	Ministry of Higher Education and Scientific Research - Iraq **Al-Naji University** **College of Engineering** **AI Engineering Department**	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Physics**			**Module Delivery**	
Module Type	**Basic**			☒ **Theory** ☐ **Lecture** ☒ **Lab** ☒ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**CEA1105**				
ECTS Credits	**7**				
SWL (hr/sem)	**175**				
Module Level		UGI	**Semester of Delivery**		1
Administering Department		AI Engineering	**College**	Engineering	
Module Leader	Dr. Ghassan Salem Abdullah		e-mail	ghassan.salem@alnaji-uni.edu.iq	
Module Leader's Acad. Title		Assist Prof.	Module Leader's Qualification		Ph.D.
Module Tutor			e-mail		
Peer Reviewer Name					
Scientific Committee Approval Date			**Version Number**		1.0

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 Objectives أهداف المادة الدراسية	1. **Understand Physical Laws and Theories**: to explain and apply fundamental laws and theories of physics, such as Newtonian mechanics, electromagnetism, and thermodynamics within the context of AI and robotics. 2. **Mathematical Application in Physics:** to use mathematical methods, including calculus and vector algebra, to analyze and solve physics problems relevant to AI and robotics. 3. **Analyze Motion and Dynamics**: to describe and analyze the motion of particles and rigid bodies in both one and multiple dimensions, including forces, work-energy principles, and conservation laws, with an emphasis on applications in robotic systems. 4. **Study of Electromagnetic Theory**: to apply principles of electricity and magnetism, including electric fields, magnetic fields, and circuits, to understand sensor technology, motor control, and data transmission in robotics. 5. **Energy Systems and Thermodynamics**:to analyze energy transformations and thermodynamic processes, particularly in the context of robotics power systems, heat dissipation, and efficiency. 6. **Explore Quantum and Modern Physics Concepts**: to understand basic concepts of modern and quantum physics that can impact emerging technologies, such as quantum computing, semiconductor physics, and materials science. 7. **Practical Laboratory Skills**: to develop practical laboratory skills, including experiment design, data collection, and error analysis, to validate physics theories through hands-on experience.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understanding Fundamental Concepts:** Demonstrate a clear understanding of fundamental physics concepts, including kinematics, dynamics, energy, momentum, thermodynamics, electromagnetism, and modern physics. **2. Application of Physical Principles:** Apply core physics principles to analyze and solve engineering problems relevant to AI and robotics, including motion planning, energy management, and system dynamics. **3. Mechanical Analysis and Dynamics**: Analyze and predict the motion and dynamics of particles and rigid bodies, applying these principles to the design and control of robotic systems.

	4. Electromagnetic Theory and Application: Apply knowledge of electricity and magnetism to understand and troubleshoot circuits, sensors, and actuators commonly used in AI and robotics **5. Energy Management and Thermodynamics**: Explain and analyze energy transformation, heat transfer, and thermodynamic processes, particularly as they apply to robotic power systems and energy-efficient design. **6. Problem Solving and Critical Thinking:** Employ physics principles to develop, analyze, and solve engineering problems, using critical thinking to approach complex scenarios in AI and robotics. **7. Experimental Techniques:** Conduct laboratory experiments to investigate physical phenomena, accurately measure and analyze data, and draw conclusions based on empirical evidence. **8. Communication Skills:** Communicate complex physical concepts effectively, both verbally and in writing, to a variety of audiences, including peers, faculty, and industry professionals. **9. Collaboration and Teamwork:** Work collaboratively in teams to design, implement, and present projects that apply physics concepts to real-world problems in AI and robotics.

Indicative Contents
المحتويات الإرشادية
	Indicative content includes the following.
	1: Introduction to Physics
	
	• **Overview of Physics in Engineering**
	  ○ Role of physics in various engineering fields.
	  ○ How physics principles influence design and functionality.
	• **Significance of Physics in AI and Robotics**
	  ○ Applications of physics in robotics design and operation.
	  ○ Importance of understanding physical principles in AI algorithms.
	• **Basic Units and Measurements**
	  ○ Introduction to the International System of Units (SI).
	  ○ Measurement techniques and accuracy.
	• **Dimensional Analysis**
	  ○ Understanding dimensions and units of measurement.
	  ○ Checking equations and solving problems.
	• **Vectors**
	  ○ Definition of vectors and scalars.
	  ○ Vector addition and subtraction.
	  ○ Applications of vectors in physics problems.
	
