**M.Sc. Meteorology**

**M-301/ PO-301 Numerical Weather Prediction**

**Unit I**

Numerical models – Filtered models: Filtering of sound and gravity wave models: Barotropic model; Equivalent barotropic model; Barotropic instability, Numerical methods – Computation of Jacobian and Laplacian; solution of Helmholtz and Poisson equations using relaxation method; Finite difference method- Forward and centered finite difference methods, semi–implicit method- computational instability.

**Unit II**

Quasi Geostrophic Models – Barotropic and Baroclinic models, Two level model; Quasi- Geostropic multi level models; Omega equation; Linear balanced model; Nonlinear balanced model. Short, medium and long range weather prediction.

**Unit III**

Primitive equation models–sigma coordinate system; Two level primitive equation model; multilevel primitive equation models. Introduction to meso scale models: Non-hydrostatic assumption, basic structure of MM5 and WRF models and their applications. Application of satellite and Remote sensing data in NWP.

**Unit IV**

Representation of Physical Processes. Inclusion of moisture, Kuos method and Arakawa Schubert’s method. Boundary layer parameterisation, Deardorff’s method. Radiation parameterisation- Representation of radiation in numerical models.

**Unit V**

Objective analysis- Cressman method, method of optimum interpolation. Initialization; Static initialisation; Dynamic initialisation–Normal mode initialisation, Newton relaxation or Nudging. Nonlinear instability, Aliasing. Arakawa Jacobian. Staggered grid systems. Data Assimilation.

**Text Books**

1. Numerical Weather Prediction G.J. Haltiner, John Wiley
2. Numerical Prediction and Dynamical Meteorology by G.J.Haltiner , R.T.Williams, John Wiley
3. Numerical weather analysis and forecasting by P.D.Thompson.
4. An Introduction to Dynamical Meteorology, J.R.Holton
5. Introduction to Theoretical Meteorology by S.L. Hess
6. Tropical Meteorology by T.N.Krishnamurti, WMO publications