

MATH 265001

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This question paper consists of 4 printed pages, each of which is identified by the reference MATH 265001.

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Examination for the Module MATH 2650

(January 2013)

Calculus of Variations

Time allowed: 2 hours

Answer no more than four questions.
All questions carry equal marks.

1. (a) State and prove the Fundamental Lemma of the Calculus of Variations.

(b) The Euler-Lagrange equation for the integral

$$I = \int_{x_1}^{x_2} F(x, y(x), y'(x)) dx$$

takes the form

$$\frac{\partial F}{\partial y} - \frac{d}{dx} \left(\frac{\partial F}{\partial y'} \right) = 0.$$

Write down a first integral of the Euler-Lagrange equation when $F = F(x, y')$.
Derive the first integral (the Beltrami identity)

$$y' \frac{\partial F}{\partial y'} - F = C$$

(where C is an arbitrary constant) of the Euler-Lagrange equation in the case when $F = F(y, y')$.

(c) Find the functions $y(x)$ that are extrema of the following integrals, subject to the given end conditions:

(i) $I = \int_1^2 (x^2 y'^2 + 2y^2) dx$, $y(1) = 2$, $y(2) = 5$;

(ii) $I = \int_1^3 \left(y'^2 + \frac{y'}{x^2} \right) dx$, $y(1) = 1$, $y(3) = 4$;

(iii) $I = \int_0^2 (y'^2 + y^2) dx$, $y(0) = 0$, $y(1) = \sinh(1)$.

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The first six chapters contain, more or less, the material given in the usual university course in the calculus of variations (with applications to the mechanics of systems with a finite number of degrees of freedom), including the theory of fields (presented in a somewhat novel way) and sufficient conditions for weak and strong extrema.

CALCULUS - EKIII

Calculus Of Variations Gelfand Solution Manual Introductory text for calculus of variations - Stack Exchange calculus of variations. Its constraints are differential equations, and Pontryagin's maximum principle yields solutions. That is a whole world of good mathematics. Remark To go from the strong form to the weak form, multiply by v and integrate. For matrices the strong form is Page 8 ...

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Textbook: Calculus of Variations by I. M. Gelfand and S. V. Fomin (Dover Publications, Inc., 2000). We will cover most part of the book. We will cover most part of the book. 5.

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What's more, the methods that we use in this module to solve problems in the calculus of variations will only find those solutions which are in $(C^2[a,b])$. More advanced

techniques (i.e. beyond MATH0043) are designed to overcome this last restriction. This isn't just a technicality: discontinuous extremal functions are very important in optimal control problems, which arise in ...

MATH0043 §2: Calculus of Variations

The calculus of variations is a field of mathematical analysis that uses variations, which are small changes in functions and functionals, to find maxima and minima of functionals: mappings from a set of functions to the real numbers. Functionals are often expressed as definite integrals involving functions and their derivatives. Functions that maximize or minimize functionals may be found ...

Calculus of variations - Wikipedia

Calculus of Variations solvedproblems Pavel Pyrih June 4, 2012 (public domain) Acknowledgement.The following problems were solved using my own procedure in a program Maple V, release 5. All possible errors are my faults. 1 Solving the Euler equation Theorem.(Euler) Suppose $f(x,y;y')$ has continuous partial derivatives of the second order on the interval $[a,b]$. If a functional $F(y) = \int_a^b f(x,y,y') dx$...

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Gelfand & Fomin - Calculus of Variations - Prentice Hall 1963 3. Forray - Variational Calculus - McGraw Hill 1968 4. Weinstock - Calculus of Variations - Dover 1974 5. J. D. Logan - Applied Mathematics, Second Edition -John Wiley 1997 The figures are plotted by Lt. Thomas A. Hamrick, USN and Lt. Gerald N. Miranda, USN using Matlab. They also revamped the numerical examples chapter to include ...

CALCULUS OF VARIATIONS MA 4311 LECTURE NOTES

Calculus of Variations I. M. Gelfand, S. V. Fomin First 6 chapters include theory of fields and sufficient conditions for weak and strong extrema. Chapter 7 considers application of variation methods to systems with infinite degrees of freedom, and Chapter 8 deals with direct methods in the calculus of variations.

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In this video, I introduce the subject of Variational Calculus/Calculus of Variations. I describe the purpose of Variational Calculus and give some examples ...

Introduction to Calculus of Variations - YouTube

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Based on a series of lectures given by I. M. Gelfand at Moscow State University, this book actually goes considerably beyond the material presented in the lectures. The aim is to give a treatment of the elements of the calculus of variations in a form both easily understandable and sufficiently modern. Considerable attention is devoted to physical applications of variational methods, e.g., canonical equations, variational principles of mechanics, and conservation laws.

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