هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	Differential Equations For Physics
Course Code:	2032203-3
Program:	BSc. in Physics
Department:	Physics Department
College:	College of Science
Institution:	Taif University
Version:	1
Last Revision Date:	2020

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (4th / 2nd)					
4. Course general Description:					
Basic concepts of differential equations (order, degree, linearity, homogenous, non-homogeneous and linearity – initial-value and boundary-value problems)– First-order degree differential equations (standard and differential form – separable, exact, linear, homogenous equations and non-homogeneous equations can be converted into homogeneous) –nonlinear equations that can be converted into linear differential equations (Bernoulli and Riccati equations…) -First-order and higher-degree differential equations(Clairaut and Lagrange equations….) - Application of first-order differential equations in physics - Higher order homogeneous, non-homogeneous and linear differential equations with constant coefficients, cases of different roots of the characteristic equation,) - Methods of finding the homogeneous and particular solutions - Some physics applications.					
5. Pre-requirements for this course (if any):					
Differentiation and Integration (2022111-4)					
6. Co-requisites for this course (if any):					
None					
7. Course Main Objective(s):					
Recognize the types of differential equations and apply knowledge of mathematics to the solution of problems. Designing and implementing solutions to practical problems in physics and transform practical problems in physics into differential equations.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45 (3h per week)	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		**45**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	State the basic concepts and classify the various differential equations	K1	Lecture	Written exam and Homework reports
1.2	Recognize the theory of solution of various differential equations describing natural phenomena	K3	Lecture Discussion	Written exam
2.0	**Skills**			
2.1	Solve 1st and 2nd order linear ordinary differential equations using appropriate theoretical methods	S2	Lectures	Written exam and Homework reports
2.2	Formulate a physical phenomenon into a differential	S3	Lecture and	Written exam

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	equation by using physics laws and evaluate its adequate solution related to the boundary (subsidiary) conditions of the problem		Groups discussion	
3.0	**Values, autonomy, and responsibility**			
3.1	Show responsibility for working independently and for continuous improvement of personal capacities.	V1	Groups discussion	Homework

C. Course Content

No	List of Topics	Contact Hours
1.	**Basic concepts of differential equations:** ▪ Ordinary and partial differential equations ▪ Order and degree of a differential equation ▪ Linear, nonlinear, homogeneous and non-homogeneous differential ▪ equations ▪ General and particular solution of differential equations ▪ Initial –Value and Boundary –Value problems ▪ Some examples	3
2.	**First-Order and First-degree differential equation:** ▪ Standard form and differential form ▪ Separable equation ▪ Homogeneous equation and reduction to homogeneous equation ▪ Exact equation and reduction to exact equation by multiplying by integrating factor ▪ Linear equation ▪ Nonlinear equations that can be converted into linear differential equations (Bernoulli equation, Riccati equations...) ▪ Higher-degree differential equation can be converted to First-degree differential equation. The equation can be solved relative to x or relative to y ▪ Clairaut equation ▪ Lagrange equation	15
3.	**Applications of First-order differential equation:** ▪ Growth and Decay problems ▪ Temperature problems ▪ Falling Body problems ▪ Dilution problems	6

	▪ Electrical Circuits ▪ Orthogonal Trajectories	
4.	**Higher-order linear differential equation with constant coefficients:** ▪ Linearly independent and linear dependant functions ▪ The Wronskian ▪ The differential operator and the Characteristic equation ▪ Solution of homogeneous equation according the nature of roots of its characteristic equation ▪ Particular solution of a non-homogeneous equationby using the inverse differential operatorfor different cases of the second term of equality ▪ Particular solution of a non-homogeneous equation by using the method of variation of parameters ▪ Particular solution of a non-homogeneous equation by using the method of undetermined coefficients ▪ Homogenous differential equation with variable coefficients: Cauchy-Euler equation, Legendrelinear equation ▪ Method of factorisation ▪ Reduction of order and its cases	18
5.	**Application of Second-order differential equation with constant coefficients:** ▪ Spring problems ▪ Electrical Circuits problems ▪ Buoyancy problems	3
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Activities	continuous	20%
2.	First Periodical exam	8th	15%
3.	Second Periodical exam	12th	15%
4.	Final exam	16th	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	- Introduction to Ordinary Differential Equations and Some Application by Edward Burkard - Elementary Differential Equations by William F. Trench - Differential Equations with Boundary-Value Problems a Zill Cullen

	- Differential Equations by Richard Bronson and Gabriel B. Costa, third edition
Supportive References	
Electronic Materials	
Other Learning Materials	Mathematica, Mathlab

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room with max 60 seats Labs
Technology equipment (projector, smart board, software)	data show, Smart Board, software
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect
Effectiveness of Students assessment	Faculty	Indirect
Quality of learning resources	Program leaders	Direct
The extent to which CLOs have been achieved	Faculty	Direct
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**PHYSICS DEPARTMENT COUNCIL**
REFERENCE NO.	**NO. 4-45**
DATE	**27/09/2023 (12/03/1445)**

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