Sana'a University
Faculty of Engineering
Mechatronics Engineering Department
Mechatronics Engineering Program

Course Specification of Power Electronics and Drives

I. Course Identification and General Information:

1.	Course Title:	Power Electronics and Drives.				
2.	Course Code & Number:	MT304.				
3.	Credit Hours:	C.H.				TOTAL Cr. Hrs.
		Th.	Seminar	Pr.	Tu.	
		2	-	2	2	4
4.	Study Level/ Semester at which this Course is offered:	Fourth Year- First Semester				
5.	Pre –Requisite (if any):	Computer Programming (1), Electrical Machines (1) and Electrical Machines (2).				
6.	Co –Requisite (if any):	None.				
7.	Program (s) in which the Course is offered:	Mechatronics Engineering Program.				
8.	Language of Teaching the Course:	English Language.				
9.	Location of Teaching the Course:	Mechatronics Engineering Department.				
10.	Prepared by:	Ass. Prof. Dr. Radwan Mohammed AL Bouthigy				
11.	Date of Approval:					

II. Course Description:

This course is offered to provide students with the principle concepts in the field of power electronics and drives as enabling technologies. It gives students the skills in defining, analyzing, and solving problems related to power semiconductor devices and drive circuits. The course enables students to understand the basic topologies of power switching devices, rectifiers, AC voltage controllers, DC

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Ass. Prof. Dr. Radwan AL Bouthigy	Ass. Prof. Dr. Abdul-Malik Momin	Ass. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Ass. Prof. Dr. Huda Al-Emad

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choppers, and voltage-fed inverters with special emphasis on application of devices and current industrial practice. Further, it helps students to identify commonly employed electric motor drives and their speed control methods. Computer simulations are also introduced to develop students' knowledge towards electric-drives-based power-electronics converters and the design of feedback controllers.

III. Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a.1	Recognize the common power control devices includes, diodes, Thyristors and transistors and their circuits.	A1
a.2	Define the dynamic modeling of induction and synchronous motor drive and the V/f, vector control and speed control of Induction/synchronous motors	A2
b.1	Analyze the common power electronic devices used in control systems.	B1
b.2	Differentiate between theory of operation for different power semiconductor devices circuits, and DC- motor drives.	B4
c.1	Apply practical hands-on experiments in the field of power electronics and drives.	C1
c.2	Choose electronic instrumentation and modern simulation tools to implement, design and test power electronic circuits, electric drives and useful power control project.	C3
d.1	Rank transferable skills of problem solving and communication during the course activities.	D1
d.2	Co-operate in teams to conduct experiments, analyze results, and develop technically sound reports of outcomes.	D6

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(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1. Recognize the common power control devices includes, diodes, Thyristors and transistors and their circuits.	• Active Lectures • Tutorials • Group Learning	• Written Assessments. • Laboratory Reports. • Presentations.
a2. Define the dynamic modeling of induction and synchronous motor drive and the V/f, vector control and speed control of Induction/synchronous motors.	• Active Lectures • Tutorials • Independent Learning • Group Learning	• Written Assessments • Laboratory Reports • Presentations.

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1. Analyze the common power electronic devices used in control systems.	• Active Lectures • Tutorials • Independent Applications of Engineering Analysis. • Problem-Based Learning	• Written Tests • Practical Assessment • Laboratory Reports • Presentations
b2. Differentiate between theory of operation for different power semiconductor devices circuits, and DC- motor drives.	• Active Lectures • Independent Applications of Engineering Analysis. • Problem-Based Learning	• Written Tests • Simulations • Presentations

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(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1. Apply practical hands-on experiments in the field of power electronics and drives.	• Hands-on Laboratory Work • Computer-Based Learning. • Case Studies. • Design Work and Projects	• Practical Assessment • Case Studies • Project Reports • Presentations
c2. Choose electronic instrumentation and modern simulation tools to implement, design and test power electronic circuits, electric drives and useful power control project.	• Hands-on Laboratory Work • Computer-Based Learning. • Case Studies. • Design Work and Projects	• Practical Assessment • Laboratory Reports • Case Studies • Project Reports

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Rank transferable skills of problem solving and communication during the course activities.	• Group Learning and Problem-Based Learning. • Design Work and Projects	• Practical Assessment • Project Reports • Laboratory Reports • Case Studies
d2. Co-operate in teams to conduct experiments, analyze results, and develop technically sound reports of outcomes.	• Group Learning • Design Work and Projects	• Practical Assessment • Project Reports • Laboratory Reports • Presentations