	2: Mechanics – Kinematics
	
	• **Motion in One Dimension**
	  ○ Definitions of displacement, velocity, and acceleration.
	  ○ Graphical representation of motion.

- **Velocity and Acceleration**
  - Average vs. instantaneous velocity.
  - Acceleration as a vector quantity.
- **Free-Falling Bodies**
  - Equations of motion under gravity.
  - Free-fall experiments and calculations.

3: Mechanics – Kinematics (cont.)

- **Motion in Two Dimensions**
  - Analyzing motion in the x-y plane.
  - Concepts of vector components in two dimensions.
- **Projectile Motion**
  - Trajectory, range, and maximum height calculations.
  - Factors affecting projectile motion.
- **Circular Motion**
  - Uniform circular motion and its characteristics.
  - Centripetal acceleration and forces.

4: Mechanics – Dynamics

- **Force, Mass, and Acceleration**
  - Newton's second law of motion.
  - Relationship between force, mass, and acceleration.
- **Newton's Laws of Motion**
  - Detailed exploration of all three laws.
  - Applications and examples.
- **Friction and Its Effects on Motion**
  - Types of friction (static, kinetic).
  - Calculating frictional forces and their impact on motion.

5: Work and Energy

- **Work Done by Forces**
  - Definition and calculation of work.
  - Work-energy theorem.
- **Kinetic and Potential Energy**
  - Types of energy and conversion.
  - Calculating kinetic and potential energy.
- **Conservation of Energy Principle**
  - Principles and examples of energy conservation.
  - Application of conservation laws in mechanical systems.

6: Rotational Motion

- **Angular Displacement, Velocity, and Acceleration**
  - Definitions and relationships to linear motion.
- **Torque and Rotational Inertia**
  - Understanding torque and its applications.
  - Moment of inertia and its significance in rotational dynamics.
- **Dynamics of Rotational Motion**

- Application of Newton's laws to rotational systems.
- Problem-solving in rotational dynamics.

7: Electricity and Magnetism

- **Electrostatics and Electric Fields**
  - Coulomb's law and electric force.
  - Electric field concepts and calculations.
- **Current, Resistance, and Ohm's Law**
  - Definitions and calculations of current and resistance.
  - Practical applications of Ohm's Law.
- **Electrical Energy and Capacitance**
  - Electrical energy calculations.
  - Capacitors in circuits and their behavior.
- **Magnetism and Electromagnetic Induction**
  - Magnetic fields and forces.
  - Faraday's law of induction and applications.

8: Midterm Exam

- **Midterm Examination**
  - Assessment of knowledge and understanding of the course material.

9: Thermodynamics

- **Laws of Thermodynamics**
  - Overview of the first, second, and third laws.
  - Applications of thermodynamics in engineering.
- **Heat Transfer Methods**
  - Conduction, convection, and radiation concepts.
- **Thermodynamic Processes and Cycles**
  - Understanding different thermodynamic processes (isothermal, adiabatic).
  - Analysis of thermodynamic cycles (Carnot cycle).

10: Oscillations and Waves

- **Simple Harmonic Motion**
  - Characteristics and equations of SHM.
  - Energy in simple harmonic motion.
- **Wave Properties and Sound Waves**
  - Wave characteristics (frequency, wavelength, amplitude).
  - Sound wave properties and applications in engineering.
- **Damping and Resonance**
  - Effects of damping on oscillatory motion.
  - Conditions for resonance and applications.

