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Paper II — REAL AND COMPLEX ANALYSIS

(For those who joined in July 2003 and after)

Time : Three hours Maximum : 100 marks

SECTION A — (4 × 10 = 40 marks)

Answer any FOUR questions.

1. Prove that $\Sigma \frac{1}{n^p}$ converges if $p > 1$ and diverges if $p \leq 1$.

2. If Σa_n is a series of complex numbers which converges absolutely then prove that every rearrangement of Σa_n converges, and they all converge to the same sum.

3. State and prove Mean value theorem.

4. If f is continuous on $[a, b]$ then prove that $f \in \mathcal{R}(\alpha)$ on $[a, b]$.

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5. State and prove Luca's theorem.

6. Prove that the ratio (z_1, z_2, z_3, z_4) is real if and only if the four points lie on a circle or on a straight line.

7. State and prove Weierstrass theorem.

8. If $f(z)$ is analytic and nonconstant in a region Ω, then prove that its absolute value $|f(z)|$ has no maximum in Ω.

SECTION B — (3 × 20 = 60 marks)

Answer any THREE questions.

9. State and prove

(a) Root test

(b) Ratio test.

10. State and prove the fundamental theorem of calculus.

11. State and prove Taylor's theorem.

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12. (a) Prove that a mapping f of a metric space X into a metric space Y is continuous if and only if $f^{-1}(C)$ is closed in X for every closed set C in Y.

(b) Suppose f is a continuous mapping of a compact metric space X into a metric space Y. Then prove that $f(X)$ is compact.

13. State and prove Cauchy's theorem for rectangle.

14. Prove that the nonempty connected subsets of the real line are the intervals.

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