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IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction.	a1, a2, b1, b2	• Power Electronics Defined • Power semiconductor devices • Conversion Examples	1	2
2.	Semiconductor Switching Devices used in Power Electronics.	a1, a2, b1, b2, c2, , d1	• Power Diodes • Power Transistors • Thyristors and TRIAC	1	2
3.	Uncontrolled Rectifiers.	a1, a2, b1, b2, c2, d1	• Single phase uncontrolled rectifiers • Three phase uncontrolled rectifiers • Harmonic analysis • Output voltage with LC filter	1	2
4.	Controlled Rectifiers.	a1, a2, b1, b2, c2, d1	• Single phase controlled rectifiers • Three phase controlled rectifiers • Harmonic analysis • Power factor improvement	1	2

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5.	DC –DC Chopper Converters.	a1, a2, b1, b2, c2, d1	• Step down chopper converter • Step up chopper converter • Classifications of chopper converter	1	2
6.	DC – AC Inverters.	a1, a2, b1, b2, c2, d1	• Single-Phase Voltage Source Inverters • Three-Phase Voltage Source Inverters • Current Source Inverters • Pulse width modulation technique • Harmonic analysis • Closed-Loop Operation of Inverters	2	4
7.	Mid-Term Exam.	a1, a2, b1, b2	• The first 6 chapters.	1	2
8.	AC Voltage Converter.	a1, a2, b1, b2, c2, d1	• Single Phase AC Controllers. • Three Phase AC Controllers. • Harmonic analysis • Cycle-converters	1	2
9.	DC Drives.	a1, a2, b1, b2, c2, d1	• Single phase drives • Three phase drive • Chopper drives	3	6

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			• Closed loop control of DC motors		
10.	AC Drives.	a1, a2, b1, b2, c2, d1	• Stator voltage control • Rotor voltage control • Frequency control • Voltage frequency control • Current control • Voltage, current and frequency control • Closed loop control of induction motor • Synchronous motor control	3	6
11.	Final Exam.	a1, a2, b1, b2	All the chapters.	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

B – Case Studies and Tutorial Aspect:

Order	Tasks/ Tutorial	Number of Weeks	Contact Hours	Learning Outcomes
1.	• Operation and characteristics of diode rectifiers • Performance parameters of uncontrolled rectifiers (diode) • Analyzing of uncontrolled rectifier circuits • Simulating uncontrolled rectifiers by using MATLAB • Effects of load inductance on load currents	2	4	a1, b2, c2, d1, d2

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2.	• Operation and characteristics of controlled rectifiers (Thyristor) • Performance parameters of controlled rectifiers • Analyzing of controlled rectifier circuits • Simulating controlled rectifiers by using MATLAB • Effects of load inductance on load currents	2	4	a1, a2, b1, b2, c2, d1, d2
3.	• Operation dc – dc converters (chopper) • Performance parameters of dc converter • Analyzing of dc converter • Simulating dc converter by using MATLAB • Effects of load inductance on load currents and the conditions for continuous current	2	4	a1, a2, b1, b2, c2, d1, d2
4.	• Operation dc – ac converters known as inverters • Performance parameters of inverters • Analyzing of dc converter • Simulating inverters by using MATLAB • Effects of load impedance on load currents	2	4	a1, a2, b1, b2, c2, d1, d2
5.	• Operation of ac voltage controllers • Operation of matrix converters • Performance parameters of ac voltage controllers • Analyzing of ac voltage controllers • Simulating ac converter by using MATLAB • Effects of load inductance on load currents	2	4	a1, a2, b1, b2, c1, c2, d1, d2
6.	• Characteristics of dc motor and their control parameters • Operating modes of dc drives • Control requirements of four quadrants drives	2	4	a1, a2, b1, b2,

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	• Parameters of transfer function of converter- fed dc motor for closed control of motor speed and torque • Simulating dc drive by using MATLAB			c2, d1, d2
7.	• Control Characteristics of induction motor and the method for speed control • Principle of vector or field control for induction motor • Control characteristics of synchronous motor and the methods for speed control • Simulating ac drive by using MATLAB	2	4	a1, a2, b1, b2, c2, d1, d2
Number of Weeks /and Units Per Semester		**14**	**28**	