11: Electromagnetic Waves

- **Nature and Properties of Electromagnetic Waves**

	○ Overview of the electromagnetic spectrum. ○ Speed of light and its implications. • **Applications of Electromagnetic Waves in Technology** ○ Wireless communication, radar, and other applications. **12: Light and Optics** • **Nature and Propagation of Light** ○ Wave-particle duality of light. • **Speed and Source of Light** ○ Measurement of the speed of light and its implications. • **Refraction and Reflection Laws** ○ Laws of reflection and refraction. ○ Practical applications in lenses and mirrors. • **Total Internal Reflection** ○ Conditions for total internal reflection. • **Dispersion and Prisms** ○ Understanding how prisms disperse light.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	• **Lectures:** Traditional lectures provide theoretical foundations, explanations of key concepts, and demonstrations of mathematical derivations. Lectures may include visual aids such as slides, diagrams, and multimedia presentations to enhance understanding. • **Interactive Discussions:** Facilitating interactive discussions encourages student engagement and deeper understanding of concepts. Encourage students to ask questions, share insights, and participate in group discussions. • **Problem-Solving Sessions**: Conducting problem-solving sessions allows students to apply theoretical knowledge to solve engineering problems. Work through example problems together and provide opportunities for students to practice solving problems individually or in groups. • **Laboratory Work:** Hands-on laboratory experiments and simulations provide practical experience in implementing control systems, conducting experiments, and

	analyzing experimental data. This helps reinforce theoretical concepts and develop practical skills. • **Continuous Assessment**: Implementing regular quizzes, assignments, and assessments helps monitor student progress, identify areas for improvement, and provide feedback. Continuous assessment encourages regular review and reinforcement of learning objectives.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ 15 اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	93	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	82	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	5
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	175		

Module Evaluation
تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	3, 10	LO #1,2, 3,4
	Assignments	3	10% (10)	2,7,14	LO # 1,2,3,4, 5,6,8
	Lab	1	15% (15)	continuous	All
	Report	1	5% (5)	15	All
Summative assessment	**Midterm Exam**	2 hrs	10% (10)	7	LO # 1,2,3,6
	Final Exam	3 hrs	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	**Introduction to Physics :** Overview of physics in engineering; significance of physics in AI and robotics; basic units and measurements; dimensional analysis, Vectors.
Week 2	**Introduction to Physics : *(cont.)*** Overview of physics in engineering; significance of physics in AI and robotics; basic units and measurements; dimensional analysis, Vectors.
Week 3	**Mechanics – Kinematics:** Motion in one Dimension , velocity, acceleration, Free falling bodies.
Week 4	**Mechanics – Kinematics: *(cont.)*** Motion in two dimensions ,Project motion , Circular motion
Week 5	**Mechanics – Dynamics:** Force, mass, and acceleration , Newton's laws of motion ,Friction and its effects on motion
Week 6	**Work and Energy:** Work done by forces, Kinetic and potential energy, Conservation of energy principle
Week 7	**Rotational Motion:** Angular displacement, velocity, and acceleration, Torque and rotational inertia, Dynamics of rotational motion
Week 8	**Midterm Exam**
Week 9	**Electricity and Magnetism**: Electrostatics and electric fields, Current, resistance, and Ohm's law, Electrical Energy and Capacitance , Magnetism and electromagnetic induction
Week 10	**Electricity and Magnetism**: **(cont.)** Electrostatics and electric fields, Current, resistance, and Ohm's law, Electrical Energy and Capacitance , Magnetism and electromagnetic induction
Week 11	**Electricity and Magnetism**: **(cont.)** Electrostatics and electric fields, Current, resistance, and Ohm's law, Electrical Energy and Capacitance , Magnetism and electromagnetic induction
Week 12	**Thermodynamics:** Laws of thermodynamics, Heat transfer methods, Thermodynamic processes and cycles.
Week 13	**Oscillations and Waves:** Simple harmonic motion**,** Wave properties and sound waves**,** Damping and resonance.
Week 14	**Electromagnetic Waves:** Nature and properties of electromagnetic waves, Applications of electromagnetic waves in technology.
Week 15	**Light and Optics** The Nature and propagation of light , Speed and source of light ,The Refraction and Reflection law ,Total internal reflection ,Dispersion and Prisms.
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	HOOKE'S Law of springs
Week 2	Acceleration of free fall by mean of the Simple pendulum
Week 3	Forces
Week 4	The surface tension of water by the pull of microscope slide
Week 5	Refractive index of (glass) by real and apparent depth using traveling microscope
Week 6	Moment of inertia and angular acceleration
Week 7	Heat capacity of metals
Week 8	Boyle's Law
Week 9	Laws of lenses and optical instruments
Week 10	Final Lab Exam

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Textbooks	University Physics, Sear - Zemasky - Young Seventh Edition ,Volume 1 ,1987-2000	yes
Recommended Textbooks	Physics, OpenStax Rice University,2020	No
Websites	Google classroom	

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.