The Hashemite University
Faculty of Science
Department of Physics

Course Title:	Mathematical Physics (II)	**Course Number:**	110102282
Semester:	Spring	**Year:**	2023/2024
Designation:	Compulsory	**Prerequisite(s):**	11010281
Instructor:	Dr. Gassem Alzoubi	**Instructor's e-mail:**	gassem@hu.edu.jo
		Webpage:	http://staff.hu.edu.jo/gassem
Office Hours:	Monday and Wednesday, 1:00 –2:00 Pm, Physics Building, Room # 107		

Course Description (catalog): Physics 282 is the second course in a two-semester sequence of mathematical physics courses for physics majors. It introduces students to a variety of basic and advanced mathematical tools that will be used in subsequent physics courses. It involves curvilinear coordinates, special functions and integrals (factorial, gamma, beta, and delta functions; Gaussian integrals), series solutions of Legendre, Bessel, and Hermite differential equations, partial differential equations: Laplace's equation in rectangular and spherical coordinates systems.

. **Textbook(s) and/or Other Supplementary Materials:**

Textbook: Mathematical Methods in the Physical Sciences, third edition by Mary L. Boas (Wiley, New York, 2006)

References:

(1) Mathematical Methods for Physicists, 6th edition by George B. Arfken and Hans J. Weber (Academic Press, Elsevier, 2013)

(2) Mathematical Methods for Physics and Engineering, third Edition by K. F. RILEY, M. P. HOBSON and S. J. BENCE (Cambridge University Press, 2006)

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Major Topics Covered:

Topics	No. of Weeks	Contact hours*	Chapter in Text	Sections	Suggested Problems (from textbook 3d edition)
Curvilinear coordinates and vector operations in orthogonal curvilinear coordinates: cartesian, spherical, and cylindrical coordinate systems	2	6	10	10.8-10.9	**HW#1**: 10.8.1, 10.8.8, 10.8.15, 10.9.16-21
Special Functions: the factorial function, Gamma function, Beta function, Stirling's formula, Dirac delta function	3	9	8 and 11	8.11, 11.1-11.7, 11.11	**HW#2**: 11.3.2, 11.3.5, 11.3.10, 11.3.12, 11.5.1, 11.5.3-5, 11.7.2-3, 11.7.6, 11.7.9-11, 11.11.5, 8.11.13, 8.11.15, 8.11.21(d), 8.11.18(d), 8.11.23(c),
First Exam					
Series Solutions of Differential Equations; Legendre, Bessel, and Hermite	6	18	12	12.1-12.10, 12.12-12.17, 12.19, 12.22	**HW#3**: 12.1.2-4, 12.1.9, 12.1.5, **HW#4**: 12.2.1-3, 12.4.3, 12.5.3-4, 12.5.11, 12.6.2-3, 12.6.5-6, 12.6.9, **HW#5**: 12.7.4-6, 12.8.1-2, 12.8.4, 12.9.2, 12.9.12, 12.10.2, 12.10.4, **HW#6**: 12.12.1-2, 12.12.4-5, 12.12.7, 12.13.2-3, 12.13.6, 12.14.1-6 **HW#7**: 12.15.7(a),

					12.15.8, 12.16.2, 12.16.14, 12.17.3-4, 12.19.2, 12.23.14 **HW#8**: 12.22.7, 12.22.9, 12.22.11,
Second Exam					
Partial Differential Equations: Laplace's equation in rectangular coordinates, steady-state temperature distribution in semi-infinite and finite plate. the diffusion and heat flow equation: heat flow through a slab, Schrodinger equation and particle in a box problem. Laplace's equation in spherical coordinates, steady-state temperature in a sphere with azimuthal symmetry (m=0) and without azimuthal symmetry (m#0: introducing spherical harmonics).	4	12	13	13.1-13.3, 13.5, 13.7,	**HW#9**: 13.2.1, 13.2.3-4, 13.2.10-13, 13.3.2-3, 13.3.6, 13.3.8, 13.3.11-12 **HW#10**: 13.7.1, 13.7.9,
Final Exam					
Total	**15**	**45**			

*Contact hours include lectures and exams

Specific Outcomes of Instruction (Course Learning Outcomes):
After completing the course, the student will be able to:

	Course Learning Outcomes (CLO)	**(SO*)**
CLO1.	Develop fundamental mathematical methods, techniques, and skills required for a physics major as an integral part of the student's overall education	(a), (k), (i)
CLO2.	Use several techniques to solve advanced integrals involving Factorial, Gamma, Betta, delta functions, and Gaussian integrals	(a), (k)
CLO3.	Demonstrate the ability to solve partial second order linear differential equations with initial and boundary conditions in various fields of physics, such as mechanics, quantum, and electricity	(a), (e) (k)

(SO*) = Student Outcomes Addressed by the Course.

Student Outcomes (SO) Addressed by the Course:

#	**Outcomes Description** **Applied and Natural Sciences Student Outcomes**	**Contribution**
(a)	**an ability to apply knowledge of mathematics, science, and applied sciences**	**H**
(b)	**an ability to design and conduct experiments, as well as to analyze and interpret data**	
(c)	**an ability to formulate or design a system, process or program to meet desired needs**	
(d)	**an ability to function on multidisciplinary teams**	
(e)	**an ability to identify and solve applied sciences problems**	**L**
(f)	**an understanding of professional and ethical responsibility**	
(g)	**an ability to communicate effectively**	
(h)	**the broad education necessary to understand the impact of solutions in a global and societal context**	

(i)	**a recognition of the need for, and an ability to engage in life-long learning**	
(j)	**a knowledge of contemporary issues**	
(k)	**an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.**	**M**
H = High, M = Medium, L = Low		

Grading Plan:

1st Exam	30 Points	**TBA**
2nd Exam	30 Points	**TBA**
Final exam	40 Points	**TBA**

General Notes: **Attendance Policy:** students are expected to attend every class and arrive on time in compliance with HU regulations. In case you find yourself in a situation that prevents you from attending class or exam, you have to inform your instructor. If you miss more than 6 classes for the (Sunday, Tuesday, and Thursday model) or 4 classes for the (Monday and Wednesday Model), you cannot pass the course. Makeup excuses will be accepted only for very limited justified cases, such as illness and emergencies.

Prepared by: Dr. Gassem Alzoubi **Date: Feb**, 25, 2024