COURSE HANDOUT

POWER ELECTRONICS (EE-602)

EE-6TH SEMESTER

ACADEMIC YEAR (2023-24)

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Department of Electrical Engineering

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Course Code	Course Name	Course Type	Cd	L	T	P	Marks		
							Sessional	Final Exam	Total
EE-602	Power Electronics	Core	4	3	1	2	50	100	150

COURSE OUTCOMES

At the end of the course the student will be able to:	
CO1	Explain the concept and operation of various power semiconductor devices.
CO2	Articulate the performance of single phase and three phase controlled converter under different loads.
CO3	Design of different DC-DC converters for industrial applications.
CO4	Compare the performance of AC voltage controllers under different loads.
CO5	Develop ability to understand the use of inverters for industrial applications.

Unit-I

Introduction: Concept of power electronics, applications, advantages and disadvantage, solid state devices: SCR basic theory of operation, static and dynamic characteristics, ratings, protection of SCR against overcurrent, overvoltage, dv/dt and di/dt protection, snubber circuit, series and parallel operation, gate protection, firing circuit of SCR, SCR gate characteristics, two transistor analogy model of SCR, family of SCR: TRAIC, GTO, LASCR, DIAC, commutation techniques in SCR.

(10 Hours)

Unit-II

Phase Controlled Rectifiers: Single phase half wave and fully controlled converter (rectification and inversion mode), half controlled converter (semi-converter), operation of all converters with R, RL and RLE load with and without freewheeling diode, derivation of Average and RMS output voltage, power factor, THD, TUF, three phase Fully controlled converter, rectification and inversion mode, Half controlled converter (Semi-converter), Operation of all converters with R, RL load, derivation of Average and RMS output voltage, power factor.

(10 Hours)

Unit-III

DC-DC Converter:Principle of operation of chopper and its classification, different quadrants operation, Control techniques: CLC, TRC, PWM and FM techniques, analysis of step down chopper with RLE load and Numerical, Buck-Boost Chopper. (8 Hours)

Unit- IV

AC-AC Converter: Single phase AC voltage regulator principle with R and RL Load, derivation of Average and RMS output voltage, single phase to single phase step up and step down cycloconverters, three phase to single phase cycloconverters, output voltage equation for a Cycloconverter. (8 Hours)

Unit-V

Inverter:Single phase half bridge and full bridge converter derivation of output voltage and current, current source converter with ideal switches, PWM techniques: Single pulse, multiple pulse and sinusoidal pulse modulation with Fourier analysis, three phase VSC using 120 degree and 180 degree mode and their comparison. (10 Hours)

Textbooks

S.No	Name of the Books	Name of the Author	Publisher Name	Edition (Pub.Yr.)
1	Power Electronics	Ned Mohan, T. M. Undeland and W. P. Robbins	John Wiley and Sons	3rd (2007)
2	Power Electronics	M. H. Rashid	Pearson	4th (2017)
3.	Power Electronics	P.S. Bimbhra	Khanna Publishers	5th (2012)

Reference Books

S.No	Name of the Books	Name of the Author	Publisher Name	Edition (Pub.Yr.)
1	Power Electronics	M. D. Singh and K. B. Khandchandani	Tata McGraw Hill	2nd (1998)
2	Power Electronics-Essentials and Applications	L. Umanand	Wiley	1st (2009)

COURSE PLAN		
Unit-I Introduction		
S.No	**Topics**	**Recommended Books**
1	Concept of Power electronics	Book 1, Ch.1
2	SCR basic theory of operation	Book 1, Ch.1
3	Static and dynamic characteristics	Book 1, Ch.1
4	Protection of SCR	Book 2, Ch.2
5	Snubber circuit	Book 2, Ch.2
6	Series and parallel operation of SCR	Book 2, Ch.2
7	Firing circuit of SCR	Book 2, Ch.2
8	SCR gate characteristics	Book 2, Ch.2
9	Two transistor analogy model of SCR	Book 2, Ch.2
10	Family of SCR	Book 2, Ch.2
Unit-II Phase Controlled Rectifiers		
11	Single phase half wave	Book 2, Ch.3
12	Fully controlled converter	Book 2, Ch.3
13	Half controlled converter (semi-converter)	Book 2, Ch.3
14	Operation of all converters with R, RL and RLE load with and without freewheeling diode	Book 2, Ch.3
15	Derivation of Average and RMS output voltage, power factor, THD, TUF	Book 2, Ch.3
16	Three phase Fully controlled converter	Book 2, Ch.3
17	Rectification and inversion mode	Book 2, Ch.3
18	Half controlled converter (Semi-converter)	Book 2, Ch.3
19	Operation of all converters with R, RL load	Book 2, Ch.3
29	Derivation of Average and RMS output voltage, power factor	Book 2, Ch.3
Unit-III DC-DC Converter		
30	Principle of operation of chopper	Book 2, Ch.4
31	Classification of chooper	Book 2, Ch.4

32	Different quadrants operation	Book 2, Ch.4
33	Control techniques	Book 2, Ch.4
34	CLC, TRC	Book 2, Ch.4
35	PWM and FM techniques	Book 2, Ch.4
36	Analysis of step-down chopper with RLE load and Numerical	Book 2, Ch.4
37	Buck-Boost Chopper	Book 2, Ch.4
Unit-IV AC-AC Converter		
38	Single phase AC voltage regulator principle with R Load	Book 2, Ch.5
39	Single phase AC voltage regulator principle with RL Load	Book 2, Ch.5
40	Derivation of Average voltage	Book 2, Ch.5
41	Derivation of RMS output voltage	Book 2, Ch.5
42	Single phase to single phase step up cycloconverters	Book 2, Ch.5
43	Single phase to single phase step down cycloconverters	Book 2, Ch.5
44	Three phases to single phase cycloconverters	Book 2, Ch.5
45	Output voltage equation for a Cycloconverter.	Book 2, Ch.5
Unit-V Inverter		
46	Single phase half bridge	Book 1, Ch.6
47	Full bridge converter	Book 1, Ch.6
48	Derivation of output voltage and current	Book 1, Ch.6
49	Current source converter with ideal switches	Book 1, Ch.6
50	PWM techniques: Single pulse, multiple pulse and sinusoidal	Book 1, Ch.6
51	PWM techniques: Single pulse, multiple pulse and sinusoidal	Book 1, Ch.6
52	PWM techniques: Single pulse, multiple pulse and sinusoidal	Book 1, Ch.6
53	Pulse modulation with Fourier analysis	Book 1, Ch.6
54	Three phase VSC using 120-degree mode	Book 1, Ch.6
55	Three phase VSC using 180-degree mode	Book 1, Ch.6

ADDITIONAL WEB RESOURCES

1.	**MOOC:** Power Electronics Specialization https://www.coursera.org/specializations/power-electronics
2.	**NPTEL:** Video lectures on Fundamental of Power Electronics https://onlinecourses.nptel.ac.in/noc22_ee03/preview

GRADING AND ASSESSMENT

- **Sessional Test**: 20 marks
- **Assignment**: 20 marks
- **Attendance**: 10 marks
- **Final Examination**: 100 marks

COURSE POLICIES

- **Attendance**: Minimum 75% attendance is mandatory to appear in the final examination of the course.
- **Academic Integrity**: MIET's academic integrity policies apply. Plagiarism will not be tolerated.

- **Late Submissions**: Assignments and projects must be submitted by the specified timelines.

FACULTY INFORMATION

- **Office Hours**

  Monday (12:05 PM - 12:55 PM)
  Friday (12:05 PM - 12:55 PM)

- **Contact Information**
  Parveen.ee@mietjammu.in