



Course Specification

— (Postgraduate)

Course Title: Stability Theory of Differential Equations

Course Code: 202658-3

Program: Master of Pure Mathematics

Department: Mathematics

College: Science

Institution: Taif university

Version: 1

Last Revision Date: 21\10\2023



Table of Contents

A. General information about the course:.....	3
B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:	4
C. Course Content:	5
D. Students Assessment Activities:	6
E. Learning Resources and Facilities:.....	6
F. Assessment of Course Quality:	7
G. Specification Approval Data:	7



A. General information about the course:

1. Course Identification:

1. Credit hours: (3)h			
2. Course type			
A.	<input type="checkbox"/> University	<input type="checkbox"/> College	<input type="checkbox"/> Department <input type="checkbox"/> Track
B.	<input type="checkbox"/> Required		<input checked="" type="checkbox"/> Elective
3. Level/year at which this course is offered: (..... Third level)			
4. Course general Description:			
Theory of general systems – properties of linear systems - stability of systems – Perturbation method – Lyapunov function - periodic solutions and approximations of periodic solutions.			
5. Pre-requirements for this course (if any):			
None			
6. Pre-requirements for this course (if any):			
None			
7. Course Main Objective(s):			
<ol style="list-style-type: none"> 1. Understanding the concept of stability of systems and equilibrium points 2. Using different methods to determine the stability of the periodic solutions of linear and nonlinear differential equation. 3. Using perturbation method and Lyapunov function 4. 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	3	100%
2	E-learning	0	0
3	Hybrid <ul style="list-style-type: none"> • Traditional classroom • E-learning 	0	0
4	Distance learning	0	0



3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	0
3.	Field	0
4.	Tutorial	0
5.	Others (specify).....	0
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 systems and equilibrium points.	K1	-Lectures -Group Discussions	-Assignments -Exams
1.2	Identify different method to determine the stability of equilibrium points of linear and nonlinear differential equations,	K2	-Lectures -Group Discussions	-Assignments -Exams
1.3	Explain concepts of perturbation method and Lyapunov function	K3	-Lectures -Group Discussions	-Assignments -Exams
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 Discussions	-Assignments -Exams
2.2	Employ the suitable methods for estimating the stability of a	S2	-Lectures -Group Discussions	-Assignments -Exams





Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	system of ordinary differential equation.			
2.3	Explain the perturbation method and Lyapunov function and periodic solutions of the system of ordinary differential equation.	S3	-Lectures -Group Discussions	-Assignments
3.0	Values, autonomy, and responsibility			
3.1	Accept critical thinking, communication skills, and the stability of the differential equations.	V1	-Projects	-Reports -Presentation
3.2	Participate the capability to use programming in solving differential equations systems problems.	V2	-Projects	-Reports -Presentation
...	Give ability of self-learning and self-assessment during solving mathematical problems	V3	-Projects	-Reports -Presentation

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	Perturbation method and Lyapunov's Direct Method, stability theorems of system about critical points, Limit Cycles and Periodic Solutions,	9
5	Bendixson's Nonexistence Criterion, Poincare-Bendixson Theorem,	9





	The Index of a Critical Point.	
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	9 th -10 th	20 %
3.	Final exam	16 th	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	Nonlinear Dynamics and Chaos. By: Strogatz
Supportive References	<ol style="list-style-type: none"> 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 6- Nonlinear oscillations 1973 7-Problems in perturbations
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms containing whiteboard and electronic monitors Computer laboratory equipped with hardware and software. Math software (MATLAB, LaTeX)



Items	Resources
Technology equipment (Projector, smart board, software)	Laptop- Smart board- Projector.
Other equipment (Depending on the nature of the specialty)	Wi Fi internet connection.

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect
Effectiveness of students assessment	Students	Indirect
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	
REFERENCE NO.	
DATE	21/10/2023

قسم الرياضيات والإحصاء
Mathematics and Statistics
Department

