

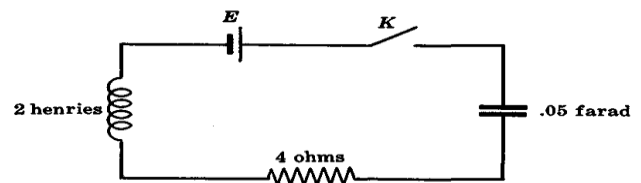


Mathematical Physical Methods (3 Year Physics Branch)

Answer the following questions: (80 MARKS)

Question (1) (20 MARKS)

- Expand $f(x) = \cos x$, for $0 < x < \pi$ in a *Fourier sine series*?
- How should $f(x)$ be defined at $x = 0$ and $x = \pi$, so that the series will converge to $f(x)$ for $0 \leq x \leq \pi$?



Question (2) (20 MARKS)

The charge on the capacitor in the illustrated figure is 2 coulombs. If the switch K is closed at time $t = 0$, *find* by using Laplace transforms the *charge* and the *current* at any time $t > 0$ when $E = 100 \sin (4t)$?

Question (3) (20 MARKS)

Find the value of each integral using *Gamma and Beta functions*

- $\int_0^2 x^3 \sqrt{8-x^3} dx$,
- $\int_0^\infty x^6 e^{-2x} dx$,
- $\int_0^\infty \sqrt{y} e^{-y^3} dy$,
- $\int_0^2 \frac{x^2 dx}{\sqrt{2-x}}$

Question (4) (20 MARKS)

- Solve the boundary-value problem $\frac{\partial u}{\partial x} = 4 \frac{\partial u}{\partial y}$ with $u(0, y) = 8e^{-3y}$?
- Show that $z(x, y) = 4e^{(-3x)} \cdot \cos(3y)$ is a solution to the boundary-value problem:

$$\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = 0, \quad z\left(x, \frac{\pi}{2}\right) = 0, \quad z(x, 0) = 4e^{-3x}?$$