هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Mathematical Modelling**
Course Code:	**2024202-3**
Program:	**Bachelor in Mathematics.**
Department:	**Mathematics and Statistics Department**
College:	**Faculty of Sciences**
Institution:	**Taif University**

Table of Contents

A. Course Identification

1. Credit hours: Three Hours
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: 11th level / 4th year
4. Pre-requisites for this course (if any)**:** **Linear algebra (2022204-3) & Ordinary Differential Equations (2022201-4)**
5. Co-requisites for this course (if any)**:** **None**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	**4Hr /Week**	**100**
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**40**
2	**Laboratory/Studio**	
3	**Tutorial**	
4	**Others** (specify)	
	Total	**40**

B. Course Objectives and Learning Outcomes

1. Course Description

This course introduces mathematical modelling: Study modelling change with difference equations, approximating change with difference equations, dynamical systems, systems of difference equations, difference operators. Study mathematical models, proportionality, geometric similarity, graphical fitting, analytic fitting, least squares fitting, choosing models, polynomial models, smoothing, cubic splines. Simulation modelling, modelling using graph theory, modelling with differential equation (Population growth, Drug dosage, graphical solutions, numerical approximations, separation of variables, linear equations), some additional applications of mathematics modeling: biological applications, social, chemistry and behavioral sciences applications, physics and engineering applications.

2. Course Main Objective

The students will be taught as follows:

1. Introducing basic notations and concepts about mathematical modelling.
2. Analyzing modeling using geometric similarity, difference equations, differential equations, model fitting and simulation modeling.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding:**	
1.1	**Recognize the meaning of mathematical model with difference and differential equations.**	**K2**
1.2	**Describe modeling, dynamical systems, modelling using geometric similarity, model fitting and simulation modelling.**	**K2**
2	**Skills:**	
2.1	**Use the model through analytical, graphical solutions or statistical analysis.**	**S1**
2.2	**Explain standard modelling procedures, which involve observations of a natural system and the development of a numeric or analytical model.**	**S1**
2.3	**Apply mathematical descriptions of some real systems**	**S1**
3	**Values:**	
3.1	**Work effectively within groups and independently.**	**V1**
3.2	**Articulate ethical behaviour associated with institutional Guidelines in classroom, and in Lab.**	**V3**

C. Course Content

No	List of Topics	Contact Hours
1	Introduction to mathematical modelling & Modelling change with difference equations, Approximating Change with Difference Equations.	**4**
2	Dynamical systems, Systems of difference equations, Difference operators & Mathematical models, Proportionality.	**4**
3	Geometric similarity, Graphical fitting & Analytic fitting, least squares fitting.	**4**
4	Choosing models & Polynomial models & Smoothing.	**4**
5	Cubic splines.	**4**
6	**Midterm exam,** Simulation Modelling	**4**
7	Modelling using Graph Theory.	**4**
8	Modeling with a Differential Equation Population growth, Drug dosage.	**4**
9	Graphical solutions, Numerical approximations & Separation of variables & Linear equations	**4**
10	Some additional applications of Mathematics modeling: Biological applications, Chemical Reaction applications, Social and Behavioral Sciences applications, Physics and Engineering applications.	**4**
Total		**40**

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding:**		
1.1	Recognize the meaning of mathematical model with difference and differential equations.	• Lectures • Group discussions	• Quizzes Assignments
1.2	Describe modelling, dynamical systems, modelling using geometric similarity, model fitting and simulation modelling.	• Lectures • Group discussions	• Exams • Assignments
2.0	**Skills**		
2.1	Use the model through analytical, graphical solutions or statistical analysis.	• Interactive classes Group discussions	• Quizzes Assignments
2.2	Explain standard modelling procedures, which involve observations of a natural system and the development of a numeric or analytical model.	• Lectures • Group discussions	• Exams • Quizzes
2.3	Apply mathematical descriptions of some real systems.	• Lectures Self-learning through the website	• Exams • Quizzes Assignments
3.0	**Values**		
3.1	Work effectively within groups and independently.	Interactive classes. Give students tasks of duties.	Assessment of design projects that have elements of interpersonal skills.
3.2	Articulate ethical behaviour associated with institutional Guidelines in classroom, and in Lab.	• Lectures • Group discussions	• Exams • Quizzes

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes + Home works**	**Continues**	**10 %**
2	**Midterm exam**	**5^{th}-6^{th}**	**30 %**
3	**Class Work (Homework- report- class test….)**	**8^{th}**	**10 %**
4	**Final exam**	**11^{th}**	**50 %**

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:
6 hours per week (as defined in the teaching schedule of the faculty member) for academic advice and consultations.
Teaching staff is also available using Blackboard web site and Taif University "Edugate" System.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	**S. Banerjee, Mathematical Modelling (Models, Analysis and Applications), 2015**
Essential References Materials	**Bradshow, Noel-Ann, A first course in mathematical modeling, 2012. ISBN 0-53-403367-9**
Electronic Materials	**1. Journal of Differential Equations (http://www.journals.elsevier.com/journal-of-differential-equations)** **2. Applied Mathematical Modeling (https://www.journals.elsevier.com/applied-mathematical-modelling)** **3. International Journal of Mathematical Modelling and Numerical Optimization (http://www.inderscience.com/jhome.php?jcode=ijmmno)** **Mathematical Modelling and Analysis (http://www.tandfonline.com/toc/tmma20/current)**
Other Learning Materials	**1-Finkelstein, L and Carson E.R. (1985), Mathematical Modelling of Dynamic Biology.** **2- Edward A. Bender-An Introduction to Mathematical Modelling-John Wiley & Sons Inc (1978).** **3-Shum book series in Partial Differential Equations.**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Lecture halls, containing white boards, and electronic monitors - The seats fit the number of students - Laboratories equipped with suitable numbers of computers**
Technology Resources (AV, data show, Smart Board, software, etc.)	**Laptop and projector.**
Other Resources (Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list)	**Wi-Fi internet connections**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment	Students	Indirect
Quality of learning resources	Peer Reviewer Students	Direct Indirect
Extent of achieving the course learning outcomes	Peer Reviewer Students	Direct Indirect

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	**Department of Mathematics and Statistics**
Reference No.	**11**
Date	**12-7-1443 H**

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