C - Practical Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes
1.	• Safety regulations and requirements in electrical laboratories. • Introduction to main laboratory devices and instrumentations. • Introduction to main measurement devices. • Reporting format.	1	2	a1, b2, c1, c2
2.	Diodes, SCR and TRIC Characteristics	1	2	a1, b2, c1, c2, d1, d2
3.	Single phase half and full wave uncontrolled rectifier	1	2	a1, a2, b1, b2, c1, c2, d1, d2

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4.	Three phase half wave and full wave uncontrolled rectifier	1	2	a1, a2, b1, b2, c1, c2, d1, d2
5.	Single phase half wave, semi and full wave controlled rectifier	2	4	a1, a2, b1, b2, c1, c2, d1, d2
6.	Three phase half wave and full wave controlled rectifier	2	4	a1, a2, b1, b2, c1, c2, d1, d2
7.	Step down chopper drive control	1	2	a1, a2, b1, b2, c1, c2, d1, d2
8.	Regenerative brake drive control	1	2	a1, a2, b1, b2, c1, c2, d1, d2
9.	Induction motors control used inverters	1	2	a1, a2, b1, c1, c2, d1, d2
10.	Induction motors control used volt/hertz control	1	2	a1, a2, b1, c1, c2, d1, d2
11.	Slip power control of wound rotor induction motors	1	2	a1, a2, b1, c1, c2, d1, d2
12.	Final exam	1	2	a1, a2, b1, b2, c1, c2
Number of Weeks /and Units Per Semester		**14**	**28**	

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V.Teaching Strategies of the Course:

The teaching strategies of the course are as follows:

- Active Lectures.
- Tutorials.
- Independent Learning.
- Group Learning.
- Independent Applications of Engineering Analysis.
- Problem-Based Learning.
- Hands-on Laboratory Work.
- Computer-Based Learning.
- Case Studies.
- Design Work and Projects.

VI.Assessment Methods of the Course:

The assessment methods of the course are as follows:

- Written Assessments.
- Laboratory Reports.
- Presentations.
- Practical Assessment.
- Case Studies.
- Project Reports.
- Presentations.

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VII. Assignments:

Order	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1.	Comparison between types of power diodes.	a1, a2, b1, b2, d1	3	4
2.	Design and implementation of uncontrolled rectifier circuits using MATLAB tools.	a1, a2, b1, b2, c2	4	3
3.	Design and implementation of controlled rectifier circuits using MATLAB tools.	a1, a2, b1, b2, c2	6	3
4.	Design and implementation of DC – DC choppers circuits using MATLAB tools.	a1, a2, b1, b2, c2	8	3
5.	Design and implementation of DC- AC rectifier circuits using MATLAB tools.	a1, a2, b1, b2, c2	10	3
6.	Lab-reports.	a1, a2, b1, b2	Weekly	4
Total				**20**

VIII. Schedule of Assessment Tasks for Students During the Semester:

Order	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Quizzes.	4, 7, 10, 13	20	10%	a1, a2, b1, b2

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2.	Assignments & Homework, Tasks & Presentation.	Weekly	20	10%	a1, a2, b1, b2, c2 d1, d2
3.	Mid-Term Exam.	8	20	10%	a1, a2, b1, b2
4.	Final Exam Practical.	15	20	10%	a1, a2, b1, b2, c1, c2
5.	Final Exam Theory.	16	120	60%	a1, a2, b1, b2
	Total		**200**	**100%**	

IX. Learning Resources:

- Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).

1- Required Textbook(s) (maximum two).

1. M. H. Rashid, 2014, Power electronics: circuits, devices, and applications, 4 th edition, NJ-USA, Prentice Hall.
2. Austin Hughes, 2006, Electric Motors and Drives Fundamentals, Types and Applications, 3 rd edition, USA, Elsevier Ltd.

2- Essential References.

1. Cyril W. Lander, 1993, Power electronics, 3 rd edition, NY-USA, McGraw-Hill.
2. Ned Mohan, Undeland and Robbins, 2003, Power Electronics –Converters, Applications and Design, 3 rd edition, NY-USA, John Willey & sons, Inc.
3. Fang Lin Luo, Hong Ye, Muhammad Rashid, 2005, Digital Power Electronics and Applications, USA, Elsevier Ltd.
4. E. Acha, 2002, Power Electronics control in Electrical system, 1st editions , UK, Newnes.

