

[4223]-404
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.
- 2) 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 $f_0 : X \rightarrow Y$ is homotopic to $f_1 : X \rightarrow Y$ and $g_0 : Y \rightarrow Z$ is homotopic to $g_1 : Y \rightarrow Z$. Show that $g_0 f_0 : X \rightarrow Z$ is homotopic to $g_1 f_1 : X \rightarrow Z$. [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 B^3 in $\mathbb{R}^3$ is contractible but the sphere S^2 in $\mathbb{R}^3$ is not contractible. [5]
c) Let $A \subset B \subset X$. Suppose B is a retract of X and A is a retract of B . Show that A is a retract of X . [5]
- Q3)** a) Prove that a non-empty open connected subset of $\mathbb{R}^n$ is path connected. [6]
b) Let f and g be paths in X such that $f * \bar{g}$ exists and is a closed path. Then $f * \bar{g}$ is homotopic to a null path if and only if f is homotopic to g . [5]
c) Let $A \subset X$ be a path connected subset and $\{A_n : n \in \mathbb{Z}^+\}$ a collection of path connected subsets of X each of which intersects with A . Show that $A \cup \{\cup_n A_n\}$ is path connected. [5]

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