

4/1/4. Course Specification:

## COURSE SPECIFICATIONS

### Form

Course Title: **Tensor Analysis**

Course Code: **4047709-4**

## Course Specifications

Institution: Umm Al-Qura University Date: 8/10/2018
College/Department: Faculty of Applied Science/ Department of Mathematical Sciences

### A. Course Identification and General Information

1. Course title and code: Tensor Analysis (4047709-4)			
2. Credit hours: 4 Credit Hours			
3. Program(s) in which the course is offered. (If general elective available in many programs indicate this rather than list programs) PhD in Mathematics			
4. Name of faculty member responsible for the course: DR. Mohammad Bilal Abdul Ghaffar			
5. Level/year at which this course is offered: Level 3 Ph. D.			
6. Pre-requisites for this course (if any):			
7. Co-requisites for this course (if any):			
8. Location if not on main campus: Al-Abidiyah campus and Al-Zahir campus			
9. Mode of Instruction (mark all that apply)			
a. traditional classroom	<input checked="" type="checkbox"/>	What percentage?	<input type="text" value="85"/>
b. blended (traditional and online)	<input type="checkbox"/>	What percentage?	<input type="text"/>
c. e-learning	<input checked="" type="checkbox"/>	What percentage?	<input type="text" value="15"/>
d. correspondence	<input type="checkbox"/>	What percentage?	<input type="text"/>
f. other	<input type="checkbox"/>	What percentage?	<input type="text"/>
Comments:			

## B Objectives

1. What is the main purpose for this course?

The role of the course is to introduce the principles of tensor analysis. It is assumed that students entering this course have previously taken the entry level course on Continuum Mechanics.

2. Briefly describe any plans for developing and improving the course that are being implemented. (e.g. increased use of IT or web based reference material, changes in content as a result of new research in the field)

1. Updating references used in teaching process.
2. Using e-learning facilities more efficiently.
3. Encouraging students to collect problems from web based references and supervise discussions in the class.

C. Course Description (Note: General description in the form used in Bulletin or handbook)

Course Description:

This is a 4 credit Ph. D. course introducing the concepts of tensor analysis. The course comprises approximately 60 hours of lectures. The course is suitable for postgraduates who have no previous experience of tensors.

1. Topics to be Covered

List of Topics	No. of Weeks	Contact hours
<p>Chapter 1 – Tensors and their algebra</p> <ul style="list-style-type: none"> <li>- Transformation of coordinates.</li> <li>- Summation convention.</li> <li>- Kronecker delta, scalar, contravariant and covariant vectors.</li> <li>- Tensors of higher rank.</li> <li>- Symmetry of tensors.</li> <li>- Algebra of tensors: addition, subtraction, equality, inner and outer products, contraction.</li> <li>- Quotient law.</li> <li>- Irreducible tensor.</li> <li>- Metric tensor.</li> <li>- Fundamental and associated tensors.</li> <li>- Relative and absolute tensors.</li> </ul>	8	32
<p>Chapter 2 – Christoffel Symbols and Covariant Differentiation</p> <ul style="list-style-type: none"> <li>- Christoffels Symbols.</li> <li>- Transformation laws for Christoffel Symbols.</li> <li>- Equation of geodesic.</li> <li>- Covariant differentiation.</li> <li>- Divergence of a vector field.</li> <li>- Curl of a vector field.</li> <li>- Divergence of tensor field.</li> <li>- Null geodesics.</li> </ul>	7	28

2. Course components (total contact hours and credits per semester):						
	Lecture	Tutorial	Laboratory or Studio	Practical	Other :	Total
Contact Hours	60	--				60
Credit	4	--				4

3. Additional private study/learning hours expected for students per week.	4
4. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategy	

On the table below are the five NQF Learning Domains, numbered in the left column.

**First**, insert the suitable and measurable course learning outcomes required in the appropriate learning domains (see suggestions below the table). **Second**, insert supporting teaching strategies that fit and align with the assessment methods and intended learning outcomes. **Third**, insert appropriate assessment methods that accurately measure and evaluate the learning outcome. Each course learning outcomes, assessment method, and teaching strategy ought to reasonably fit and flow together as an integrated learning and teaching process. (Courses are not required to include learning outcomes from each domain.)