3- Electronic Materials and Web Sites *etc*.

1. www.goelectricdrive.com/

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	2. www.electricmachinery.com/ 3. www.goelectricdrive.com/ 4. http://www.ece.tamu.edu/~empelab/

X. Course Policies:

1.	**Class Attendance:** The students should have more than 75 % of attendance according to rules and regulations of the Faculty.
2.	**Tardy:** The students should respect the timing of attending the lectures. They should attend within 10 minutes from starting of the lecture.
3.	**Exam Attendance/Punctuality:** The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam.
4.	**Assignments & Projects:** The assignment is given to the students after each chapter, the student has to submit all the assignments for checking on time.
5.	**Cheating**: If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for enquires.

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6.	**Plagiarism**: The student will be terminated from the Faculty, if one student attend the exam on another behalf according to the policy, rules and regulations of the university.
7.	**Other policies:** • All the teaching materials should be kept out the examination hall. • The mobile phone is not allowed. • There should be a respect between the student and his teacher.

Reviewed By	Vice Dean for Academic Affairs and Post Graduate Studies: Dr. Tarek A. Barakat President of Quality Assurance Unit: Ass. Prof. Dr. Mohammed Algorafi Head of Mechatronics Engineering Department: Ass. Prof. Dr. Abdul-Malik Momin Dr. Hatem Al-Dois
	Deputy Rector for Academic Affairs Dr. Ibrahim AlMutaa Ass. Prof. Dr. Ahmed Mujahed Dr. Munaser Alsubri

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Template for Course Plan of Power Electronics and Drives

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Ass. Prof. Dr. Radwan Mohammed AL-Bouthigy	**Office Hours**					
Location& Telephone No.	775284933	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	Radwan006@yahoo.com						

II. Course Identification and General Information:						
1.	Course Title:	Power Electronics and Drives.				
2.	Course Code & Number:	MT304.				
3.	Credit Hours:	C.H.				TOTAL
		Th.	Seminar	Pr.	Tu.	
		2	-	2	2	4
4.	Study Level/ Semester at which this Course is offered:	Fourth Year- First Semester.				
5.	Pre –Requisite (if any):	Computer Programming (1), Electrical Machines (1) and Electrical Machines (2).				
6.	Co –Requisite (if any):	None				
7.	Program (s) in which the Course is offered:	Mechatronics Engineering Program.				
8.	Language of Teaching the Course:	English Language**.**				

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9.	System of Study:	Semesters.
10.	Mode of Delivery:	Lectures, Tutorials and Labs.
11.	Location of Teaching the Course:	Mechatronics Engineering Department.

III. Course Description:

This course is offered to provide students with the principle concepts in the field of power electronics and drives as enabling technologies. It gives students the skills in defining, analyzing, and solving problems related to power semiconductor devices and drive circuits. The course enables students to understand the basic topologies of power switching devices, rectifiers, AC voltage controllers, DC choppers, and voltage-fed inverters with special emphasis on application of devices and current industrial practice. Further, it helps students to identify commonly employed electric motor drives and their speed control methods. Computer simulations are also introduced to develop students' knowledge towards electric-drives-based power-electronics converters and the design of feedback controllers.

IV.	Course Intended learning outcomes (CILOs) of the course	Referenced PILOs
a.1	Recognize the common power control devices includes, diodes, Thyristors and transistors and their circuits.	A1
a.2	Define the dynamic modeling of induction and synchronous motor drive and the V/f, vector control and speed control of Induction/synchronous motors	A2
b.1	Analyze the common power electronic devices used in control systems.	B1

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b.2	Differentiate between theory of operation for different power semiconductor devices circuits, and DC- motor drives.	B4
c.1	Apply practical hands-on experiments in the field of power electronics and drives.	C1
c.2	Choose electronic instrumentation and modern simulation tools to implement, design and test power electronic circuits, electric drives and useful power control project.	C3
d.1	Rank transferable skills of problem solving and communication during the course activities.	D1
d.2	Co-operate in teams to conduct experiments, analyze results, and develop technically sound reports of outcomes.	D6

V. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction.	• Power Electronics Defined • Power semiconductor devices • Conversion Examples	1	2
2.	Semiconductor Switching Devices used in Power Electronics.	• Power Diodes • Power Transistors • Thyristors and TRIAC	2	2

