CYK/2023/PH201 Mathematical Physics

QUIZ 2

Total Marks: 10 Marks, Duration: 45 Mins
Date: 11 Sept 2023, Tuesday

B

1. [4×1 **Marks**] Answer the following short questions (You can write the answers directly. Also, do not calculate numerical values unless asked.):

   (a) Find $\int_1^{2+i} (2z^4 + \cos z)\, dz$ over a straight path between the two limits.

   (b) Find $\oint_C \frac{\sin(\pi z)}{z - \sqrt{2}e^{i\pi/4}} dz$, where the contour C is a circle $|z+1| = 2$.

   (c) What is the radius of convergence for the Taylor series expansion of $\frac{1}{3+z}$ about $z = 0$.

   (d) What is the coeffiecient of z in the series expansion of $\frac{1}{z^3(2-z)}$ about $z = 0$.

2. [**3 Marks**] Evaluate $\oint_C \frac{\cos z\, dz}{z^3 (z - z_0)}$ where C is a quadrangle with vertices at ± 2 and $\pm 2i$ and $z_0 = 2\sqrt{2}e^{-i\pi/4}$.

3. [**3 Marks**] Find series expansions for $\frac{1}{2z - 3z^2}$ about $z_0 = 0$ for different regions of the complex plane. Specify the region of validity of each series expansion.

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QUIZ 3

Total Marks: 10 Marks, Duration: 1 Hour
Date: 30 Oct 2023, Monday

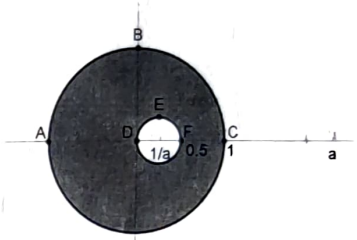
B

1. **[5 Marks]** A circular metallic (thermally conducting) disc of radius a is subjected to the boundary conditions

$$T(a,\phi) = \begin{cases} \sin\phi, & 0 < \phi < \pi \\ 0, & \text{otherwise.} \end{cases}$$

Find the steady state temperature $T(\rho,\phi)$ in the disc. Sketch isotherms.

2. **[5 Marks]** Find the potential V in the gray region shown in the figure by completing the following steps. The outer circle has a unit radius and is kept at potential $V = 0$. Inner circle has a radius of $1/4$ and has a center at $\left(\frac{1}{4}, 0\right)$ and is kept at $V = 1$.



(a) Find a (> 1) such that the points $(a, 0)$ and $(1/a, 0)$ are symmetric wrt the inner circle.

(b) Consider the conformal transformation

$$w = \frac{z - a}{az - 1}.$$

Find the images of points A, B, C, D, E and F. Find the image of the gray region.

(c) Obtain the expression for the potential in w-*plane* with given boundary conditions.

(d) Obtain the expression for the potential in z-plane.

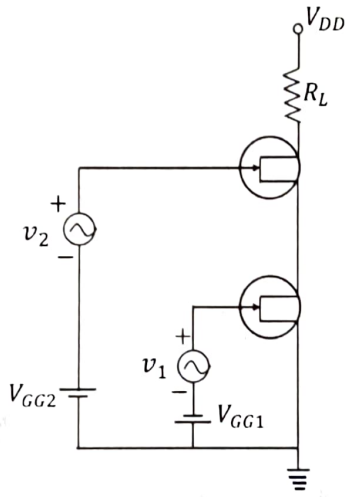
Quiz-2

Course: PH209 Time: 1 Hour

1. a) Why the input impedance of MOSFET is very high? [Marks 1]

b) Highly doped P^+ regions are constructed at the drain and source end of a P-Channel MOSFET. What are the roles of those regions? [Marks 2]

c) Find expression for the signal voltage across r_L using small signal equivalent model. Two FETs are identical, with parameters μ, r_d. [Marks 4]



2. Using the concept of feedback, find the small signal voltage gain of the circuit given below. Use simplified h parameter model for the analysis. [Marks 3]