# DEPARTMENT OF M.Sc MATHEMATICS
# N A M COLLEGE, KALLIKKANDY


Certificate Course

2017-2018

# INTRODUCTION TO CALCULUS OF VARIATION

Offered by

Department of M.Sc Mathematics

NAM College, Kallikkandy

# About the course

The Certificate Course "Introduction to Calculus of Variation" is open to all students who are currently doing M.Sc in Mathematics. The aim of this course is to *prepare them for competitive examinations.*

Course duration : 30 hours

## For Details & Registration


Contact :Mumthas . P.V
Course Co-ordinator
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# COURSE DETAILS

| Title of the course | Introduction to Calculus of Variation |
|---|---|
| Total number of hours | 30 |
| Hours per weak | 5 |
| Semester assigned | |

## About the Course

The Certificate Course "Introduction to Calculus of Variation" is open to all students who are currently doing M.Sc in Mathematics. The aim of this course is to make the learner acquire knowledge on the basics of variational problems. Calculus of variation is a field of mathematical analysis that uses variations, which are small changes in functions and functionals, to find maxima and minima of the functionals.

## Necessity of the Course

The calculus of variation is a powerful technique to solve some dynamic problems that are not intuitive to solve otherwise. The shortest path between two arbitrary points is a straight line. It looks obvious to us with our intuition –based brains, but the mathematical proof still requires the employment of the calculus of variational theory. There are many laws of physics which are written as variational principles.

## Objectives

- To understand the term functionals and find the maxima and minima of functionals.
- To frame the connection of laws of physics and variational principles.
- To understand the different forms of variational problems.
- To expertise in solving variational problems.

## ❖ Learning Outcomes

At the end of the course, learners will be able to:

i. Able to apply the formula that determines stationary path of a functional to deduce the differential equations in simple case.
ii. Use the Euler's equation or its first integral to find differential equation for stationary path.
iii. Solve differential equations for stationary Paths, subject to boundary conditions in straight forward case.

## Content Specification(Syllubus)

**Chapter 1.** Elements of the theory (7 hours)

1.1. Functionals, some simple variational problems.
1.2. Function spaces and the variation of a functional.
1.3. A necessary condition for an extremum.

**Chapter 2.** Variational problems (13 hours)

2.1. The simplest variational problem. Euler's equation.
2.2. The case of several variables.
2.3. A simple variable end point problem. The variational derivative.
2.4. Invariance of Eulers equations.

**Chapter 3.** Further genaralizations (10 hours)

3.1. The fixed end point problems for n-unknown functions.
3.2. Variational problem in parametric form.
3.3. Functionals depending on higher order derivatives.
3.4. Variational problems with subsidiary conditions.

Text Book: M.Gelfand and S V Fomin; Calculus of variation, Prentice Hall Inc, N.Y(1963)

Reference:
1. Bliss G A; Calculus of of Variations,Open Court Publishing Co. Chicago(1925)
2. Elsgoltz I; Differential Equations and Calculus of Variations,Mr Publishers Moscow(1973)

**Evaluation Pattern**

There will be an examination after the completion of all classes. To pass the course, the candidate must secure atleast 40% of the examination marks. A certificate will be issued by the college to the candidate who has been successfully completed the course.

**Examination structure and marks**

Maximum Marks for Examination is 30

Maximum time for Examination is 2 hours.

Question pattern is as follows (All questions wiil be compulsory)

Two questions with 6 marks each (Total 12)

Three questions with 4 marks (Total 12)

Two questions with 3 marks (Total 6)

**Grading**

Above 80% (including) is first division with distinction and will obtain $A^+$grade.

60% and above but below 80% is first class and will obtain A grade.

50% and above but below 60% is second class and will obtain B grade.

40% and above but below 50% is third class and will obtain C grade.