MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	Internal Combustion Engines			**Module Delivery**	
Module Type	Core			☒ Theory ☐ Lecture ☒ Lab ☒ Tutorial ☐ Practical ☐ Seminar	
Module Code	UOMU0206052				
ECTS Credits	6				
SWL (hr/sem)	180				
Module Level		UGIII	**Semester of Delivery**		5
Administering Department		**Fuel and Energy Techniques Engineering Department**	**College**	**Engineering Technical college**	
Module Leader	**Sagr Mohammed Khalaf Al-Farttoosi**		**e-mail**	**sagr.mohammed.khalaf@uomus.edu.iq**	
Module Leader's Acad. Title		**Lecturer**	**Module Leader's Qualification**		**Ph.Dr. Internal Combustion Engines**
Module Tutor			**e-mail**		
Peer Reviewer Name			**e-mail**		
Scientific Committee Approval Date			**Version Number**	1	

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

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Aims أهداف المادة الدراسية	1. To Analyze Engine components and basic engine nomenclature. I.C. 2. To Explain Four stroke SI Engines and CI Engines. Two stroke Engines. 3. To Analyze Fundamental differences between SI Engines and CI engines. 4. To Analyze the Ideal or air standard cycles. 5. To study the Carnot cycle, Otto cycle, Diesel cycle, dual combustion cycle. 6. To Analyze the Engine Parameters. 7. To study the Hydrocarbon Fuels-Gasoline. 8. To Analyze the Carburetion system. 9. To Analyze the Heat release pattern and fuel injection 10. To Explain Types of injection systems 11. To Explain Lubrication principles. 12. To Explain Necessity of Engine cooling systems. 13. To Analyze the Objects of supercharging.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Ability to Analyze Engine components and basic engine nomenclature. I.C. 2. Ability to Explain Four stroke SI Engines and CI Engines. Two stroke Engines. 3. Ability to Analyze Fundamental differences between SI Engines and CI engines. 4. Ability to Analyze the Ideal or air standard cycles. 5. To study the Carnot cycle, Otto cycle, Diesel cycle, dual combustion cycle. 6. Ability to Analyze the Engine Parameters. 7. Ability to study the Hydrocarbon Fuels-Gasoline. 8. Ability to Analyze the Carburetion system. 9. Ability to Analyze the Heat release pattern and fuel injection 10. Ability to Explain Types of injection systems 11. Ability to Explain Lubrication principles. 12. Ability to Explain Necessity of Engine cooling systems. 13. Ability to Analyze the Objects of supercharging.
Indicative Contents المحتويات الإرشادية	**Introduction** Introduction to internal combustion engine. Terminology, TDC & BDC, Stroke &swept volume, compression ratio [15 hrs.] **I.C.E. Classification** Engine components and basic engine nomenclature. I.C. Engines classifications. Four stroke SI Engines. Four stroke CI Engines. [15 hrs.] **Air Standard Cycles**

	Introduction. Ideal or air standard cycles. Useful thermodynamic relations. The Carnot cycle. The Otto cycle. The Diesel cycle. [8 hrs.] **Operating Characteristic (Indicated and Effective values)** Engine Parameters. Work. Mean Effective Pressure. Torque and Power. Air-Fuel Ratio and Fuel-Air Ratio. Specific Fuel Consumption. [10 hrs.] **Fuels and Combustion** Hydrocarbon Fuels-Gasoline. Some Common Hydrocarbon Components. Self-Ignition and Octane Number. Diesel fuel. Chemical equilibrium. [15 hrs.] **Mixture Preparation in S.I Engines** Carburetion. Mixture requirements for steady state operation. Distribution. Transient mixture requirements. A simple or elementary carburetor. [10 hrs.] **Fuel Injection** Heat release pattern and fuel injection. Requirements of a diesel injection system. Types of injection systems. Fuel pump. [8 hrs.] **Ignition** Ignition system requirements. Battery ignition system. Magneto ignition system. Ignition Timing. Spark plugs. [8 hrs.] **Combustion in Spark Ignition Engines** Stages of combustion in S.I.E. Abnormal combustion. Ricardo's theory of combustion chamber. [12 hrs.] **Combustion in Compression Ignition Engines** Combustion stages in C.I engines. Factors effecting on ignition delay. Type of combustion chamber in C.I engines. [15 hrs.] **Lubrication System in I.C Engines** Lubrication principles. Function of lubrication. Properties of lubricating oil. Classification of lubricating oils. Oil Filters. [10 hrs.] **Cooling System in IC Engines** Necessity of Engine cooling. Air Cooling. Water-cooling. Comparison of air and water-cooling systems. Radiators. [10 hrs.] **Supercharging** Objects of supercharging. Thermodynamic cycle with supercharging. Supercharging of spark ignition engine. [10 hrs.] **Rotary Engines** The working principle. Features of the rotary engines. Engine geometry. Combustion in rotary engines. Applications of rotary engines. [15 hrs.]

