

Course Description Form

1. Course Name: CALCULUS OF VARIATION	
2. Course Code: MATH 518	
3. Semester / Year: First/ M.SC.	
4. Description Preparation Date: MARCH 2024	
5. Available Attendance Forms: Attendance lectures in the classroom	
6. Number of Credit Hours (45) / Number of Units (45)	
7. Course administrator's name (mention all, if more than one name)	
Name: MANAF ADNAN SALEH SALEH	
Email: manaf.adnan@nahrainuniv.edu.iq	
8. Course Objectives	
Course Objectives	<ul style="list-style-type: none"> ➤ Study of functionals and their properties. ➤ Study the variational and its applications. ➤ Study of variational Problems with Fixed Boundaries. ➤ Study of variational Problems with Movable Boundaries. ➤ Necessary and sufficient Conditions for an extremum. ➤ Direct Methods of solving Variational Problems.
9. Teaching and Learning Strategies	
Strategy	<ol style="list-style-type: none"> 1. Attend classroom lectures, electronic homework, and various activities and assignments. 2. Adopting the interactive aspect between the teacher and the student when explaining the subject. 3. Direct questions to students to test their understanding of the topic. 4. Adopting the principle of preparing reports by students in various subject areas.

3. Course Structure					
Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	3	Give the basics definitions of functionals	The functionals and their properties	Attendance Interactive lectures	Ask questions and Give assignments
2	3	Illustrate important practical physics examples of functionals	Physical problems of functionals	Attendance Interactive lectures	Ask questions and Give assignments
3	3	Studying variational is important for finding The maximum and minimum values of functionals	Variationals of the functionals	Attendance interactive lectures	Ask questions and Give assignments
4	3	Recognizing second-order partial differential equations, which is to be satisfied by each function giving an extremum	Euler-Lagrange equation	Attendance interactive lectures	Ask questions and give assignments
5	3	Studying further special cases of second-order partial differential equations	Special cases of Euler-Lagrange equation	Attendance interactive lectures	Ask questions and give assignments
6	3	-	-	-	1st attended mid exam
7	3	Extended almost Without change to functionals involving several independent functions	Functionals with several variables	Attendance interactive lectures	Ask questions and give assignments
8	3	Extended almost Without change to functionals involving several independent functions	Functionals with several variables	Attendance interactive lectures	Ask questions and give assignments
9	3	Studying methods of solving variational problems with fixed boundaries for finding the maxima or minima of functionals	Variationals problems with fixed boundaries	Attendance interactive lectures	Ask questions and give assignments
10	3	Studying methods of solving variational problems with movable boundaries for finding	Variationals problems with movable boundaries	Attendance interactive lectures	Ask questions and give assignments

		the maxima or minima of functionals			
11	3	Crucial conditions for finding the maxima and minima of functional curves	Necessary and sufficient conditions of extremal curves	Attendance interactive lectures	Ask questions and give assignments
12	3	-	-	-	2nd attended mid exam
13	3	Studying the functional itself instead of solving the Euler equation, find out the approximate expression of the extremal function that makes the functional obtain extremum	Direct methods of solving variational problems	Attendance interactive lectures	Ask questions and give assignments
14	3			Attendance interactive lectures	Ask questions and give assignments
15	3			Attendance interactive lectures	Ask questions and give assignments
4. Course Evaluation					
30% (mid exams) and 70% (final exam)					
5. Learning and Teaching Resources					
Required textbooks (curricular books any)		<ul style="list-style-type: none"> ➤ A First Course in the Calculus of Variations by Mark Kot. ➤ The Calculus of Variations and Optimal Control by George Leitmann. ➤ Introduction to the Calculus of variations and control with modern applications by John A. Burns. 			
Main references (sources)		Calculus of Variations by I. E. Elsgolc.			
Recommended books and references (scientific journals, reports...)		Any website that specializes in the study of Calculus of Variations.			
Electronic References, Websites		<ul style="list-style-type: none"> • Introduction to Calculus of Variations - YouTube • Deriving the Second Variation Calculus of Variatio YouTube 			