | **DC to DC Converters:**<br>Introduction, Switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode, Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter. | 9 | 25 |
| 3 | **DC to AC Converters (Inverters)**:<br>Introduction and Classification, Concept of Unipolar and Bipolar PWM, Sine-triangular PWM, Space Vector Pulse Width Modulation, Selective Harmonics Elimination, Hysteresis Current Control, Harmonic reduction techniques, Current Source Inverters, Z- source inverters, Dead time for bridge inverters. | 8 | 22 |
| 4 | **Multilevel Inverters:**<br>Introduction, Classification and Application, Cascaded H-Bridge Multilevel Inverters, Diode-Clamped Multilevel Inverters, Flying-Capacitor Multilevel Inverters, Comparison of Power Topologies, Neutral-Point Voltage Control, Carrier Based PWM Schemes, Space Vector Modulation for MLI. | 6 | 10 |

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|---|---|---|---|
| 5 | **AC to DC Converters (Rectifiers):**<br>Introduction, Single phase and three phase half wave and full wave, 1-phase and 3- phase half controlled and fully controlled converters, Analysis with R & RL load, Performance parameters for converters,, Operation in continuous and dis- continuous mode, Operation in conversion and inversion mode, Effect of source inductance, 12-Pulse SCR Rectifier, Power factor improvement techniques. | 8 | 20 |
| 6 | **AC voltage controllers and Cycloconverters:**<br>AC voltage controllers: Review of On-off and phase control; Single phase full wave controllers and their analysis with resistive loads; Three phase full wave controllers, Analysis with R-load, Three phase bi-directional delta-connected controllers Cycloconverters: single-phase to single-phase cycloconverter, 3-phase to 1-phase cyclo-converter, 3-phase to 3-phase cycloconverter circuits; circulating current operation; non-circulating current operation; mean output voltage and harmonics in supply current waveform | 9 | 23 |

**List of References:**

1. Muhammad H. Rashid, “Power Electronics - Circuits, Devices and Applications”, Prentice Hall of India, 3rd ed., 2003.
2. Mohan, Undeland and Robbins, “Power Electronics – Converters, Applications and Design”, John Willey & sons, Inc., 3rd ed., 2003.
3. Bin Wu, “High Power Converters and AC Drives”, IEEE Press, A John Wiley & Sons, Inc., Publication. 2006.
4. P.C.Sen, “Modern Power Electronics ”, S. Chand and Co. Ltd., New Delhi, 2012.
5. Recent reputed journal papers.

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# Ph. D. Program
# (July-2019 Batch)

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| **Subject Code: 1RI3000103** | **Subject Title: Essentials of Disciplinary Research Subject-2**<br>**Subject Sub-Title: Power Electronics For Renewable Energy Systems** |
| **Pre-requisite Subject** | Fundamental Knowledge of Power Electronics and Renewable Energy |

**Objectives of course**: : This course is aimed to provide detailed knowledge of these renewable energy sources, need of power electronic converters, issues in their operation, control and integration etc.

**Learning outcomes:** **1.** Correlate the need of renewable energy for the benefit of the society
2. Select appropriate power electronic converter for particular renewable energy source.

| Teaching Scheme ( Credit Distribution) | | | | Assessment Scheme (Weightage) | |
|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Hall Exam** | **Continuous Evaluation** |
| 2 | -- | -- | 2 | 60% | 40% |

| Subject Contents | | | |
|---|---|---|---|
| **Unit** | **Topic** | **No. of Lecture** | **Weightage** |
| **1.** | **Energy Scenario**<br>National and International current energy scenario; Share of renewable and non-renewable energy sources. | **01** | **5%** |
| **2.** | **Photovoltaic Energy Conversion Systems**<br>Introduction to solar cell, PV cell technology, I-V and P-V curves of PV cell/modules/array, Electrical modelling of PV cell,<br>MPPT techniques, I-V and P-V curves under non-uniform conditions, PV inverter configurations, Distributed MPPT, Control of PV inverter/converter configurations, Grid connected Systems, Islanded systems, Recent development in converter configurations for PV. | **08** | **40%** |
| **3.** | **Wind Energy Conversion Systems**<br>Basics of wind energy, Components of wind turbine, Wind turbine aerodynamics, MPPT control, Modelling of wind energy system, Types of generators: induction (singly fed and doubly fed) and synchronous generators, Converters for wind energy conversion system, Fixed speed and variable speed wind energy conversion system, | **08** | **40%** |
| **4.** | **Energy Storage system**<br>Introduction, The Structure of Power Storage Devices, Pumped-storage Hydroelectricity, Compressed Air Energy Storage System, Flywheels, Battery. | **03** | **15%** |

**List of References:**


1. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, "Grid Converters for Photovoltaic and Wind Power Systems", Wiley IEEE Press, Jan 2011.
2. Bin Wu, Yongqiang Lang, Navid Zargari, Samir Kouro ,"Power Conversion and Control of Wind Energy Systems", Wiley IEEE Press, July 2011.
3. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications", Wiley IEEE Press, June 2014.
4. Ali Keyhani, Mohmmand N. Marwadi, Min Dai; "Integration of Green and Renewable energy in electric power system", John Wiley & sons, 2010.
5. Chetan S. Solanki; "Solar Photovoltaics: Fundamentals, Technologies & applications", Prentice Hall of India, 2009.