Kingdom of Saudi Arabia
National Commission for
Academic Accreditation & Assessment

المملكـة العربيـة السعوديـة
الهيئـــة الوطنيـــة للتقويـم
والاعـتـمـــاد الأكـاديـمـــي

كلية العلوم التطبيقية
Faculty of Applied Sciences

Kingdom of Saudi Arabia
The National Commission for Academic Accreditation & Assessment

T6. Course Specifications (CS)

Course title: Theoretical Methods in Physics

Course code: 23062241-4

Course Specifications

Institution: **Umm AL – Qura University**	Date : **18/2/1439**
College/Department : **Jamoum University College – Physics Department**	

A. Course Identification and General Information

1. Course title and code: **Theoretical Methods in Physics 23062241-4**
2. Credit hours: **4 hrs.**
3. Program(s) in which the course is offered. **BSc Physics;**
(If general elective available in many programs indicate this rather than list programs)
4. Name of faculty member responsible for the course
One of the staff members
5. Level/year at which this course is offered : **2nd Year / Level 4**
6. Pre-requisites for this course (if any) : **Differentiation and Integration (2) 2304102-4**
7. Co-requisites for this course (if any) : ---
8. Location if not on main campus: **Al-Jamoum**
9. Mode of Instruction (mark all that apply)

a. traditional classroom	✓	What percentage?	**100%**
b. blended (traditional and online)		What percentage?	
c. e-learning		What percentage?	
d. correspondence		What percentage?	
f. other		What percentage?	

Comments:

B Objectives

1. What is the main purpose for this course? This course is designed to demonstrate and consolidate the different concepts of mathematics and algebra and ways of using them in the different branches of physics
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) Encourage students to practice in the basics of mathematics and algebra – like differentiation and integration, limits, related to the course

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

Course Description:
The course provides a direct preparation for an advanced study in theoretical physics and is also an interesting element in the education of an experimental physicist. The physical principles behind the mathematical models are stressed so that insight and problem solving ability become primary. This course will cover the basic mathematical tools used in physical science and engineering: Vector analysis, partial differentiation, power and series, differential equations, special functions, integral transforms, and complex analysis. The course is designed to supply students for a variety of mathematical methods that need for advanced undergraduate and beginning graduate study in physical science and to develop a solid background for those who will continue into the mathematics of advanced theoretical physics

1 Topics to be Covered

Topics	No of Weeks	Contact hours
❖ **Vector Analysis** 1- Triple (Scalar-Vector) products- 2- Differentiation of vectors- 3- grad, Div, Curl and Laplace's operator, 4- Vector integral- 5- Green's, Gauss' and Stokes theorems, 6- General curvilinear coordinates- 7- vector operators in orthogonal curvilinear coordinates	**3**	**12**
❖ **Infinite series, Power series** **1-** Geometric series, **2-** testing series for convergence, **3-** Alternating series, **4-** interval of convergence- **5-** expanding functions in power series, **6-** Taylor and Maclaurin expansions,	**2**	**8**

7- Solving Problems about Series		
❖ **Partial Differentiation** 1- Total differentials- 2- Approximating using differentials, 3- chain rule 4- Implicit differentiation, A 5- pplication to Maximum and Minimum problems, 6- Lagrange Multipliers, Change of Variables, 7- Differentiation of Integrals	**3**	**12**
❖ **Fourier series and transforms** 1- Simple Harmonic Motion and Wave Motion; 2- Periodic Functions, 3- Average Value of a Function, 4- Fourier Coefficients, 5- Complex Form of Fourier Series, 6- Even and Odd Functions, 7- Applications of Fourier Series, Fourier Transforms.	**3**	**12**
❖ **Ordinary differential equations** 1- First order differential equations; 2- separable differential equations, 3- linear 1st order equations, 4- 2nt order differential equations; 5- Homogeneous differential equations, 6- Non-homogeneous differential equations.	**2**	**8**
❖ **Solution of Differential Equations by Laplace Transforms** 1- The Laplace Transform, 2- Convolution, 3- The Dirac Delta Function, 4- A Brief Introduction to Green Functions.	**2**	**8**
	15 weeks	**60hrs**

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

	Lecture	Tutorial	Laboratory or Studio	Practical	Other:	Total
Contact Hours	**60**		**0**		**10**	**70**
Credit	**4**		**0**			