	Air Pollution Pollutants from gasoline engines. Emission control for Gasoline engine. Diesel emission. Diesel smoke and control. [8 hrs.]
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises are 1. Teamwork 2. Visualization 3. Inquiry-Based Teaching 4. Student-led Classroom 5. Implementing Technology in the Classroom 6. Auditory strategies 7. Reading & Writing

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	74	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	106	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	7
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	180		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10	LO #1, 2, 10 and 11
	Assignments	2	10% (10)	2, 12	LO # 3, 4, 6 and 7
	Projects / Lab.	1	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 Covered
Week 1	Introduction to internal combustion engine. Terminology, TDC & BDC, Stroke &swept volume, compression ratio
Week 2	I.C.E. Classification Engine components and basic engine nomenclature. I.C. Engines classifications. Four stroke SI Engines. Four stroke CI Engines. Two stroke Engines. Fundamental differences between SI Engines and CI engines. Application of IC Engines. First law analysis of engine cycle-energy balance.
Week 3	Air Standard Cycles Introduction. Ideal or air standard cycles. Useful thermodynamic relations. The Carnot cycle. The Otto cycle. The Diesel cycle. The dual combustion cycle. Comparison of Otto, Diesel, and dual combustion cycles.
Week 4	Operating Characteristic (Indicated and Effective values) Engine Parameters. Work. Mean Effective Pressure. Torque and Power. Air-Fuel Ratio and Fuel-Air Ratio. Specific Fuel Consumption. Engine Efficiencies. Volumetric Efficiency. Emissions.
Week 5	Fuels and Combustion Hydrocarbon Fuels-Gasoline. Some Common Hydrocarbon Components. Self-Ignition and Octane Number. Diesel fuel. Chemical equilibrium. Combustion temperature. Adiabatic flame temperature. Liquid and gaseous combustion.
Week 6	Mixture Preparation in S.I Engines Carburetion. Mixture requirements for steady state operation. Distribution. Transient mixture requirements. A simple or elementary carburetor. Complete carburetor. Carburetor types. Theory of simple carburetor. Aircraft carburetor. Petrol injection. The Lucas petrol injection. Electronic fuel injection. Advantage and disadvantage of petrol injection.

Week 7	Fuel Injection Heat release pattern and fuel injection. Requirements of a diesel injectionsystem. Types of injection systems. Fuel pump. Types of fuel injectors. Injection nozzles. Quantity of fuel per cycle, size of nozzle orifice. Spray formation. Spray direction. Injection timing.
Week 8	Ignition Ignition system requirements. Battery ignition system. Magneto ignition system. Ignition Timing. Spark plugs. Disadvantage of conventional system. Electronic ignition system. Factors affecting spark plug operation.
Week 9	Combustion in Spark Ignition Engines Stages of combustion in S.I.E. Abnormal combustion. Ricardo's theory of combustion chamber. Basic types of combustion chamber in S. I. Engines.
Week 10	Combustion in Compression Ignition Engines Combustion stages in C.I engines. Factors effecting on ignition delay. Type of combustion chamber in C.I engines.
Week 11	Lubrication System in I.C Engines Lubrication principles. Function of lubrication. Properties of lubricating oil. Classification of lubricating oils. Oil Filters. Lubrication systems. Engine performance and lubrication.
Week 12	Cooling System in IC Engines Necessity of Engine cooling. Air Cooling. Water-cooling. Comparison of air and water-cooling systems. Radiators.
Week 13	Supercharging Objects of supercharging. Thermodynamic cycle with supercharging. Supercharging of spark ignition engine. Supercharging of C.I engine. Supercharging limits. Methods of supercharging. Turbo charging. Methods of Turbo charging. Limitations of Turbo charging.
Week 14	Rotary Engines The working principle. Features of the rotary engines. Engine geometry. Combustion in rotary engines. Applications of rotary engines.
Week 15	Air Pollution

	Pollutants from gasoline engines. Emission control for Gasoline engine. Diesel emission. Diesel smoke and control. Comparison of diesel and gasoline emissions. Air pollution from gas turbine.
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Lab 1: Introduction & Classifications of Internal Combustion Engines
Week 2	Lab 2: Performance & Testing of IC Engines
Week 3	Lab 3: Effects of Operation Variables on Engine Performance
Week 4	Lab 4 : Chemical Correct Ratio for Air-Fuel Mixture
Week 5	Lab 5: Air-Fuel Mixture Calculations
Week 6	Lab 6: Experimental analysis for Exhaust Gases
Week 7	**Preparatory week before the final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	[1] Engineering fundamentals of the internal combustion engines by Willard P. [2] Internal combustion engines, by Mathur and Sharma [3] Internal combustion engines applied thermo sciences by Colin F. and Allan T. [4] Introduction to I.C.E by J.B Heywood.	yse
Recommended Texts		
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.