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## M.Sc.

# MATHEMATICS

### MT-804: Algebraic Topology (2008 Pattern) (Semester - IV)

Time: 3 Hours!

[Max. Marks :80

- Instructions to the candidates:
  - 1) Attempt any Five questions.
  - Figures to the right indicate full marks.
- Q1) a) Prove that the homotopy relation is an equivalence relation. [6]
  - b) Let f and g be homotopic mappings of X into Y and h be a continuous mapping of Y into Z. Prove that hf and hg are homotopic mappings of X into Z.
    [5]
  - c) Let  $f_0: X \to Y$  is homotopic to  $f_1: X \to Y$  and  $g_0: Y \to Z$  is homotopic to  $g_1: Y \to Z$ . Show that  $g_0 f_0: X \to Z$  is homotopic to  $g_1 f_1: X \to Z$ . [5]
- Q2) a) Prove that the relation of being of the same homotopy type is an equivalence relation.
  [6]
  - b) Prove that the closed unit ball B³ in R³ is contractible but the sphere S² in R³ is not contractible,
     [5]
  - c) Let A ⊂ B ⊂ X. Suppose B is a retract of X and A is a retract of B. Show that A is a retract of X.
- Q3) a) Prove that a non-empty open connected subset of R<sup>n</sup> is path connected.
  [6]
  - b) Let f and g be paths in X such that  $f * \overline{g}$  exists and is a closed path. Then  $f * \overline{g}$  is homotopic to a null path if and only if f is homotopic to g. [5]
  - c) Let A⊂X be a path connected subset and {A<sub>n</sub> : n∈ Z<sup>+</sup>} a collection of path connected subsets of X each of which intersects with A. Show that A∪{∪<sub>n</sub>A<sub>n</sub>} is path connected.
     [5]

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