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3.	Uncontrolled Rectifiers.	• Single phase uncontrolled rectifiers • Three phase uncontrolled rectifiers • Harmonic analysis • Output voltage with LC filter	3	2
4.	Controlled Rectifiers.	• Single phase controlled rectifiers • Three phase controlled rectifiers • Harmonic analysis • Power factor improvement	4	2
5.	DC –DC Chopper Converters.	• Step down chopper converter • Step up chopper converter • Classifications of chopper converter	5	2
6.	DC – AC Inverters.	• Single-Phase Voltage Source Inverters • Three-Phase Voltage Source Inverters • Current Source Inverters • Pulse width modulation technique • Harmonic analysis • Closed-Loop Operation of Inverters	6,7	4
7.	Mid-Term Exam.	• The first 6 chapters.	8	2
8.	AC Voltage Converter.	• Single Phase AC Controllers. • Three Phase AC Controllers. • Harmonic analysis • Cycle-converters	9	2

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9.	DC Drives.	• Single phase drives • Three phase drive • Chopper drives • Closed loop control of DC motors	10,11,12	6
10.	AC Drives.	• Stator voltage control • Rotor voltage control • Frequency control • Voltage frequency control • Current control • Voltage, current and frequency control • Closed loop control of induction motor • Synchronous motor control	13,14,15	6
11.	Final Exam.	All the chapters.	16	2
Number of Weeks /and Units Per Semester			**16**	**32**

B – Case Studies and Tutorial Aspect:

Order	Tasks/ Tutorial	Number of Weeks	Contact Hours	Learning Outcomes
1.	• Operation and characteristics of diode rectifiers • Performance parameters of uncontrolled rectifiers (diode) • Analyzing of uncontrolled rectifier circuits • Simulating uncontrolled rectifiers by using MATLAB	1,2	4	a1, b2, c2, d1, d2

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	• Effects of load inductance on load currents			
2.	• Operation and characteristics of controlled rectifiers (Thyristor) • Performance parameters of controlled rectifiers • Analyzing of controlled rectifier circuits • Simulating controlled rectifiers by using MATLAB • Effects of load inductance on load currents	3,4	4	a1, a2, b1, b2, c2, d1, d2
3.	• Operation dc – dc converters (chopper) • Performance parameters of dc converter • Analyzing of dc converter • Simulating dc converter by using MATLAB • Effects of load inductance on load currents and the conditions for continuous current	5,6	4	a1, a2, b1, b2, c2, d1, d2
4.	• Operation dc – ac converters known as inverters • Performance parameters of inverters • Analyzing of dc converter • Simulating inverters by using MATLAB • Effects of load impedance on load currents	7,8	4	a1, a2, b1, b2, c2, d1, d2
5.	• Operation of ac voltage controllers • Operation of matrix converters • Performance parameters of ac voltage controllers • Analyzing of ac voltage controllers • Simulating ac converter by using MATLAB • Effects of load inductance on load currents	9,10	4	a1, a2, b1, b2, c1, c2, d1, d2
6.	• Characteristics of dc motor and their control parameters • Operating modes of dc drives	11,12	4	a1, a2, b1, b2,

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	• Control requirements of four quadrants drives • Parameters of transfer function of converter- fed dc motor for closed control of motor speed and torque • Simulating dc drive by using MATLAB			c2, d1, d2
7.	• Control Characteristics of induction motor and the method for speed control • Principle of vector or field control for induction motor • Control characteristics of synchronous motor and the methods for speed control • Simulating ac drive by using MATLAB	13,14	4	a1, a2, b1, b2, c2, d1, d2
Number of Weeks /and Units Per Semester		**14**	**28**	

C - Practical Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes
1.	• Safety regulations and requirements in electrical laboratories. • Introduction to main laboratory devices and instrumentations. • Introduction to main measurement devices. • Reporting format.	1	2	a1, b2, c1, c2
2.	Diodes, SCR and TRIC Characteristics	2	2	a1, b2, c1, c2, d1, d2
3.	Single phase half and full wave uncontrolled rectifier	3	2	a1, a2, b1, b2, c1, c2, d1, d2

