King Fahd University of Petroleum & Minerals
Department of Mathematics

MATH-640: Calculus of Variations
Instructor: Dr. Abdullah Shah
Time: 1600-1650 AM, B-59, R-2015
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Office: Building# 5, Room# 419.

Calculus of Variations is a powerful mathematical tool for solving optimization problems involving functions.

Course Description:
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.
Gateaux and Fréchet differentials.
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 optimal control problems.

Credit hours: 3, **Pre-requisite**: Graduate standing

Textbook:
1. Mark Kot: **A First Course in the Calculus of Variations**, *American Mathematical Society*, 2014.
2. John L. Troutman, **Variational Calculus and Optimal Control**, Optimization with Elementary Convexity, 2nd edition, 1996.
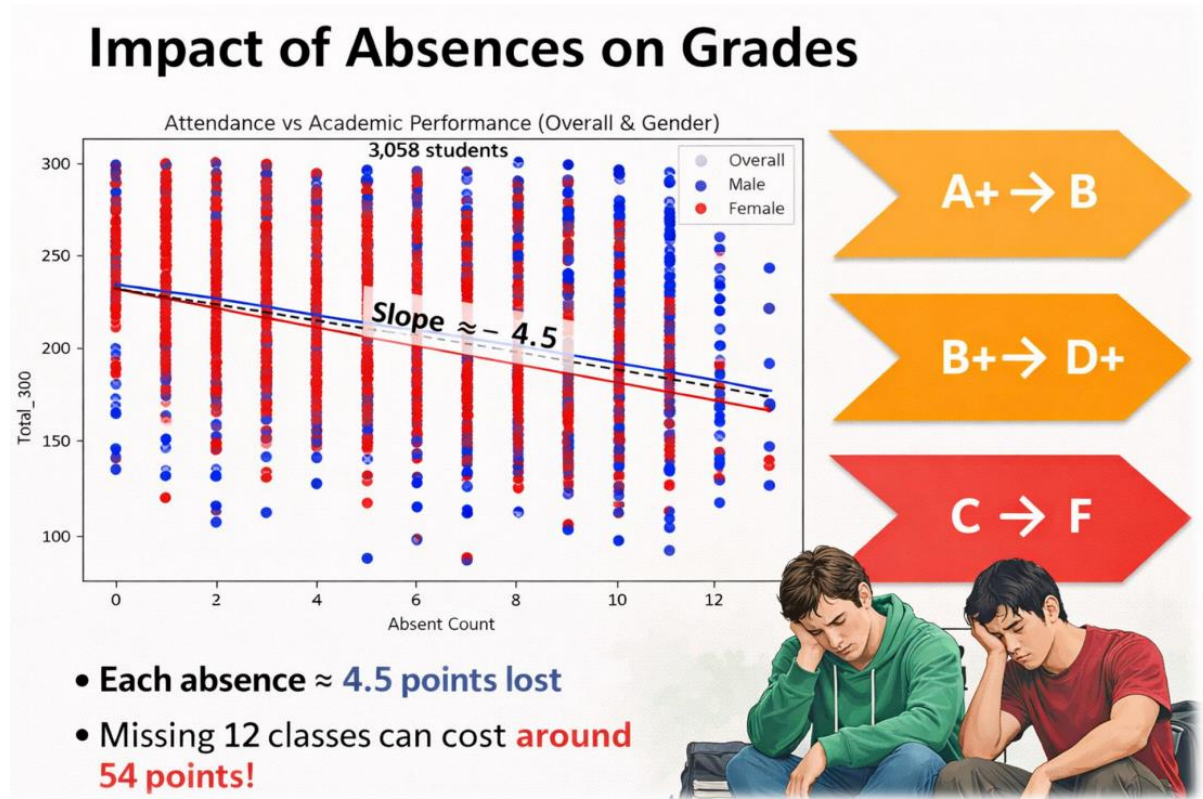
Reference Books:

1. Naveen Kumar, An Elementary Course on Variational Problems in Calculus, 2005.
2. 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		(10+15) =25%
Final Exam		35%
Total		**100%**

Attendance: Students are expected to attend all classes. Frequent absences may lead to DN grade.

Excused Policy: Must follow excused letter policy approved by Coordinator Graduate studies or Chair of the department.

Office Hours:

Courses	SUNDAY	TUESDAY	THURSDAY
	1430-15:30	14:30-15:30	14:30-15:30

Remark: Students can also ask for an **appointment** by email or MS TEAMS.