هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	NUMERICAL METHODS TO SOLVE PARTIAL DIFFERENTIAL EQUATIONS
Course Code:	**MATH 4500**
Program:	**BACHELOR OF SCIENCE IN MATHEMATICS**
Department:	**MATHEMATICS**
College:	**COLLEGE OF SCIENCE AND HUMANITIES STUDIES**
Institution:	**PRINCE SATTAM BIN ABDULAZIZ UNIVERSITY**

Table of Contents

A. Course Identification

1. Credit hours: 04
2. Course type **a.** University ☐ College ☐ Department ☒ Others ☐ **b.** Required ☐ Elective ☒
3. Level/year at which this course is offered: Elective
4. Pre-requisites for this course (if any)**:** **Math 3370, Math 4360**
5. Co-requisites for this course (if any)**:** **NIL**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	Weekly 4 hrs	100%
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture (14 x 3)**	**48**
2	**Laboratory/Studio**	
3	**Tutorial (14 x 2)**	**00**
4	**Others** (specify) - Office Hours (14 X 5)	**60**
	Total	**140**

B. Course Objectives and Learning Outcomes

1. Course Description

Finite Differences: Elliptic Problems – Parabolic Problems – 2D Problems – Solution Methods – Iterative Methods – Multigrid Methods – Hyperbolic Problems – Finite Volumes: Linear Problems – Conservation Laws. Nonlinear Problems. Finite Elements: Variational Formulation – General Elliptic Problems – Overview –Parabolic Problems – Eigenvalue Problems. Integral Equations: Collocation and Galerkin Methods – Fast Solvers

2. Course Main Objective

The Objective is to make the students acquire skills to find numerical solution of partial differential equations using various techniques.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	Have a thorough understanding about Iterative Method and Multigrid method of solving PDEs	K1,
1.2	Understand the concept of finite element method	K2,
2	**Skills :**	
2.1	Able to solve problems such as Hyperbolic problems , finite volumes, Linear problems with conservation laws.	S1
2.2	Solve integral equations using Collocation and Galerkin methods.	S2

C. Course Content

No	List of Topics	Contact Hours
1	Review of PDEs – Finite differences	**4**
2	Elliptic Problems – Parabolic Problems – 2 D Problems	**6**
3	Iterative Method	**4**
4	Multigrid Method	**4**
5	Hyperbolic Problems	**4**
6	Finite Volumes: Linear Problems – Conservation Laws. Nonlinear Problems	**6**
7	Finite Elements: Variational Formulation – General Elliptic Problems	**4**
8	Overview –Parabolic Problems	**4**
9	Eigenvalue Problems.	**3**
10	Integral Equations: Collocation and Galerkin Methods	**6**
11	Fast Solvers	**3**
Total		48

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	Have a thorough understanding about Iterative Method and Multigrid method of solving PDEs	1. Class Room Lectures 2. Interactive sessions 3. Exclusive Office Hours for clearing doubts in small groups	1. Two Internal Exams 2. Atleast two Quiz 3. End Semester Exam
1.2	Understand the concept of finite element method		
2.0	**Skills**		
2.1	Able to solve problems such as Hyperbolic problems , finite volumes, Linear problems with conservation laws.	1. Application oriented exercises during tutorial session.	1. Homework 2. Assignments 3. Quiz

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.2	Solve integral equations using Collocation and Galerkin methods.	2. Homework to improve the analytical skills	

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Mid Term Exam I	6	20%
2	Quiz	4 & 10	5%
3	Mid Term Exam II	13	20%
4	Continuous Assessment – Homework, Assignment, Attendance etc.	--	5%
5	End Semester Exam (Practical 10%, Theory 40%)	15	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 :

1. Exclusive Office Hours – 5 Hours per week
2. Academic Advising for Students – 1 Hour per week

F. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	Trefethen L. N. and Bau D., " Numerical Linear Algebra", Philadelphia, PA: SIAM, (1997). ISBN: 9780898713619. - Levecque R., "Numerical Methods for Conservation Laws", Lectures in Mathematics, ETH Zurich, Birkhauser. - Quarteroni A. and Valli A., " Numerical Approximation of Partial Differential Equations", Berlin; New York, NY: Springer– Verlag, (1997), ISBN: 9783540571117. - Atkinson K. E., "The Numerical Solution of Integral Equations of the Second Kind", Cambridge, UK: Cambridge University Press (1997), ISBN: 9780521583916.
Essential References Materials	Higher Engineering Mathematics by BS Grewal – SS Chand – Delhi – India
Electronic Materials	NIL
Other Learning Materials	Lecture Notes Prepared by the Department of Mathematics

2. Facilities Required

Item	Resources
Accommodation	1. Classrooms with Smart boards with seating facilities for atleast 30 students

Item	Resources
(Classrooms, laboratories, demonstration rooms/labs, etc.)	
Technology Resources (AV, data show, Smart Board, software, etc.)	Smartboard, Internet Connection for Blackboard
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	NIL

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of Teaching	Students, Graduates	Course Evaluation and Program Evaluation Survey (Indirect)
	Program Leaders	Peer Review (Direct)
Achievement of CLOs	Faculty and Quality Personnel	Direct (Tests and Quiz) and Review of Course Report
Quality of Learning Resources	Students	Course Evaluation (Indirect)
	Graduates	Program Evaluation(Indirect)
Facilities	Students / Graduates	Course and Program Evaluation (Indirect)
	Faculty	Faculty Survey (Indirect), Course Reports (Direct)

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	
Reference No.	
Date	