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
1.0	**Knowledge**		
1.1	Define the physical quantities, physical phenomena, and basic principles.	1- Demonstrating the basic principles through lectures. 2. Discussing phenomena with illustrating pictures and diagrams. 3. Lecturing method: Board, Power point. 4. Discussions 5. Brain storming 6. Start each chapter by general idea and the benefit of it.	Solve some example during the lecture. Discussions during the lectures Exams: a) Quizzes (E-learning) b) Short exams (mid- term exams) c) Long exams (final) d) Oral exams .
1.2	Describe the physical laws and quantities using mathematics		
2.0	**Cognitive Skills**		
2.1	Apply the laws of physics to calculate some quantities.	1. Preparing main outlines for teaching. 2. Following some proofs. 3. Define duties for each chapter	1. Exams (Midterm, final, quizzes) 2. Asking about physical laws previously taught
2.2	Solve problems in physics by using suitable mathematics.		
2.3	Analyse and interpret quantitative results.		

2.4	Apply physical principle on day life phenomena.	4. Encourage the student to look for the information in different references. 5. Ask the student to attend lectures for practice solving problem.	3. Writing reports on selected parts of the course. 4. Discussions of how to simplify or analyze some phenomena.
2.5	Derive the physical laws and formulas.		
3.0	**Interpersonal Skills & Responsibility**		
3.1	Show responsibility for self-learning to be aware with recent developments in physics	• Search through the internet and the library. • Small group discussion. • Enhance self-learning skills. • Develop their interest in Science through : (lab work, visits to scientific and research institutes).	• Evaluate the efforts of each student in preparing the report. • Evaluate the scientific reports. • Evaluate the team work in lab and small groups. • Evaluation of students presentations.
3.2	Work effectively in groups and exercise leadership when appropriate.		
4.0	**Communication, Information Technology, Numerical**		
4.1	Communicate effectively in oral and written form.	• Incorporating the use and utilization of computer, software, network and multimedia through courses • preparing a report on some topics related to the course depending on web sites	• Evaluating the scientific reports. • Evaluating activities and homework
4.2	Collect and classify the material for the course.		
4.3	Use basic physics terminology in English.		
4.4	Acquire the skills to use the internet communicates tools.		
5.0	**Psychomotor (NA)**		

5. Map course LOs with the program LOs. (Place course LO #s in the left column and program LO #s across the top.)																
Course LOs #	**Program Learning Outcomes (Use Program LO Code #s provided in the Program Specifications)**															
	1.1	**1.2**	**1.3**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**3.1**	**3.2**	**4.1**	**4.2**	**4.3**	**4.4**	**5.1**	**5.2**
1.1	✓															
1.2		✓														
1.3																
2.1				✓												
2.2					✓											
2.3						✓										
2.4							✓									
2.5								✓								
3.1									✓							
3.2										✓						
4.1											✓					
4.2												✓				
4.3													✓			
4.4														✓		
5.1																
5.2																

6. 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	Exercises & Home works	All weeks	10 %
2	Participation	All weeks	10 %
3	In-Class Problem Solving	All weeks	10 %
4	Midterm 1	6th week	10 %
5	Midterm 2	12th week	10 %
6	Final Exam	16th week	50 %

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)
Students are supervised by academic advisers in physics Department and the time table for academic advice were given to the student each semester. (4hrs per week)

E Learning Resources

1. List Required Textbooks
1- Mary L. Boas, Mathematical methods in the Physical sciences, second edition, John Wiley and Sons (1966) and (1983).
2- G. Dennis Zill, R. Michael Cullen, Advanced engineering mathematics, Jones and Bartlett Publisher (2006), ISBN 9780763745912.
3- Eugene Butkov, Mathematical Physics, World student series edition (1973)

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

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.)
There are enough classrooms provided with a good accommodation, including good air condition, good Data show, suitable white board.

2. Computing resources (AV, data show, Smart Board, software, etc.)
In each class room, there is a data show, and board.

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 • Course reports • Course evaluation
2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department • Revision of student answer paper by another staff member. • Analysis of the grades of students.
3 Processes for Improvement of Teaching • Preparing the course as PPT. • Coupling the theoretical part with real physics problems • Periodical revision of course content.
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 of the course are checking together and put a unique process of evaluation. • Check marking of a sample of papers by others in the department. • Feedback evaluation of teaching from independent organization. • Independent evaluation by another instructor that give the same course in another faculty. • Evaluation by the accreditation committee in the university.
5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. 1- The following points may help to get the course effectiveness • Student evaluation • Course report • Program report • Program Self study 2- According to point 1 the plan of improvement should be given.