هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specification

(Postgraduate)

Course Title	**Stability Theory of Differential Equations**
Course Code:	**202613-3**
Program:	**Master of Pure Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Taif university**
Version:	1
Last Revision Date:	**20/10/2023**

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (3)

2. Course type

A.	☐University	☐College	☐Department	☐Track	
B.	☐Required		☒ Elective		

3. Level/year at which this course is offered: Level 1/First Year

4. Course general Description:

This course is related with study of the behavior of dynamical systems as well as means to analyze autonomous and non- autonomous systems, general theory of systems of differential equations, properties of linear and almost linear systems, stability and boundedness, energy method, Lyapunov's direct method for stability and limit cycles and periodic solution.

5. Pre-requirements for this course (if any):

None

6. Pre-requirements for this course (if any):

None

7. Course Main Objective(s):

1. **Understanding the concept of stability of equilibrium points**
2. **Using different methods to determine the stability of the solutions of linear and nonlinear differential equation.**
3. **Perception of some applications of ordinary differential equations in different field in science.**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	√	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	NA
3.	Field	NA
4.	Tutorial	NA
5.	Others (specify)……	NA
	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	**Recognize** the definitions and have deeper understanding of the concept of stability of equilibrium points.	K1	Lectures, group discussion `	Exams, Quizzes, Assignments
1.2	**Identify** different method to determine the stability of equilibrium points of linear and nonlinear differential equations,	K2	Lectures, group discussion	Exams, Quizzes, Assignments
2.0	**Skills**			
2.1	**Apply** different methods to determine the stability of equilibrium points of linear and nonlinear systems of ordinary differential equation	S1	Lectures, group discussion	Exams, Quizzes, Assignments, report
2.2	**Employ** the suitable methods for estimating the stability of a system of ordinary differential equation.	S2		
2.3	**Explain** the existence of limit cycles and periodic solutions of the system of ordinary differential equation.	S3		
2.4	**Use** mathematical proofs.	S4		
2.5	**Demonstrate** how the stability theory can be applied in real-life application.	S5	Lectures, group discussion	Exams, Quizzes, Assignments, report
3.0	**Values, autonomy, and responsibility**			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.1	**Accept** critical thinking, communication skills, and the stability of the differential equations.	V1	Lectures, group discussion	Exams, Quizzes, Assignments, report
3.2	**Participate** the capability to use programing in solving differential equations systems problems.	V2		
3.3	**Give** ability of self-learning and self-assessment during solving mathematical problems .	V3	Lectures, group discussion	Exams, Quizzes, Assignments, report

C. Course Content:

No	List of Topics	Contact Hours
1.	Review of Higher Order Linear Equations and linear Systems: fundamental solutions, Wronskian, variation of constants, matrix exponential solution, behavior of solutions,	9
2.	Linear Systems with Periodic Coefficients, Abel Liouville formula, Lagrange Identity, Green's Formula.	9
3.	Phase Plane, Paths and Critical Points, Types of Critical points, Basic-Theorems on Stability, Application to Dynamics, Dependence on a Parameter	9
4.	Liapunov's Direct Method, stability theorems of system about critical points, Limit Cycles and Periodic Solutions,	9
5.	Bendixson's Nonexistence Criterion, Poincare-Bendixson Theorem, The Index of a Critical Point.	9
Total		**45**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Quizzes and HomeWorks**	**Continues**	**10 %**
2.	**Midterm exam**	**8th -9th**	**20 %**
3.	**Final exam**	**16th**	**70%**

*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	1. G. Birkhoff and G.C., Rota. Ordinary Differential Equations, John Wiley and Sons inc., NY, 1978. 2. S. L. Ross. Differential Equations, John Wiley and Sons inc., NY, 1984. 3. D. Somasundaram. Ordinary Differential Equations, Narosa Publishing House, Chennai, 2008. 4. G. F. Simmons. Differential Equations with Applications and Historical Notes, McGraw Hill, 1991. 5. Differential equations, dynamical systems and an introduction to chaos By: Smale and Devaney
Supportive References	Classrooms containing whiteboard and electronic monitors Computer laboratory equipped with hardware and software. Math software(MATLB, LaTeX)
Electronic Materials	Laptop- Smart board- Projector.,Wi Fi internet connection.
Other Learning Materials	**None**

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Classrooms**
Technology equipment (Projector, smart board, software)	**Data show, Blackboard, Maple and MATLAB software**
Other equipment (Depending on the nature of the specialty)	**Wi-Fi internet connections**

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	**Indirect**
Effectiveness of students assessment	**Students**	**Indirect**

Assessment Areas/Issues	Assessor	Assessment Methods
Quality of learning resources	Students	Indirect
The extent to which CLOs have been achieved	Peer reviewer	Direct
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	Department of Mathematics and Statistics
REFERENCE NO.	11
DATE	17-3-1443 H