

SYLLABUS FOR
INTERMEDIATE TRAINING COURSE
(GENERAL METEOROLOGY)
(DURATION 4 MONTHS)

PAPER I

DYNAMIC METEOROLOGY –

- 1.1 Its scope and uses. Concepts of displacement, velocity, acceleration, force, angular velocity.
- 1.2 Newton's laws of motion. Absolute and relative motion, Basic concepts regarding Coriolis force, Pressure gradient force, Centrifugal force, Gravity and Gravitation,
- 1.3 Equation of motion (in component form) explanation (without derivation) of all the terms and their significance.
- 1.4 Balanced motion:- Geostrophic, Gradient and cyclostrophic winds. Ageostrophic wind. Thermal wind and calculation of thermal wind by the graphical method with examples. Elementary ideas regarding atmospheric boundary layer.
- 1.5 Kinematics of wind and pressure field:- Lows, highs, trough, ridge and Col. Hydrostatic balance. Equation of continuity . Dines compensation principle, Vertical motion in the atmosphere.
- 1.6 Divergence and vorticity in natural co-ordinates. Illustration by typical cases on synoptic charts.

Paper II

PHYSICAL METEOROLOGY

2.1 Thermodynamics

- 2.1.1 Gas Laws. Ideal gas equation. Concepts of internal energy and specific heats of gas. First and second laws of thermodynamics. Concepts of adiabatic process, potential temperature and entropy. Dry adiabatic lapse rate.
- 2.1.2 Moisture in the atmosphere - vapour pressure, saturation vapour pressure, relative humidity, mixing ratio, virtual temperature, dew point and wet bulb temperatures. Changes in saturation vapour pressure with temperature. Moist adiabatic lapse rate. Equivalent potential temperature.
- 2.1.3 Geopotential, pressure height curve. Thermodynamic diagram. Construction of Tephigram and its uses. Statement of Normand's theorem. Computation of derived moisture variable and the height of pressure surface. Study of static stability Parcel method.
- 2.1.4 Clouds fog and precipitation, basic knowledge of their formation.

2.2 Radiation

- 2.2.1 Kirchoff's Law, Stefan Boltzman's Law. Wien's displacement law. Planck's Law, Elementary ideas of absorption, emission and scattering of radiation.
- 2.2.2 solar radiation direct and diffuse. Solar constant. Albedo. Beer's law of solar absorption in the atmosphere.
- 2.2.3 Terrestrial radiation. Green House Effect. Heat balance of the earth and atmosphere. Minimum and maximum temperature.

Paper III

CLIMATOLOGY AND METEOROLOGICAL STATISTICS

3.1 Climatology

3.1.1 Introduction:-

Earth sun relationship. Ecliptic and equatorial plane. Rotation and revolution of the earth. Equinoxes, Solstices. Perihelion and Aphelion. Causes of seasons. Seasonal and latitudinal variation of insolation.

3.1.2 Elementary ideas of general circulation of the atmosphere over the globe. Distribution of pressure and temperature over the surface of earth. Equatorial trough and inter tropical convergence zone (ITCZ) Climatic zones. Climate and climatic controls. Climatic elements such as pressure temperature and rainfall.

3.1.3 Indian Climatology:- Division of Indian Climatological year into four seasons.

Winter season - Western disturbance and Easterly waves and weather associated with them. Fog cold wave, Thunderstorm and Hail. Sub tropical westerly Jet stream.

Premonsoon season – Heat wave. Cyclonic storms in the Indian seas. Western disturbances with associated induced lows. Factors affecting visibility India – fog, duststorm, dust raising winds Thunderstorms hailstorms, Norwesters.

Southwest monsoon season – Onset and advance of southwest monsoon. Semipermanent systems of monsoon, strong and weak monsoon. Break monsoon. Factors affecting distribution of monsoon rainfall. Synoptic systems in monsoon particularly monsoon depression. Interannual and intra seasonal variability of monsoon.

Post monsoon season - Withdrawal of southwest monsoon and northeast monsoon, Cyclonic storms in the Indian seas. Western disturbances, Easterly waves.

NOTE: Climatological aspects of various phenomena in India occurring in the above mentioned seasons are to be covered including a special study of mean upper wind and temperature charts.

Meteorological statistics

3.2.1 Introduction -

Statistical variables – continuous and discrete. Frequency distribution – Graphical representation of frequency distribution- Histogram, Cumulative frequency distribution- ogives.

