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Y–312

M. A./M. Sc. (First Semester)
EXAMINATION, Dec., 2014

MATHEMATICS

Paper Third

(Topology)

Time : Three Hours] [*Maximum Marks : 80*

Note : Attempt any *two* parts from each question. All questions carry equal marks.

Unit—I

1. (a) Prove that the union of a countable family of countable sets is countable.

   (b) Prove that intersection of two topologies is also a topology, but union of two topologies is not necessarily a topology.

   (c) Find the topology T for R generated by the collection **B** of all closed intervals of the form $[p, p + 1]$ of length 1.

Unit—II

2. (a) Characterize a topological space in terms of Kuratowski Closure Operator.

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(b) Define continuity in a topological space and prove that a mapping f from a topological space (X, T_X) to a topological space (Y, T_Y) is continuous iff the inverse image of each T_Y-closed set is T_X-closed.

(c) Prove that every second countable space is separable.

Unit—III

3. (a) Prove that a topological space (X, τ) is a T_0-sapce iff for any pair of distinct points :

$$x, y \in X, \{\bar{x}\} \neq \{\bar{y}\}.$$

(b) Give examples to show that :

$$T_0 \not\Rightarrow T_1 \not\Rightarrow T_2$$

(c) State and prove Tietze's Extension theorem.

Unit—IV

4. (a) Prove that every compact subspace of a Hausdorff space is closed.

(b) Prove that a topological space X is countably compact iff every sequence in X has a cluster point in X.

(c) Define one point compactification. Prove that any locally compact space X can be embedded in a compact space $\hat{X}$ so that $\hat{X} - X$ is a single point.

Unit—V

5. (a) Prove that every open cover of a sequentially compact metric space has a Lebesgue number.

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(b) Prove that a topological space X is connected iff every non-empty proper subset of X has a non-empty frontier.

(c) Show that the connected components of a topological space are closed.

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