Code #	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
<b>1.0</b>	<b>Knowledge</b>		
1.1	Have an enhanced knowledge and understanding of tensor analysis and tensor calculus.	Lectures- Discussion-solve problems	Short quizzes, periodical and final exams.
1.2	Have the ability to recall the learned material of the course	Lectures- Discussion-solve problems	Short quizzes, periodical and final exams.
<b>2.0</b>	<b>Cognitive Skills</b>		
2.1	Be able to apply the learned material of the course in real life problems.	Lectures- Discussion-solve problems	Short quizzes, periodical and final exams.
2.2	Be able to integrate related topics from separate parts of the course	Lectures – Discussion- solve problems	Short quizzes, periodical and final exams
<b>3.0</b>	<b>Interpersonal Skills &amp; Responsibility</b>		
3.1	Have the ability to prove theorems and develop lemmas using different techniques	Lectures – Discussion- solve problems	Short quizzes, periodical and final exams
3.2	Be able to describe and analyze models using related equations	Lectures – Discussion- solve problems	Short quizzes, periodical and final exams
<b>4.0</b>	<b>Communication, Information Technology, Numerical</b>		
4.1	Have the ability to use computer programs in obtaining numerical solutions.	Discussion - Use Matlab, Mathematica or Numerical Packages to solve some problems	Homework projects

		numerically.	
4.2			
<b>5.0</b>	<b>Psychomotor</b>		
5.1	Not applicable	Not applicable	Not applicable

5. Schedule of Assessment Tasks for Students During the Semester			
	Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.)	Week Due	Proportion of Total Assessment
1	Periodic exam (1)	6	20
2	Periodic exam (2)	10	20
3	Home work	Over all weeks	20
4	Final exam	End of semester	40

#### D. Student Academic Counseling and Support

<p>1. Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week)</p> <ul style="list-style-type: none"> <li>- Office hours are specified throughout the week (6 hours/week)</li> <li>- Contacts with students by e-mail, SMS, and e-learning facilities.</li> </ul>
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#### E Learning Resources

<p>1. List Required Textbooks:</p> <ul style="list-style-type: none"> <li>- Tensor Analysis with Applications by Zafar Ahsan, Anamaya Publication, 2008.</li> <li>- Tensor Analysis by Edward Nelson, Princeton University Press.</li> <li>- Tensor Calculus : A concise Course by Barry Spain.</li> </ul>
2. List Essential References Materials (Journals, Reports, etc.)
3. List Recommended Textbooks and Reference Material (Journals, Reports, etc)
4. List Electronic Materials, Web Sites, Facebook, Twitter, etc.
5. Other learning material such as computer-based programs/CD, professional standards or regulations and software.

Matlab, Mathematica and Numerical Packages

F. Facilities Required

Indicate requirements for the course including size of classrooms and laboratories (i.e. number of seats in classrooms and laboratories, extent of computer access etc.)
1. Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.) Properly equipped classroom
2. Computing resources (AV, data show, Smart Board, software, etc.)  - Classroom equipped with desktop computers. - Projectors and related items. - Numerical packages. - Compilers
3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list) Non

G Course Evaluation and Improvement Processes

1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching Course evaluation questionnaire conducted electronically by the University at the end of the term.
2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department  - Results analysis. - Self- assessment of the program - External revisions and assessment. - Course report. - Annual reports sufficiently prepared by the head of department.
3 Processes for Improvement of Teaching  - Application of modern technologies in the education. - Application of e-learning. - Programs and trainings to improve the skills of teaching and learning. Several workshops on the improvement of teaching are conducting yearly by the University.

4. Processes for Verifying Standards of Student Achievement (e.g. check marking by an independent member teaching staff of a sample of student work, periodic exchange and remarking of tests or a sample of assignments with staff at another institution)  
Non

5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.

- Comparisons of the course with other institutes in other universities.
- Reviewing process of courses for improvement and development is done normally every five years.

Name of Instructor: DR. Mohammad Bilal Abdul Ghaffar

Signature: \_\_\_\_\_ Date Report Completed: 8/10/2018

Name of Field Experience Teaching Staff \_\_\_\_\_

Program Coordinator: \_\_\_\_\_

Signature: \_\_\_\_\_ Date Received: \_\_\_\_\_