MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Power electronics**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☐ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	RETE 303				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level	3		**Semester of Delivery**	5	
Administering Department	RETE		**College**	College of Oil & Gas Techniques Engineering/Kirkuk	
Module Leader			**e-mail**		
Module Leader's Acad. Title			**Module Leader's Qualification**	M.Sc.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name			**e-mail**	@ntu.edu.iq	
Scientific Committee Approval Date	01/06/2023		**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	AC Electrical Circuits	**Semester**	1
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Aims أهداف المادة الدراسية	The aims of this module are: 1. To introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics. 2. To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications. 3. To give students the ability to practice problem solving and design skills individually and in small groups, reflecting the requirements of the engineering profession. 4. To further develop student's awareness of the multifaceted and often conflicting dimensions of electronics design including performance, cost and energy efficiency. 5. To inform and to allow students to question the practices of modern power electronics engineering via discussions, interactions and case studies led by leading industry professionals. 6. To provide strong foundation for further study of power electronic circuits and systems.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	On successful completion of this module a student will be able to: 1. Relate basic semiconductor physics to properties of power devices, and combine circuit mathematics and characteristics of linear and non-linear devices. 2. Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits. 3. Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields. 4. Formulate and analyze a power electronic design at the system level and assess the performance. 5. Identify the critical areas in application levels and derive typical alternative solutions, select suitable power converters to control Electrical Motors and other industry grade apparatus.

	6. Recognize the role power electronics play in the improvement of energy usage efficiency and the applications of power electronics in emerging areas.
Indicative Contents المحتويات الإرشادية	• Concept of power electronics, application of power electronics, advantages and disadvantages of power electronics converters, power electronics systems. • Power diodes, Its characteristics, types. • Brief Discussion about uncontrolled converters (Diode rectifiers). • Power transistors, Steady state characteristics, switching performance, safe operating area. • Power mosfets, characteristics, comparison with BJT. • IGBT, characteristics. • Thyristors, V-I characteristics and applications. SCR turn on methods. • Switching characteristics of thyristor, Two transistor model of SCR • Gate characteristics, ratings. • Thyristor protection • Series and parallel operation of thyristor, Gate triggering circuits of thyristor. • Different commutation techniques of SCR. • Brief description of members of thyristor family with symbol, GTO. • Principle of operation of single-phase half wave-controlled rectifiers with R, RL and RLE load, effects of freewheeling diodes. Calculation of performance parameters • Principle of operation of single-phase full wave controlled and half controlled rectifiers with R, RL and RLE loads, effects of freewheeling diodes. Calculation of performance parameters • Three phase half wave and full wave controlled and half controlled rectifiers with different loads. Effects of source inductance on the performance of converters • Techniques of power factor improvement, single phase and three phase dual converters. • DC-DC converters: Principle of operation, control strategies • Step-down chopper, performance parameters. • Step-up chopper, performance parameters. • Step-down/ step-up chopper, performance parameters. • Types of chopper circuits based on quadrant of operation. • Multiphase choppers and switching mode regulators. • Inverters: Definition, classification of inverters based on nature of input source, wave shape of output voltage, method of

	commutation & connections. • Principle of operation of single-phase bridge inverter with R and R-L loads, performance parameters. • Principle of operation of three phase bridge inverter with R and R-L loads, performance parameters • Methods of voltage control and harmonic reduction of inverters • Brief idea of Resonant Pulse inverters. • AC controllers: Principle of on-off and phase control • Single phase and three phase controllers with R and R-L loads, performance parameters.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	• series of lectures. The lectures containing numerous practical design examples. Circuit simulation models of all of the circuits analyzed are provided and students are encouraged to use these to gain a better understanding. • Laboratory sessions are arranged in the form of a mini-project which is conducted over several sessions where students get the opportunity to design, simulate, build and test a DC-DC converter circuit and hence put into practice the theory covered in the lectures. • Bite-sized pre-recorded content and detailed lecture notes aimed at independent learning. • Guest lectures and discussion sessions from industry. • Visualization and sensory experience to correlate electronic circuit mathematical analysis and physical behavior. • person tutorials to focused on problem solving, case studies and discussion of engineering challenges. • In-class review of taught material during revision week • in-class tests where one or more of these are an assessment on the module.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ أسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	63	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	62	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.13
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	1,4,6,8,11	LO #1, 2 and 3
	Assignments	5	10% (10)	3, 5,7,9,12	LO # 3,4, 5 and 6
	Projects / Lab.	14	10% (10)	Continuous	
	Report	1	10% (10)	13	LO # 5, 8 and 10
Summative assessment	**Midterm Exam**	2 hr	10% (10)	7	LO # 1-7
	Final Exam	2hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material to be Covered
Week 1-2	• Introduction to power electronics
Week 3	• Switching devices, power and control devices
Week 4	• Type and characteristic, rating (diode, transistor, …)
Week 5	• Methods of turning – ON and turning – OFF
Week 6	• Protection of power devices
Week 7	Triggering and base drive circuits

Week 8	• Controlled rectifiers, 1-phase and 3-phase circuits
Week 9	• Half-wave and full-wave circuits
Week 10	• DC choppers, step-up and step-down choppers
Week 11	• AC phase controller
Week 12	• Invertors, 1-phase and 3-phase bridges
Week 13	• Some applications, a uninterrup table power supply.
Week 14	• (UPS) b-switched mode power supply (SMP)
Week 15	**Review for final exam**
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material to be Covered
Week 1-2	Thyristor trigger angle & conduction angle
Week 3-4	SCR half –wave rectifier with load resistance .
Week 5-6	SCR half wave rectifier with inductive load
Week 7-8	SCR Full - wave Rectifier with load resistance .
Week 9-11	light dimmer circuit by using one scr
Week 12-14	AC voltage controlled
Week 15	**Review for final exam**
Week 16	**Final exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	1. Power Electronics by M.H. Rashid, PHI. 2. 2. Power Electronics by P.S. Bhimra, Khanna Publishers. 3. 3. Power Electronics by M.D. Singh and K.B. Khanchandani, TMH.	Yes
Recommended Texts		Yes
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks (%)**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.