King Fahd University of Petroleum & Minerals
Department of Mathematics

MATH-640: Calculus of Variations

Instructor: Dr. Abdullah Shah

Office hours: Sunday and Tuesday from 1100-1150 AM or by appointments,

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Course Description:
Gateaux and Fréchet differentials. Classical calculus of variations. Necessary conditions. Sufficient conditions for extrema. Jacobi and Legendre conditions. Natural boundary conditions. Broken extrema, Erdmann-Weierstrass condition. Multiple integral problems. Constrained extrema. Hamilton principle with applications to mechanics and theory of small oscillations. Problems of optimal control. Direct methods including the Galerkin and the Ritz-Kantorovich methods. Variational methods for eigenvalue problems.

Course main Objective: The objective of the course is to:

1. Provide students with rich knowledge and skills in the field of calculus of variations.
2. Implement concepts of the calculus of variations to define and solve optimization problems.

Credit hours: 3
Pre-requisite: Graduate standing

Textbook:
John L. Troutman, Variational Calculus and Optimum Control, Optimization with Elementary Convexity, 2nd edition, 1996

Reference Books:

1. A.S. Gupta, Calculus of Variations with Applications. 1999.
2. Naveen Kumar, An Elementary Course on Variational Problems in Calculus, 2005
3. Richard L. Burden, J. Douglas Faires, Numerical Analysis, 10th Edition, Cengage Learning, 2016.

Course Grade
The final grade will be based on the following distribution:

Exam I		20%
Exam II		20%
Assignments and Project		25%
Final Exam		35%
Total		**100%**

Note: Any student will get less than 50 % will be given an F grade.

Attendance: Students are expected to attend all classes.