4/1/4. Course Specification:

COURSE SPECIFICATIONS

Form

Course Title: ..... **Asymptotic Theory**...

Course Code: .... **4046708-4**.....

Course Specifications

Institution: Umm Al-Qura University Date: 31/10/2018
College/Department: Faculty of Applied Science/ Department of Mathematical Sciences

A. Course Identification and General Information

1. Course title and code: Asymptotic Theory (4046701-4)				
2. Credit hours: 4 Hours				
3. Program(s) in which the course is offered. Master of Science in applied mathematics (If general elective available in many programs indicate this rather than list programs) Master of Science in Mathematic				
4. Name of faculty member responsible for the course: Dr. Muntaser Safan				
5. Level/year at which this course is offered: Leve 1/ Master				
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	√	What percentage?	85	
b. blended (traditional and online)		What percentage?		
c. e-learning	√	What percentage?	15	
d. correspondence		What percentage?		
f. other		What percentage?		

Comments:

The course is suitable for undergraduates at Level 8 and for postgraduates at Masters level for those who have no previous experience of Asymptotic Methods will be introduced.

B Objectives

1. What is the main purpose for this course? The main purpose of this course is to introduce the student to the basic concepts and quantitative techniques for the study of Asymptotic Analysis in the presence of very small or very large parameters.
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 hours course comprising approximately 52 hours of lectures.**

1. Topics to be Covered		
List of Topics	No. of Weeks	Contact hours
Chapter 1: Algebraic Equations - Regular iterative and expansion methods for the solution of algebraic equations. - Singular perturbations and their application to iterative and expansion methods for the solution of algebraic equations. - Rescaling in the expansion method. - Logarithmic approach for transcendental equations. - Convergence by establishing a contraction iteration scheme. - Perturbation expansions applied to eigenvalue problems.	3	12

Chapter 2: Asymptotic Expansion of Integrals - Integral representation of solutions of differential equations with examples, e.g. Bessel functions. - Laplace Method and Watson's Lemma. - Method of Stationary Phase. - Method of Steepest Descent and applications e.g. Stirling's formula, Airy function, etc. - Approximation of common incomplete integrals, e.g. Incomplete Gamma function, Incomplete Exponential integral, etc.	3	12
Chapter 3 - Approximate Solutions of Linear Differential Equations - Classification of the nature of singular points, e.g. regular, regular singular or irregular singular with survey of solution behaviours. - Taylor series solutions of first and second order equations near regular points. - Series solution near regular singular points, e.g. modified Bessel equation. - Asymptotic expansion of solution near irregular singular points. - Asymptotic properties of oscillatory functions, e.g. Bessel functions and Airy function. - Stokes phenomenon.	3	12
Chapter 4: Boundary Layer Theory - What is boundary layer theory? - The outer approximation. - The inner approximation (commonly called the boundary layer solution). - Matching inner and outer approximations and Van Dyke's matching rule. - Choosing boundary layer stretching variable and identification of the boundary layer. - Boundary layer not $O(\varepsilon)$. - Intermediate regions between the inner and outer solutions. - Examples in the use of boundary layer analysis. - Examples where boundary layer analysis fails.	3	12

Chapter 5 - Multiple Scales and WKBJ Theory - Analysis of the van der Pol oscillator. - The WKBJ approximation and conditions for the validity of the theory. - WKBJ approximation of the solution to an inhomogeneous linear equation. - Examples in the use of the WKBJ approximation, e.g. transmission and reflection of waves by potential barriers.	3	12

2. Course components (total contact hours and credits per semester):

	Lecture	Tutorial	Laboratory or Studio	Practical	Other:	Total
Contact Hours	60	0				60
Credit	4	0				4

3. Additional private study/learning hours expected for students per week.
Four hours weekly for homework and revision

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
1.0	**Knowledge** Upon completion of the course, the student is expected to		
1.1	Develop knowledge and understanding	Lectures and	Short quizzes,

	on the perturbation expansions and their applications to algebraic equations, integrals, and differential equations.	homework.	periodical and final exams.
1.2	Be aware of the multiple scales method and its applications.	Lectures and homework.	Short quizzes, periodical and final exams.
2.0	**Cognitive Skills** Upon completion of the course, the student is expected to		
2.1	Solve problems using the fundamental ideas of asymptotic and multiple scale analysis.	Lectures and homework.	Short quizzes, periodical and final exams.
2.2	Develop practical skills in applying asymptotic methods for analysing mathematical problems.	Lectures and homework.	Short quizzes, periodical and final exams.
3.0	**Interpersonal Skills & Responsibility** Upon completion of the course, the student is expected to		
3.1	Identify small model parameters that influence the overall behavior of systems.	Lectures and homework.	Short quizzes, periodical and final exams.
3.2	Practice techniques for incorporating multiple scales into complicated nonlinear equations, and for solving the resulting simplified systems methodically to obtain increasingly accurate approximations of the true solution.	Lectures and homework.	Short quizzes, periodical and final exams.
4.0	**Communication, Information Technology, Numerical** Upon completion of the course, the student is expected to		
4.1	Work effectively in groups and independently.	Tasks assigned and homework.	Marking the assignments
4.2	Solve problems concerning the topics of the course.	Homework	Evaluating the homework
5.0	**Psychomotor**		
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	First periodic exam	6	20
2	Second periodic exam	10	20
3	Homework and tutorial activities	Over all weeks	20
4	Final exam	End	40

D. Student Academic Counseling and Support

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) The instructor is available for at least six hours per week. S/he is also available on appointments.

E Learning Resources

1. List Required Textbooks - A First Look at Perturbation Theory by James G. Simmonds and James E. Mann Jr. Dover publications (1998). - Perturbation methods, E. J. Hinch, Cambridge University Press (1996). - Advanced Mathematical Methods for Scientists and Engineers: Asymptotic Methods and Perturbation Theory by Carl M. Bender, Steven A. Orszag. Springer Verlag (1999).
2. List Essential References Materials (Journals, Reports, etc.) Journal of Asymptotic Analysis
3. List Recommended Textbooks and Reference Material (Journals, Reports, etc) - William Paulsen , Asymptotic Analysis and Perturbation Theory, Chapman and Hall/CRC, 2014
4. List Electronic Materials, Web Sites, Facebook, Twitter, etc. https://en.wikipedia.org/wiki/Asymptotic_analysis
5. Other learning material such as computer-based programs/CD, professional standards or regulations and software. --

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.)

Classroom with the capacity of 10-20 students.
2. Computing resources (AV, data show, Smart Board, software, etc.) -Smart board. - Classroom is equipped with a computer. - Provide projectors and related items. - Matlab software.
3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list)

G Course Evaluation and Improvement Processes

1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching Student feedback on effectiveness of teaching.
2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department Monitoring the achievement of the students in solving homework and periodical exams.
3 Processes for Improvement of Teaching Following up the student's homework. Encouraging the students to read and practice more.
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) The instructors watch and give their feedbacks to their students through all work done by them, including exams to verify standards of achievements for different domains of learning outcomes.
5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. Reviewing the course reports submitted at the end of each semester.

Name of Instructor: Dr. Muntaser Safan

Signature:_ *Muntaser Safan* _Date Report Completed: 31/10/2018

Name of Field Experience Teaching Staff _____

Program Coordinator:_____

Signature: _____ Date Received:_____