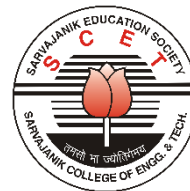




SARVAJANIK UNIVERSITY
Sarvajani College of Engineering and Technology
Bachelor of Technology



B.Tech. Semester V

Subject Name: Power Electronics

Subject Code: BTEL13503

Type of course: Professional Core Course

Prerequisite: Fundamental knowledge of Electrical Engineering and Analog Electronics

Rationale: The power electronic devices and converters employing power electronics devices are now widely used in domestic applications as well as in industrial applications like Electrical Drives, Power Systems, Renewable Energy based power generation, heating applications etc. The course is aimed to provide exposure about the commonly used power electronic devices and the power electronic converters.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	1	2	5	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

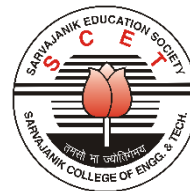
Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	Power switching devices Diode, TRIAC, Thyristor, MOSFET, IGBT; Static characteristics of these devices; Operation of power devices as switches and switching losses, Single-quadrant switches, two-quadrant and bidirectional switches; Firing circuit for thyristors; Gate drive circuits for MOSFET and IGBT.	08	15
2.	DC-DC converters Switching Voltage Regulators, Linear voltage regulator, Concept of switching voltage regulators and advantages, Operation and Principle of Basic DC-DC converter topologies like Buck, Boost and Buck-Boost converter, Various control techniques for output voltage control, Mathematical analysis for these converters for steady state, Concept of CCM and DCM and factors affecting them, Closed loop control for voltage regulation, Isolated	12	20

PCC: Professional Core Course



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	converters: Forward converter and Flyback converter; Multi-quadrant operation of DC-DC converters; Applications		
3.	DC-AC converters – Inverters Classification of Inverters, Half-bridge and full-bridge single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage, three-phase sinusoidal modulation, Three phase bridge inverter – 180° and 120° conduction mode, SPWM control, Third harmonic injection, SVPWM, Output voltage and frequency control, Harmonic spectrum, Harmonics and its effects, Applications	12	20
4.	AC-DC Converters Concept of phase control using half-wave single phase ac-dc converter, 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, Reactive power considerations, Operation in conversion and inversion mode, Effect of source inductance, Power factor improvement techniques, Dual Converters, Applications	12	20
5.	AC Voltage Controller Single-phase AC voltage controller, Principle of Phase Control, On-off Control, Mathematical analysis related to single-phase AC voltage controller, Three-phase AC voltage controller configurations: Operations, Waveforms, Analysis	8	15
6.	Miscellaneous Frequency Control: Introduction to cycloconverter and matrix converter; basic power circuit and their operating principle. Datasheet interpretation, Ratings of the devices and Selection of switches.	6	10

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	30	10	10	0

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W.e.f. AY 2021-22



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Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels (**Revised Bloom’s Taxonomy**)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	To understand the differences between signal level and power level devices.	10
CO-2	Acquire knowledge about fundamental concepts and techniques used in power electronics.	30
CO-3	To analyse the operation of power converters.	30
CO-4	Develop skills to build, and troubleshoot power electronics circuits.	10
CO-5	Develop ability to understand the use of power converters in commercial and industrial applications.	20

LIST OF PRACTICALS: (Minimum ----- performed.)

1. To obtain Static and dynamic characteristic of SCR, MOSFET and IGBT
2. To Perform R, RC and UJT based triggering circuit of SCR
3. To analyse the performance of single phase and three-phase full bridge thyristor rectifier for R and RL load.
4. To perform an experiment of DC-DC converter (Buck/Boost/Buck-Boost converter).
5. To perform single-phase bridge inverter with R and R-L load.
6. To perform three-phase bridge inverter
 - a. 120° mode of conduction
 - b. 180° mode of conduction
7. To perform SCR based single-phase ac voltage controller.
8. To perform SCR based three-phase ac voltage controller.
9. Develop a Simulink model of a step-down chopper to study the effect of inductance, switching frequency, duty cycle, load current on the output voltage
10. To simulate a closed-loop control of DC-DC converter (Buck/Boost/Buck-Boost converter).
11. To simulate single phase and three phase inverters for R and RL load.
12. To Study of harmonic spectrum of output voltage for unipolar and bipolar PWM controlled half-bridge and full bridge converter.
13. To simulate single phase and three phase-controlled converters for R and RL load.
14. To simulate single phase and three phase AC voltage controller.



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15. To study the performance of single-phase fully controlled and semi-controlled converter for R and R-L load
16. To study the performance of three-phase fully controlled and semi-controlled converter for R and R-L load

Reference Text Books:

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2. N. Mohan, T. M. Undeland, W.M. Robbins, “Power Electronics: Converters, Applications and Design”, Wiley India Edition, 2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
4. P.S. Bimbhra, “Power Electronics”, Khanna Publishers, New Delhi, 2012..
5. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

Major Equipment:

Power semiconductor devices, power electronic converter kits, CRO/DSO, choke coil, load bank, voltage and current probes, Simulation software like Scilab, MATLAB, PSIM etc. along with necessary toolbox.