

Mathematical Methods in Physics III (FYS T 300) 2010

The Final Exam : Part I 15 IV - 30 IV ; Part II 7 V .

1. (a) Describe how to solve the nonlinear integral

equation $\phi(x) = f(x) + \lambda \cdot \int_0^x \phi(x-u)\phi(u) du$. (b) Solve

(no guessing) the Hammerstein integral equation $\phi(x) =$

$$\int_{-1}^1 x^2 u^2 [\phi(u)]^2 du.$$

2. An outline of the chief points in the Hilbert-Schmidt

theory. You may consider only the homogeneous integral

equation $\phi(x) = \lambda \cdot \int_a^b K(x,u)\phi(u) du$ with a real

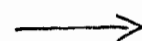
symmetric kernel.

3. (a) Derive Cauchy's integral formula by making an

appeal to an integral equation. (b) Justify. Cauchy's

integral formula is a consequence of Cauchy's residue

theorem.



4. (a) Find the harmonic conjugate $v(x, y)$ to $u(x, y) =$

$x^3y - xy^3$, so that these functions are joined together

by the analytic function $u(x, y) + iv(x, y) = f(z)$. (b) Write

down Laurent's theorem. Obtain the Laurent series for

$f(z) = z \cos\left(\frac{1}{z}\right)$ about $z=0$.

5. (a) Explain (with one or two sentences) the concept of

a Lie group. (b) What are the ingredients that specify

a Lie algebra?
