

Syllabus for M.Phil : METEOROLOGY



AIR FORCE ADMINISTRATIVE COLLEGE  
COIMBATORE  
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## **M PHIL : PART I (METEOROLOGY)**

### **PAPER III – SYNOPTIC METEOROLOGY** **(SPECIAL PAPER)**

#### **Unit I: Extra Tropical Met**

Waves in the atmosphere: Types and their differences, Methods of forecast of movement and intensity; Zonal Index: Definition, Computation, Blocking, Circulation patterns, Role of zonal index in medium range weather forecasting and its influence over Indian region; Barotropicity and Baroclinicity: Barotropic Instability, Baroclinic Instability, The distribution, Their roles in development of weather; Cut-off low: Genesis, Structure, Movement, Weather; Blocking High: Concept, Characteristics, Formation, Movement, Model, Role of ocean, Effects on Indian weather; Western Disturbances; Formation, Movement, Intensity, Weather, Induced systems, Role of upper tropospheric features in development of Western Disturbances.

#### **Unit II : Tropical Met**

Scale analysis in tropics; Equation of motion, Continuity Equation, Vorticity Equation; Pressure wind Relationship: Geostrophic hypothesis, Wind & pressure field near Equator; Tropical general circulation: Hadley cell, Asnani model, ITCZ, Walker circulation, ENSO phenomena; CISK: Concept, Ekman CISK and Wave CISK, Application of CISK in the synoptic development in the tropics; Cumulus dynamics: Instabilities of various kinds, Energetics of cumulus cloud, Local severe storms; Tropical storms: Formation, Structure, Movement, Forecasting of Movement and Intensity; Long range, medium range & short range forecasting techniques in other tropical systems (Easterly wave, LL Easterlies etc.); Middle and upper Tropospheric Vortices: Formation, Structure and Movement.

#### **Unit III: Monsoon Meteorology**

Monsoon regions in tropics: Summer and winter circulation monsoon over India; General monsoon circulation (Balance of Mass, Radiation, Angular momentum, Flow across Equator, Global Relationship); Onset and withdrawal features; Semi-permanent systems; Monsoon depressions; Other synoptic systems; Orographic effects; Oceanic features; Numerical modelling of monsoon; Long range forecasting of monsoon rainfall.

#### **Unit IV: General Circulation Studies**

General Circulation features viz. temperature & wind: Basics, Energetics, Energy conversions, Available potential Energy concept, Global aspects of atmospheric energy, Mid- latitude and tropical energy aspects; Heat Balance of earth-atmosphere system; The maintenance of Angular Momentum: Dynamic influence of mountains and friction; Seasonal and zonal variations of the mean atmosphere structure and flow patterns; Large numerical models.

#### **Unit V: Meteorological Prognosis**

Mid-latitude systems: Long waves & short waves, Western disturbances, Induced systems; General techniques of prognosis: Prognosis of tropical systems, Tropical storms, Tropical systems, Monsoon systems; Objective techniques: Technique of selecting parameters, Regression methods.

#### **References**

1. Synoptic – Dynamic Meteorology in middle latitudes Vol – I & II - By Howard B Blucstein.
2. SW Monsoon: MET Monograph- Synoptic MET 1/1976 - YP Rao
3. Structure of an Arabian Sea summer Monsoon System - YP Rao & BW Desai
4. Prognosis of Weather Forecasting - CS Ramage
5. Monsoon Meteorology - CS Ramage
6. Tropical meteorology Vol – I, II & III - GS Asnani

**PAPER III – AVIATION MET**  
**(SPECIAL PAPER)**

**Unit I: Aviation Met – I**

Importance; Met elements; Organisation: WMO, ICAO, DGCA, IMD, IAF Met; Current Weather Reports; Altimetry; Aviation Forecasts: Cautionary Met Reports, Weather Warnings; Flight Procedures/Briefing; PANSMET; Aviation Codes; Forecasts/Briefings.

**Unit II: Aviation Met – II**

Aerodromes: Aerodromes Services (Met Related), Operation of aircraft, Aeronautical information services, Aeronautical telecommunications, Regulatory documents; Requirements of military aviation; Meteorological aspects of flight planning; Pressure pattern, Flying–Air traffic services.

**Unit III: Special Aviation Phenomena**

Low level wind shear; Microburst; Thunderstorm hazards; Aircraft icing; Turbulence, CAT, Mountain Waves, Gravity waves; Surface and slant visibility; Weather radars; Nowcasting techniques: Very short range forecasting, Objective techniques in local forecasting.

**Unit IV: Prediction Models and Tools**

Prediction of mesoscale systems by statistical and probability models; Techniques of selecting predictors; Regression & use of numerically predicted flow patterns; Formation of stochastic model based on primitive equation; Prediction of mountain/valley weather; Marine weather, Local severe weather; Local weather features.

**Unit V: Synoptic Model**

Applications of waves in the atmosphere; Zonal index; Barotropicity and baroclinicity; Blocking high; Western disturbances; Lee cyclogenesis; Tropical storms; Tropical Systems; Monsoon Circulation: Semi-permanent monsoon systems, Monsoon depression, Other synoptic systems.

**References**

1. Hand Book of Aviation Meteorology HMSO Publication 1960.
2. Meteorology for Aircrew 3201.
3. IAP 3202.
4. First International Conference on Aviation weather System – Montreal 1981.
5. Aeronautical Meteorology WMO TN 95.
6. Instructions for Aviation Services in India – IMD Publication.
7. Nowcasting by KA Browning, WMO Tech Notes on CAT, Mountain Waves.
8. WMO Tech Notes on CAT, Mountain Waves.
9. Aeronautical Met – WMO TN 95.
10. Procedures for Air Navigation Services Met Procedure.
11. Memorandum on ICAO (1955 Edition) Publications.
12. Dynamic Meteorology by Holton.
13. Monsoon by YP Rao.
14. WMO Compendium by WMO.
15. Atmospheric Circulation System - by Newton and Palmen.
16. Thunderstorm Morphology & Dynamics – By Kessler.
17. Indian and other journals on Meteorology.

**PAPER III – NUMERICAL WEATHER PREDICTION**  
**(SPECIAL PAPER)**

**Unit I: Introduction**

Historical Background; Filtering problem; Finite difference techniques; Explicit and implicit schemes; Semi implicit schemes; CFL criterion and stability analysis; Staggered grid; Nonlinear instability and aliasing.

**Unit II: Hierarchy Of Numerical Models**

Barotropic Model: Equivalent barotropic model, Two-level baroclinic model; Shallow water equation model; Primitive equation models; Boundary conditions and time integration.

**Unit III: Parameterization of Sub Grid Scale Processes**

Boundary layer parameterization: Cumulus convection, Radiation parameterization.

**Unit IV: Objective Analyses and Initialization**

Basic Concepts; Ponofskys methods; Cressmans method; Optimum interpolation technique. Static, dynamic and normal mode initialization.

**Unit V: Spectral and Finite Elements Models**

Introduction; Galerkin methods; Transform method; Spectral model of shallow water equations; Overview of primitive equation; Multilayer spectral models; Finite element method.

**References**

1. Numerical Weather Prediction – 63028 – GJ Haltiner.
2. Numerical Weather Prediction Model Tech Report No 2 - Mohanty, Paliwal, Tyagi, Madan & Sareen.
3. An Introduction to Numerical Weather Prediction Technique – TN Krishna Murthy.
4. Introduction to NWP – GC Asnani.
5. Basic Concepts in NWP Model – RK Dutta.
6. Numerical Prediction and Dynamic Meteorology – Haltiner & Williams.

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