3.2.2 Measures of central tendency – Mean, median, mode quartile, decile, centile and percentile.

3.2.3 Measures of dispersion:- Range, mean deviation, quartile deviation, interquartile range and standard deviation.

3.2.4 Elementary concept of probability. Linear correlation and regression. Uses of significance tests for correlation coefficients. Basic ideas of multiple correlation and regression analysis.

3.2.5 Introduction to computers. Types of computers. Decimal, binary and extra decimal systems Computer languages. Fundamental ideas of FORTRAN 77.

Paper IV

SYNOPTIC, AVIATION & MARINE METEOROLOGY

4.1 Synoptic Meteorology :

- 4.1.1** Synoptic Analysis. Scales of atmospheric motion. Synoptic net work surface and upper air. Isobars on level surface. Contours and isotherms on an isobaric surface. Concept of Thermal wind. Analysis of tendency and departure charts. Streamline and Isotach analysis. Vertical time section and cross section.
- 4.1.2** Tropical meteorology : Distribution of pressure and wind. Subtropical high. Trade wind and equatorial trough. Trade wind inversion. Monsoons.
- 4.1.3** Synoptic Models :- Tropical cyclones, Monsoon depression, Mid tropospheric cyclones. Western disturbances. Easterly wave, Trough in westerlies Jet streams
- 4.1.4** Extra tropical Meteorology – Air mass, Fronts and associated weather.
- 4.1.5** Weather Forecasting:- Short, medium and long range forecasting (elementary ideas) Nowcasting Forecasting techniques for synoptic systems and associated weather.
- 4.1.6** Basic concepts of kinematic methods. Statistical methods (use of persistence, climatology and steering) and thermodynamic method. Meteorological satellites (elementary ideas) Use of satellite data in weather forecasting with typical illustrations. Meteorological Radars (elementary ideas) and use of radar data. Forecasting of thunderstorm. Squall, dust storm, fog, low cloud and heavy rain in different synoptic situations.

4.2 Aviation Meteorology

- 4.2.1** Structure and functions of India Meteorological Department. World Meteorological Organisation and International Civil Aviation Organisation. Publications of Civil Aviation Department. Aviation Climatological publications. Different types of aircraft (piston propelled, turbo propelled jet etc) and their meteorological requirements. Elements of air navigation Effects of weather on air craft flights. Aircraft accidents and their investigations. VVIP/VIP flights. Meteorological organization for aviation in India, Meteorological broadcasts for aeronautical purposes. Air traffic services. Briefing and documentation procedures. Meteorological services provided to airlines - flight forecast, local forecast and TAF. Area Meteorological watch. Display in Meteorological offices. Aviation registers. Standard atmosphere, barometric altimetry. Altimeter setting procedures.

4.3 Marine Meteorology

- 4.3.1** Marine Meteorological organization. Voluntary observing fleet. Meteorological broadcasts for shipping. Weather warnings issued to posts. Marine climatology.

PAPER V (PRACTICAL I)

SYNOPTIC & AVIATION METEOROLOGY

5.1 Synoptic Meteorology

Exercises in chart reading. Plotting of constant pressure charts direct from teletype messages. Techniques of analysis. Climatological charts. Surface charts. Upper wind charts. Constant pressure charts. Analysis of surface and upper air charts typical of the 4 seasons. Analysis of a few day's chart each of tropical cyclones. Monsoon depression, western disturbance and Jet stream for surface 850 hPa, 700 hPa, 500 hPa and 200 hPa. Vertical time section and cross section analysis.

5.2 Aviation Meteorology

Preparation of flight forecast two for each season. Preparation of TREND forecast for deterioration and improvement in respect of each element. Formats and elements in different types of forecasts/warning (both aviation and non aviation)

PAPER VI (PRACTICAL II)

THERMODYNAMICS, STATISTICS, INSPECTION OF OBSERVATORIES & AVIATION

6.1 Thermodynamics:

Analysis of Tephigram. Computation of derived thermodynamic parameters. Computation of height of pressure surface. Location of tropopause and inversion. Estimation of height of base and top of clouds. Study of the instability of the atmosphere (parcel method)

6.2 Statistics and Compute programming:

Computation of measures of central tendencies (like mean, mode and median) and measure of dispersion (like standard deviation etc) Computation of Karl Pearson's and rank correlation. Significant tests of correlation coefficient.

6.3 Inspection of observatories:

Recording of various meteorological parameters. Barometer comparison.

6.4 Aviation Meteorology

Decoding of flight, route and aerodrome forecasts on relevant forms.
