

EXAM TOPICS

Sect. 2.1:

- functions of several variables
- examples in physics and mathematics

Sect. 2.2:

- neighborhood of a point
- open, closed, bounded, connected sets
- boundary points, interior points
- regions, domains

Sect. 2.3:

- level curves
- level surfaces

Sect. 2.4:

- limit of a function of two variables
- continuity and discontinuity at a point and on a set

Sect. 2.5:

- partial derivatives: definition, calculation

Sect. 2.6:

- total differential
- total differential as a linear approximation
- total differential and continuity; the fundamental lemma

Sect. 2.7:

- the Jacobian matrix
- the linear transformation given by the Jacobian matrix
- n-dimensional volumes under this linear transformation

Sect. 2.8:

- derivatives and differentials of composite functions
- chain rules

Sect. 2.9:

- the general chain rule
- the Jacobian matrix as a product of Jacobian matrices

Sect. 2.10:

- implicit functions
- the Implicit Functions Theorem
- partial derivatives of implicit functions

Sect. 2.12:

- inverse mappings
- the Jacobian matrix of the inverse map
- curvilinear coordinates
- polar, cylindrical and spherical coordinates

Sect. 2.13:

- tangent vectors, unit tangent vectors
- the tangent line
- the tangent plane
- the gradient vector

Sect. 2.14:

- directional derivatives
- direction in which a function increases(decreases) the most rapidly

Sect. 2.15:

- partial derivatives of higher order
- harmonic functions

Sect. 2.16:

- calculations of higher derivatives of composite functions

Sect. 2.18:

- higher derivatives of implicit functions

Sect. 2.19:

- relative max/min of a function
- critical points
- determining the nature of a critical point
- absolute max/min of a function in a closed bounded region.

Sect. 2.20:

- min/max of a function when side conditions are present
- method of Lagrange multipliers

Sect. 3.2:

- vector and scalar fields: definition, examples
- sketching a vector field

Sect. 3.3:

- the gradient vector field
- the gradients of sums, products and scalar multiples of functions

Sect. 3.4:

- the divergence of a vector field
- properties of the divergence

Sect. 3.5:

- the curl of a vector field
- properties of the curl

Sect. 3.6:

- combined operations: curl grad f ; div curl v

Sect. 4.3:

- the definition and the geometrical meaning of the double integral
- properties of the double integral
- evaluation of double integrals
- applications of the double integral

Sect. 4.4:

- the definition of the triple integral
- evaluation of triple integrals
- applications of triple integrals

Sect. 4.5:

- integrals of vector functions

Sect. 4.6:

- change of variables in multiple integrals
- polar, cylindrical and spherical coordinates (see Sect. 2.12)

Sect. 4.7:

- arc length
- surface area

Sect. 5.2

- smooth and piecewise smooth curves
- simple closed curves
- parametrizations of curves
- line integrals of the form

$$\int_C f(x, y) dx, \int_C f(x, y) dy$$

- physical models and derivation of line integrals of the above type
- properties and evaluation of these integrals

Sect. 5.3

- different forms for arc length
- integrals with respect to arc length
- physical models and derivation of line integrals w.r.t arc length
- properties and evaluation of integrals w.r.t. arc length
- connection between the integrals w.r.t arc length and the line integrals in Sect. 5.2
- the mass of a wire

Sect. 5.4

- line integrals as integrals of vectors
- various forms of integrals for calculating work
- the unit tangent and the unit normal vectors
- integrals of u_T and v_n , w.r.t. arc length

Sect. 5.5

- positive orientation of a simple closed curve
- Green's theorem for simply connected domains
- vector forms of Green's theorem
- finding the area using Green's theorem

Sect. 5.6

- independence of path
- basic theorems about the independence of path
- simply connected domains
- path independence in simply connected domains
- evaluation of line integrals

Sect. 5.7

- Green's theorem for multiply connected domains
- evaluation of line integrals

Sect. 5.8

- parametric curves in space
- arc length
- line integrals in space
- work done by force on a path represented as line integrals
- length, mass, center of mass, moment of inertia of a wire (see no.3 p.326)

Sect. 5.9

- surfaces in space represented as $z = f(x, y)$; corresponding $\partial\sigma$ and normal vectors
- surfaces given parametrically; corresponding $\partial\sigma$ and normal vectors (see also p.324)

Sect. 5.10

- surface integrals of the type $\int \int_S H d\sigma$
- surface integrals of the type $\int \int_S L dy dz + M dz dx + N dx dy$
- vector $\vec{d}\sigma$
- evaluation of surface integrals
- vector forms of surface integrals

Sect. 5.11

- the divergence theorem

Sect. 5.12

- Stokes theorem

Sect. 5.13

- independence of path: various conditions
- irrotational vector fields
- solenoidal vector fields