Teach Yourself
CALCULUS

A set of 30 self-learning lectures

by
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Goal: To enable students to learn this beautiful subject with zero or minimal assistance.

Assumed background: Pre-college algebra and trigonometry

Languages: Urdu and English

Duration: 25-60 minutes

Number of lectures: 60 (30 Urdu, 30 English)

Availability of lectures: All lectures are available for free download from the website of the Eqbal Ahmad Centre for Public Education http://eacpe.org/calculus/.

I find these lectures to be a great resource for students, and have shared the link with my colleagues who are teaching this material. The lecture on vectors is also a very good one for a first linear algebra course.

Viqar Hussain, Chairman and Professor, Department of Mathematics, University of New Brunswick.

I have watched selections from the lectures in question, and find that they are a terrific introduction to calculus. They are sophisticated, but accessible to students in high school as well as college.

Robert L. Jaffe, Morningstar Professor of Physics, Center for Theoretical Physics, Massachusetts Institute of Technology.

Dr. Hoodbhoy's material is truly excellent...His style of delivery is modern, conversational yet precise, and in look and feel not unlike the Khan Academy videos.

Richard Charles Larson, Mitsui Professor of Engineering Systems, and, Director, Center for Engineering Systems Fundamentals, Massachusetts Institute of Technology.

Listening to the Teach Yourself Calculus lectures prepared by Professor Pervez Hoodbhoy, one realizes that one is in the presence of a master.

John Scales Avery, author of "Calculus and Differential Equations" and "Hyperspherical Harmonics and Generalized Sturmians".

This is a systematic and pedagogically clear attempt to bring about the salient features of Calculus and has a good number of applications encountered in physics and engineering. A truly marvelous effort in making Calculus an easy-to-follow subject.

Prof. Dr. Lubov Vassilevskaya, University of Applied Sciences, Fulda, Germany.

LECTURE CONTENTS

Lecture 11: **INVERSE FUNCTIONS & LOGS** Monotonic functions When does a function have an inverse? Differentiating inverse functions The Logarithm as the inverse of Exponential	Lecture 12: **TAYLOR'S THEOREM** Approximating functions with polynomials Taylor's Theorem Estimating the remainder Examples of failure
Lecture 13: **INTEGRATION – I** The integral as the anti-derivative Some common integrals Integration and the area under a curve Solved examples	Lecture 14: **INTEGRATION – II** Integration as area Upper and lower sums Functions that can be integrated Functions that cannot be integrated
Lecture 15: **INTEGRATION TECHNIQUES – I** Integration – it's best to guess the answer! Integration by parts Integration by change of variables	Lecture 16: **INTEGRATION TECHNIQUES – II** Partial fractions Completing the square Differentiating under the integral sign
Lecture 17: **INTEGRATION TECHNIQUES – III** Trigonometric functions Hyperbolic functions Applications	Lecture 18: **CONVERGENCE OF INTEGRALS** Integrals of discontinuous functions Integral with singular integrands Integrals with infinite limits
Lecture 19: **NUMERICAL INTEGRATION** When do you need numerical integration? Trapezoidal Rule Simpson's Rule Solved examples	Lecture 20: **THE LENGTH OF A CURVE** Length of a curve – general formula Worked examples Implicit functions Lengths of curves that are defined implicitly
Lecture 21: **AREAS AND VOLUMES** Surface area of a solid Volume of a solid Examples: cone, sphere, ellipsoid, toroid	Lecture 22: **PARAMETRIC CURVES** What is a parameter? Parameterized curves Derivative of a parameterized curve Length of a parameterized curve
Lecture 23: **POLAR COORDINATES** Definition of polar coordinates Polar plots Slopes and lengths in polar coordinates Area calculation	Lecture 24: **VECTORS** Scalars and vectors Adding vectors Dot product and cross product Towards abstract vectors
Lecture 25: **VECTOR-VALUED FUNCTIONS** Vector fields Differentiating vectors Tangents and planes Integration of vectors	Lecture 26: **1st ORDER DIFF. EQNS – I** How DE's arise Solving a DE numerically Easy examples Separable DE's
Lecture 27: **1st ORDER DIFF. EQNS –II** Linear DE's Integrating factor Bernoulli equation Autonomous DE's	Lecture 28: **COMPLEX NUMBERS** Imaginary and complex numbers Complex conjugation Argand diagram Euler's representation

Lecture 29: **SEQUENCES AND SERIES-I**	Lecture 30: **SEQUENCES AND SERIES-II**
Infinite sequences and functions	Convergence of infinite series
Convergence of a sequence	Geometric series
Testing for convergence	Comparison and ratio tests
Sequences of partial sums	Integral test

Recommended Textbook: Feel free to choose your favorite one. Any that is currently used in a good American university will work well. To my mind, *Calculus* by M. Spivak is the very best. Written for the mathematically minded (as opposed to physically minded), it can make you fall in love with the subject. The problems are hard! More traditional approaches can be found in calculus books by G.B. Thomas, and by S. Lang as well as numerous others.

Problems and exercises: Students or their instructors may select them from a number of excellent websites.