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4.	Three phase half wave and full wave uncontrolled rectifier	4	2	a1, a2, b1, b2, c1, c2, d1, d2
5.	Single phase half wave, semi and full wave controlled rectifier	5,6	4	a1, a2, b1, b2, c1, c2, d1, d2
6.	Three phase half wave and full wave controlled rectifier	7,8	4	a1, a2, b1, b2, c1, c2, d1, d2
7.	Step down chopper drive control	9	2	a1, a2, b1, b2, c1, c2, d1, d2
8.	Regenerative brake drive control	10	2	a1, a2, b1, b2, c1, c2, d1, d2
9.	Induction motors control used inverters	11	2	a1, a2, b1, c1, c2, d1, d2
10.	Induction motors control used volt/hertz control	12	2	a1, a2, b1, c1, c2, d1, d2
11.	Slip power control of wound rotor induction motors	13	2	a1, a2, b1, c1, c2, d1, d2
12.	Final exam	14	2	a1, a2, b1, b2, c1, c2
Number of Weeks /and Units Per Semester		**14**	**28**	

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VI. Teaching Strategies of the Course:

The teaching strategies of the course are as follows:

- Active Lectures.
- Tutorials.
- Independent Learning.
- Group Learning.
- Independent Applications of Engineering Analysis.
- Problem-Based Learning.
- Hands-on Laboratory Work.
- Computer-Based Learning.
- Case Studies.
- Design Work and Projects.

VII. Assignments:

Order	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1.	Comparison between types of power diodes.	a1, a2, b1, b2, d1	3	4
2.	Design and implementation of uncontrolled rectifier circuits using MATLAB tools.	a1, a2, b1, b2, c2	4	3
3.	Design and implementation of controlled rectifier circuits using MATLAB tools.	a1, a2, b1, b2, c2	6	3

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4.	Design and implementation of DC – DC choppers circuits using MATLAB tools.	a1, a2, b1, b2, c2	8	3
5.	Design and implementation of DC- AC rectifier circuits using MATLAB tools.	a1, a2, b1, b2, c2	10	3
6.	Lab-reports.	a1, a2, b1, b2	Weekly	4
Total				**20**

VIII. Schedule of Assessment Tasks for Students During the Semester:

Order	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Quizzes.	4, 7, 10, 13	20	10%	a1, a2, b1, b2
2.	Assignments & Homework, Tasks & Presentation.	Weekly	20	10%	a1, a2, b1, b2, c2 d1, d2
3.	Mid-Term Exam.	8	20	10%	a1, a2, b1, b2
4.	Final Exam Practical.	15	20	10%	a1, a2, b1, b2, c1, c2
5.	Final Exam Theory.	16	120	60%	a1, a2, b1, b2
	Total		**200**	**100%**	

IX.Learning Resources:

- Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).

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1- Required Textbook(s) (maximum two).	
	1. M. H. Rashid, 2014, Power electronics: circuits, devices, and applications, 4 th edition, NJ-USA, Prentice Hall. 2. Austin Hughes, 2006, Electric Motors and Drives Fundamentals, Types and Applications, 3 rd edition, USA, Elsevier Ltd.
2- Essential References.	
	1. Cyril W. Lander, 1993, Power electronics, 3 rd edition, NY-USA, McGraw-Hill. 2. Ned Mohan, Undeland and Robbins, 2003, Power Electronics –Converters, Applications and Design, 3 rd edition, NY-USA, John Willey & sons, Inc. 3. Fang Lin Luo, Hong Ye, Muhammad Rashid, 2005, Digital Power Electronics and Applications, USA, Elsevier Ltd. 4. E. Acha, 2002, Power Electronics control in Electrical system, 1st editions , UK, Newnes.
3- Electronic Materials and Web Sites *etc*.	
	1. www.goelectricdrive.com/ 2. www.electricmachinery.com/ 3. www.goelectricdrive.com/ 4. http://www.ece.tamu.edu/~empelab/

X.Course Policies:

1.	**Class Attendance:** The students should have more than 75 % of attendance according to rules and regulations of the Faculty.
2.	**Tardy:**

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	The students should respect the timing of attending the lectures. They should attend within 10 minutes from starting of the lecture.
3.	**Exam Attendance/Punctuality:** The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam.
4.	**Assignments & Projects:** The assignment is given to the students after each chapter, the student has to submit all the assignments for checking on time.
5.	**Cheating**: If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for enquires.
6.	**Plagiarism**: The student will be terminated from the Faculty, if one student attend the exam on another behalf according to the policy, rules and regulations of the university.
7.	**Other policies:** • All the teaching materials should be kept out the examination hall. • The mobile phone is not allowed. • There should be a respect between the student and his teacher.

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