MATH 150A DIFFERENTIAL GEOMETRY Winter 2001

Subject: The classical differential geometry of curves and surfaces. The lectures will be self-contained. The course will conclude with proofs of the theorems of Gauss & Bonnet and of Poincaré & Hopf connecting total curvature (from the geometry of surfaces), genus (from topology) and total index of vector fields (from analysis and differential equations).
Prerequisites: Linear algebra (Eg., Math 20F or equivalent), vector calculus (Eg., Math 20E of equivalent), and course on "mathematical reasoning" (Eg. Math 109 or equivalent).
Grades will be based on: participation in class and discussion section, a notebook of problems due at the end of the quarter, and the final exam. In solving the problems, you may collaborate, and you may consult the instructor or assistant -- just be sure to credit the ideas and work of others. Cite all sources appropriately - books, research papers, and websites.

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Books on reserve in Science and Engineering Library - at the circulation desk. Books may be checked out for 48 hours - with the exception of the five Spivak volumes which may be checked out for three hours. Do browse in the stacks.

do Carmo, Manfredo Perdigao
Differential geometry of curves and surfaces
Prentice-Hall, Englewood Cliffs, N.J., c1976.
QA641 .C33

Global differential geometry,
S.S. Chern, editor; contributors, Lamberto Cesari et al.
Mathematical Association of America Washington, D.C., 1989.
MAA Studies in mathematics; vol. 27.
QA1 M426 v.27

Klingenberg, Wilhelm
A course in differential geometry
Springer-Verlag, New York, c1978.
QA641 .K5813

Millman, Richard S. and Parker, George D. [Viewpoint of vectors]
Elements of differential geometry
Prentice-Hall, Englewood Cliffs, N.J., c1977.
QA641 .M52

O'Neill, Barrett [Viewpoint of differential forms]
Elementary differential geometry
Academic Press, New York, London, 1966.
QA641 .O58

Spivak, Michael
A comprehensive introduction to differential geometry, 2d ed.
Publish or Perish, inc., Berkeley, 1979.
QA641 .S59 1979 1-5 (5 volumes)

Struik, Dirk Jan [Classic]
Lectures on classical differential geometry, 2d ed.
Addison-Wesley Pub. Co., Reading, Mass.,1961.
QA641 .S72 1961

Willmore, Thomas [Viewpoint of tensors]
An introduction to differential geometry
Clarendon Press, Oxford, 1959.
QA641 .W738

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Outline [tentative]

Lecture 0.	Introduction	
Lecture 1.	Curves in space.	Local theory.
Lecture 2.	Curves in space.	Some global theorems.
Lecture 3.	Surfaces in space.	Fist fundamental form.
Lecture 4.	Surfaces in space.	Second fundamental form.
Lecture 5.	Surfaces in space.	Fundamental equations.
Lecture 6.	Surfaces in space.	Gauss curvature.
Lecture 7.	Abstract surfaces.	Local notions.
Lecture 8.	Abstract surfaces.	Parallel transport.
Lecture 9.	Abstract surfaces.	Geodesics.
Lecture 10.	Abstract surfaces.	Global notions.
Lecture 11.	Abstract surfaces.	The Gauss-Bonnet theorem.
Lecture 12.	Abstract surfaces.	Vector fields on surfaces.
Lecture 13.	Non-Euclidean geometries.	

Historical - important contributors to differential geometry:

R. Descartes	1596-1650	Analytic geometry
C. Huygens	1629-1695	Curvature & evolutes
G.W. Leibniz	1646-1716	Calculus
I. Newton	1647-1727	Calculus
L. Euler	1707-1783	Curves and surfaces
G. Monge	1746-1818	Curves and surfaces
C. Dupin	1784-1873	Curves and surfaces
A.L. Cauchy	1789-1857	Curvature and contact
J.C.F. Gauss	1777-1855	Intrinsic geometry of surfaces - "Disquisitiones"
B. Riemann	1828-1866	Higher dimensional spaces
G. Darboux	1842-1917	Leçons ...
G. Ricci	1853-19??	Tensor calculus
T. Levi-Civita	1873-19??	Tensor calculus
A. Einstein	1879-1955	General Relativity
F. Klein	1849-1925	Erlanger programme
S. Lie	1847-1899	Continuous groups
E. Cartan	1869-1949	Moving frames, exterior calculus
W. Blaschke	1885-1962	Miscellaneous theorems
C. Chevalley	????-	Lie groups
G. de Rham	????-????	Harmonic forms and topology
S.S. Chern	????-	Geometry and topology

--- and many others