

## Department of Electrical & Electronics Engineering

**COURSE MODULES OF THE SUBJECT TAUGHT FOR THE SESSION ODD SEM 2023**

## Course Syllabi with CO's

Faculty Name : <b>Dr Sathish K R</b>			Academic Year: 2023-24				
Department: Electrical & Electronics Engineering							
Course Code	Course Title	Core/Elective	Prerequisite	Number of Lecture Hours/Week			Total Hrs/ Sessions
				L	T	P	
21EE54	Power Electronics	Core	Overview of control design,basic fundamentals of semiconductor devices, electronic circuit design techniques, differential equations and calculus	2	2	-	50
<b>Course objectives:</b>	<ol style="list-style-type: none"> <li>1. To give an overview of applications power electronics, different types of power semiconductor devices, their switching characteristics.</li> <li>2. To explain power diode characteristics, types, their operation and the effects of power diodes on RL circuits.</li> <li>3. To explain the techniques for design and analysis of single-phase diode rectifier circuits.</li> <li>4. To explain different power transistors, their steady state and switching characteristics and imitations.</li> <li>5. To explain different types of Thyristors, their gate characteristics and gate control requirements.</li> <li>6. To explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.</li> </ol>						
<b>Topics Covered as per Syllabus</b>							
<b>Module-1</b>							<b>Teaching Hours</b>
<b>Introduction:</b> Applications of Power Electronics, Types of Power Electronic Circuits, Peripheral Effects, Characteristics and Specifications of Switches <b>Power Diodes:</b> Introduction, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Silicon Carbide Diodes, Silicon Carbide Schottky Diodes, Diode Switched <i>RL</i> Load, Freewheeling Diodes with Switched <i>RL</i> Load. <b>Diode Rectifiers:</b> Introduction, Single-Phase Full-Wave Rectifiers, Single-Phase Full-Wave Rectifier with <i>R</i> Load, Single-Phase Full-Wave Rectifier with a Highly Inductive Load.							<b>10</b>
Teaching-Learning Process		Chalk and Board, PowerPoint Presentation					
<b>Module-2</b>							
<b>Power Transistors:</b> Introduction, Power MOSFETs – Steady State Characteristics, Switching Characteristics Bipolar Junction Transistors – Steady State Characteristics, Switching Characteristics, Switching Limits, IGBTs, MOSFET Gate Drive, BJT Base Drive, Isolation of Gate and Base Drives, Pulse transformers and Opto-couplers.							<b>10</b>
Teaching-Learning Process		Chalk and Board, PowerPoint Presentation					
<b>Module-3</b>							
<b>Thyristors:</b> Introduction, Thyristor Characteristics, Two-Transistor Model of Thyristor, Thyristor Turn-On, Thyristor Turn-Off, A brief study on Thyristor Types, Series Operation of Thyristors, Parallel Operation of Thyristors, $di/dt$ Protection, $dv/dt$ Protection, DIACs, Thyristor Firing Circuits, Unijunction Transistor.							<b>10</b>

Teaching-Learning Process	Chalk and Board, Power Point Presentation	
<b>Module-4</b>		
<b>Controlled Rectifiers:</b> Introduction, Single-Phase Full Converters, Single-Phase Dual Converters, Three-Phase Full Converters, Three-Phase Dual Converters <b>AC Voltage Controllers:</b> Introduction, Single-Phase Full-Wave Controllers with Resistive Loads, Single-Phase Full-Wave Controllers with Inductive Loads, Three-Phase Full-Wave Controllers.		<b>10</b>
Teaching-Learning Process	Chalk and Board, Power Point Presentation	
<b>Module-5</b>		
<b>DC-DC Converters:</b> Introduction, principle of step down and step up chopper with RL load, performance parameters, DC-DC converter classification. <b>DC-AC converters:</b> Introduction, principle of operation single phase bridge inverters, three-phase bridge inverters, voltage control of single phase inverters, Harmonic reductions, Current source inverters.		<b>10</b>
Teaching-Learning Process	Chalk and Board, Power Point Presentation	
<b>Course outcomes:</b>	<b>CO1:</b> To give an <b>overview</b> of applications power electronics, different types of power semiconductor devices, their switching characteristics, power diode characteristics, types, their operation and the effects of power diodes on RL circuits.	
	<b>CO2:</b> To <b>explain</b> the techniques for the design and analysis of single-phase diode rectifier circuits.	
	<b>CO3:</b> To <b>explain</b> different power transistors, their steady-state and switching characteristics and limitations.	
	<b>CO4:</b> To <b>explain</b> different types of Thyristors, their gate characteristics, and gate control requirements.	
	<b>CO5:</b> To <b>explain</b> the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together <b>Continuous Internal Evaluation:</b> Three Unit Tests (Duration 01 hour) 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester Two assignments		
<b>List of Text Books</b> 1. “Power Electronics: Circuit Devices and Applications”, Mohammad H Rashid, 4 <sup>th</sup> Edition 2014		
<b>List of Reference Books</b> 1. “Power Electronics: Converters, Applications and Design”, Ned Mohan, 3 <sup>rd</sup> Edition 2014. 2. “Power Electronics”, Daniel W Hart, 1 <sup>st</sup> Edition 2011 3. “Elements of Power Electronics”, Philip T Krein, Oxford, Indian Edition, 2008.		
<b>List of URLs, Text Books, Notes, Multimedia Content, etc</b> 1. <a href="http://www.ece.rutgers.edu/332_460">http://www.ece.rutgers.edu/332_460</a> 2. Ned Mohan, et al, .Power Electronics, Wiley Eastern Ltd, 1989. 3. Shepherd, et al, .Power Electronics and Motor Control., Cambridge University Press, 1998		

## Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

Activity-Based Learning, Quizzes, Seminars.

### Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

### The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Subject Code:	21EE54	TITLE: Power Electronics					Faculty Name:			Dr. Sathish K R		
List of Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	3	-	-	-	-	-	-	-	-	-	3
CO-2	3	3	-	-	-	-	-	-	-	-	-	3
CO-3	3	3	-	-	-	-	-	-	-	-	-	3
CO-4	3	3	-	-	-	-	-	-	-	-	-	3
CO-5	3	3	-	-	-	-	-	-	-	-	-	3

**Note:** 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution = No Contribution

### The Correlation of Course Outcomes (CO's) and Program Specific Outcomes (PSO's)

Subject Code:	21EE54	TITLE: Power Electronics
List of Course Outcomes	PSO1	PSO2
CO-1	-	3
CO-2	-	3
CO-3	-	3
CO-4	-	3
CO-5	-	3

**Note:** 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution '-' = No Contribution