MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Differential Equations**			**Module Delivery**	
Module Type	**Basic**			☒**Theory** ☐ **Lecture** ☐ **Lab** ☒ **Tutorial** ☐**Practical** ☐**Seminar**	
Module Code	**ATU11407**				
ECTS Credits	**7**				
SWL (hr/sem)	**175**				
Module Level		UGII	**Semester of Delivery**		2
Administering Department			**College**	NETC	
Module Leader	Asaad. S. Daghal		**e-mail**	ad466kent@atu.edu.iq	
Module Leader's Acad. Title		Assist. Prof.	**Module Leader's Qualification**		Ph.D.
Module Tutor	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name		Nasir Hussein Selman	**e-mail**	Coj.nas@atu.edu.iq	
Scientific Committee Approval Date		01/10/2024	**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. **Understanding Transform Theory**: o To provide students with a comprehensive understanding of Fourier series and Fourier transforms, enabling them to analyze and represent both periodic and aperiodic functions in the frequency domain. 2. **Application of Fourier Analysis**: o To equip students with the skills to apply Fourier analysis to solve practical problems in signal processing, communications, and other related fields, including the use of convolution in system analysis. 3. **Differential Equations Fundamentals**: o To introduce students to the fundamental concepts of ordinary differential equations (ODEs), including first-order and second-order equations, and to develop their ability to classify and solve these equations using appropriate techniques. 4. **Analytical Techniques for ODEs**: o To teach students various analytical methods for solving first-order and second-order ordinary differential equations, including separation of variables, integrating factors, and the method of undetermined coefficients. 5. **Complex Problem Solving**: o To enhance students' problem-solving abilities by applying complex methods, such as variation of parameters, to find particular solutions of non-homogeneous differential equations. 6. **Real-World Applications**: o To emphasize the importance of differential equations in engineering and applied sciences by exploring their applications in modeling real-world phenomena, such as mechanical vibrations and electrical circuits.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1: Fourier Series** **Learning Outcome**: Students will be able to represent periodic functions using Fourier series and calculate the Fourier coefficients for given functions, identifying even and odd properties. **2: Fourier Transform** **Learning Outcome**: Students will understand the concept of the Fourier transform and its application to aperiodic functions, including the ability to compute the Fourier transform and its inverse for various functions. **3: Properties of Fourier Transforms** **Learning Outcome**: Students will demonstrate knowledge of the key properties of Fourier transforms, including linearity, time and frequency shifting, and the convolution theorem. **4: Convolution Theorem and Fourier Integral** **Learning Outcome**: Students will be able to apply the convolution theorem in signal processing and compute Fourier integrals for non-periodic functions, linking them to their Fourier transforms. **5: First Order Ordinary Differential Equations** **Learning Outcome**: Students will solve first-order ordinary differential

	equations using various methods such as separation of variables, exact equations, and integrating factors, differentiating between homogeneous and non-homogeneous cases. **6: Second Order Ordinary Differential Equations** **Learning Outcome**: Students will analyze and solve second-order ordinary differential equations, including homogeneous equations with constant coefficients, using methods such as characteristic equations, undetermined coefficients, and variation of parameters. These outcomes provide a structured approach to learning, allowing students to build on their knowledge each week.
Indicative Contents المحتويات الإرشادية	- Fourier transform - Ordinary differential equation - Bernoulli equation - High order differential equations

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Use the following Learning, Teaching, and Assessment strategies Learning Strategies: 1. **Interactive Lectures**: o Use multimedia presentations and real-world examples to introduce key concepts of Fourier series, Fourier transforms, and differential equations. o Encourage student participation through questions and discussions to reinforce understanding. 2. **Problem-Based Learning**: o Assign practical problems that require the application of Fourier analysis and differential equation techniques. o Facilitate group work where students collaborate to solve complex problems, fostering teamwork and critical thinking. 3. **Hands-On Workshops**: o Organize workshops where students can use software tools (e.g., MATLAB, Python) to visualize Fourier transforms and solve differential equations. o Provide guided practice sessions to help students build confidence in applying mathematical methods. 4. **Flipped Classroom**: o Encourage students to review lecture materials and video tutorials at home, allowing class time to be dedicated to problem-solving and collaborative discussions. o Provide online resources and forums for students to ask questions and engage with peers outside of class. 5. **Case Studies and Applications**: o Present case studies that demonstrate the real-world applications of Fourier analysis and differential equations in engineering and science. o Invite guest speakers from industry to share their experiences and the relevance of these concepts in practical scenarios. 6. **Regular Assessments and Feedback**: o Implement formative assessments (quizzes, homework) to gauge student understanding and provide timely feedback. o Use peer review and self-assessment strategies to encourage reflection on learning progress and areas for improvement.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
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	112	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	7.5
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)	5 and 10	LO #1, #2 and #10, #11
	Assignments	2	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Homework	1	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Transform Theory; Fourier series; periodic function; even and odd functions
Week 2	Fourier transform; aperiodic functions; properties.
Week 3	Convolution theorem; Fourier Integral.
Week 4	Ordinary differential equation of first order: - basic concepts in differential equations; variable separable
Week 5	Equation's reducible to separable form
Week 6	Homogenous equations and non-homogenous equations
Week 7	Exact differential equations;
Week 8	Non exact differential equations; integrating factor

Week 9	linear first order differential equations
Week 10	Bernoulli equation
Week 11	Ordinary differential equations of second order: - homogenous linear second order; homogeneous with constant coefficients; roots of characteristics equations,'initial condition and boundary condition
Week 12	Non homogeneous second order differential equations; complex methods for obtaining particular solutions (undetermined coefficients);
Week 13	Variation of parameters method;
Week 14	High order differential equations: - basic concepts; solution of high order characteristics equation.
Week 15	Applications of Differential Equations
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Thomas' Calculus 14th edition	Yes
Recommended Texts	Calculus 10th edition by Anton , Bivens , and Davis	Yes
Websites	https://www.lboro.ac.uk/departments/mlsc/student-resources/helm-workbooks/	

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.