This is a list of topics you need to be familiar with as covered in class and on the homework for the final on Thursday along with the sections in the book where they are discussed.

Preliminaries:

- partial differentiation (14.3)
- polar coordinates: (10.3)
  1. convert functions $f(x, y)$ to polar coordinates
  2. polar curves: $r = g(\theta)$
- vectors
  1. basic properties (12.2)
  2. dot product, cross product (12.3, 12.4)
  3. equation for a plane (12.5)
- parameterized curves (13.1)

Chain Rule and Gradient

- generalized chain rule (14.5)
- gradient: (14.6)
  1. definition and interpretation of gradient
  2. chain rule in terms of gradient
  3. directional derivatives
  4. using the gradient to find a normal to surface defined by $F(x, y, z) = k$

Double Integrals:

- iterated integrals, Fubini's theorem, partial integration (15.2)
- type I / type II regions, changing order of integration (15.3)
- double integration in polar coordinates (15.4)
- calculating mass, center of mass, moments of inertia (15.5)
- change of variables in two variables (15.9)

Triple Integrals

- type I, II and III regions, changing order of integration (15.7)
- calculating mass, center of mass, moments of inertia (15.6)
- change of variables in three variables (15.9)
- spherical and cylindrical coordinates and integration (15.8)

Line Integrals:

- line integral of a function with respect to arclength (16.2)
- calculating mass, center of mass, moments of inertia (16.2)
- line integral of a function with respect to x and y (16.2)
- line integral of a vector field (16.2)

Surface Integrals:

- parameterized surfaces (16.6)
  1. surfaces of graphs, e.g. $z = f(x, y)$
  2. planes
  3. the sphere of radius R
- surface integrals of functions (16.7)
- calculating mass, center of mass, moments of inertia (16.7)
- orientation on surfaces (16.7)
  1. definition of an orientation
  2. induced orientation on boundary curves
- surface integrals (flux) of a vector field (16.7)

Derivatives:

- the gradient: ∇f (14.6)
- in two dimensions, the vector field derivative: $d\mathbf{F} = Q_x - P_y$ (16.4)
- in three dimensions, the curl: $\nabla \times \mathbf{F}$ (16.5)
- divergence: $\nabla \cdot \mathbf{F}$ (16.5)
- Laplace operator: $\nabla^2 f = \nabla \cdot (\nabla f)$ (16.5)
- basic properties of these:
  1. $d(\nabla f) = 0,\ \nabla \times (\nabla f) = 0$
  2. div curl $\mathbf{F} = 0$

Theorems:

- Fundamental Theorem of Line Integrals: (16.3)
  1. statement of theorem
  2. conservative vector fields have path independent line integrals
  3. vector fields with path independent line integrals are conservative
- Green's Theorem: (16.4)
  1. statement of Green's Theorem
  2. using Green's Theorem to calculate area
  3. simple connectedness in the plane
  4. if $\mathbf{F}$ is defined on a simply connected region and $d\mathbf{F} \equiv 0$, then $\mathbf{F}$ is conservative.
  5. Green's theorem on regions "with holes", i.e. not simply connected.
- Stoke's Theorem: (16.8)
  1. statement of Stoke's Theorem
  2. simple connectedness in space
  3. if $\mathbf{F}$ is defined on a simply connected region in space and $\nabla \times \mathbf{F} \equiv 0$, then $\mathbf{F}$ is conservative
  4. flux of curl $\mathbf{F}$ across a closed surface is always 0
- Divergence Theorem (16.9)

Good Luck on the exam!