Third Year

Synoptic and Aviation Meteorology

Course Title: Synoptic and Aviation Meteorology

Course Number: MET 301 Full Marks: 100

Nature of Course: Theory Pass Mark: 35

Course objectives:

Synoptic and Aviation Meteorology course is designed to provide the students with depth knowledge on various aspects of aviation weather, weather analysis and forecasting.

Course content:

Definition and scope of synoptic meteorology: Synoptic scale, synoptic hours, surface weather map analysis 2 hrs

Air mass: Introduction, Area of formation and classification, Cold and warm air masses, Continental and maritime air masses, Air mass modification 8 hrs

Fronts: Introduction, properties and classification of fronts (warm, cold and stationary), Locations of front in different seasons, Atlantic ocean area, Pacific area, Front models and weather associated with it, Quasi-stationary front, Warm front, Cold front (slow and fast moving) front, Occluded front, Warm front occlusion, Cold front occlusion, Frontogenesis and frontolysis (derivation). 10 hrs

Wind: Global wind, Trade wind, Geostrophic and Gradient wind, Local wind (land breeze, sea breeze), the earth's heat energy balance, single and three cells models. 7 hrs

Synoptic climatology of extra-tropics: Introduction to the zonal index, Synoptic situation during high index period and low index period 2 hrs

Extra tropical cyclone and anti-cyclone: Polar front theory (life cycle), Cyclone energetic, Cloud and precipitation associated with it, Vertical structure, Movement, Polar continental highs, Subtropical anticyclone, Highs within the cyclone, Polar out-break high, Cut-off cyclone and anticyclone 10 hrs

Monsoon: Introduction- southwest monsoon and northeast monsoon, Differential heating theory, Migration of ITCZ, Monsoon vagaries: Onset of monsoon and its importance associated with it, Onset criteria, Trough and weather associated with it, Depression and its movement,

Break/active monsoon and its synoptic situation, Withdrawal of monsoon

14 hrs

Northeast monsoon: Low pressure area during northeast monsoon, Depressions and tropical storms, Easterly waves 5 hrs

Western disturbances (WD): Introduction and formation, Synoptic situation during the formation of WD, Movement of WD and weather associated with it. 3 hrs

Tropical storms: Introduction, classification of the storm, Life cycle of the tropical storm: Formative stage, Immature stage, Mature stage and Decaying stage, Areas and frequencies of formation of tropical storm, Atlantic ocean, Pacific ocean and Indian ocean, Characteristics of tropical storm, Surface pressure: Surface Temperature distribution, Surface wind, Upper wind, Rainfall distribution, Eye, State of sea, Cloud, Motion of the tropical storm, Internal force, External force, Re-curvature and Satellite tracking, Forecasting of tropical storm, Statistical method, Persistence method, Climatological method, Numerical Weather Prediction of tropical storm 14 hrs

Jet stream: Introduction, Types of Jet stream (westerly and easterly jet stream), Wind structure, Thermal structure, Geographical areas of formation and seasonal variation, Clear Air Turbulence (CAT) in relation to jet stream and its importance in aviation, Low level turbulence: convective currents, obstruction to wind flow, wind shear. 12 hrs

Thunderstorm: Introduction, Cell, super cells, etc, Life cycle of thunderstorm, Formative stage, Immature stage, Mature stage, Decaying stage, Hazards associated with thunderstorm

8 hrs

Norwesters: Introduction, Types of norwester (A, B, C and D type), Norwesters in association with winter disturbances and pre-monsoon depression, Mechanism of formation and its synoptic features. 6 hrs

Wind, Pressure and temperature: Wind near earth's surface and in free atmosphere, wind shear, mountain winds, drainage winds and their impacts in aviation, Atmospheric pressure ,(.cte .HNQ ,FFQ ,EFQ) thgilf htiw pihsnoitaler sti dnaHeat exchange processes

of atmosphere, Dew point, dry bulb and wet bulb temperatures, saturation of air and humidity. 12 hrs

Cloud and Visibility: rehtaew ni elor sti dna areneg duolC, dna ytilibisiVfactors affecting visibility, latnemurtsnI dna (CMV) snoitidnoc lacigoloroetem lausiV (sepyT) goF ,(CMI) snoitidnoc lacigoloroetem 14 srh

Turbulence ,**Icing and aviation hazards**: Low level and high level turbulence (CAT), t emarfria ,ti htiw detaicossa ecnelubrut dna mrotsrednuhicing .sdrazah noitaiva dna 10 srh

Meteorological services and flight planning 1 hrs

Meteorological Watch Office and flight documentations 1 hrs

World Area Forecasting System: wind and temperature chart, Sigmet chart, air-met chart 3 hrs

Text Books

- Petterssen, Sverre, 1941: Introduction to Meteorology, Mc-Graw Hill Book Company Inc., New York and London
- Petterssen, Sverre, 1956: Weather analysis and forecasting. Vol I and II, Mc-Graw Hill Book Company Inc., New York.
- Herbart Riehl: Tropical Meteorology, 1954, Mc Graw Hill, New York

Reference Books

- Ramage, C. S., 1971: Monsoon Meteorology, Academic Press, NewYork
- Critchfield, H. J., 1974: General Climatology, Prentice-Hall
- Manual of Aviation Meteorology, Australia, Bureau of Meteorology.

Mountain Meteorology

Course Title: Mountain Meteorology

Course Number: MET 303 Full Marks: 50

Nature of Course: Theory Pass Mark: 17.5

Course objectives:

Mountain Meteorology course is designed to provide the students in depth knowledge on various aspects of weather and climate of mountainous region.

Course content:

Mountain Climates: Factors that determine climate (latitude, altitude, continentality, regional circulation) 4 hrs

Atmosphere: Atmospheric Scales of motions and atmospheric composition, Pressure and wind, Clouds and fogs, mountain thunderstorm 12 hrs

Mountain winds: Anabatic and Katabatic wind, Terrain-forced flows (three factors that Affect Terrain-Forced Flows, Flow over Mountains, Flow around Mountains, Flow through gaps ,channels, and passes, Blocking, cold Air Damming, and Obstruction of air masses, On the high plains: The low-Level Jet) 14 hrs

Diurnal Mountain Winds: The Daily Cycle of Slope and Along-Valley (Winds and Temperature Structure, Modification of Diurnal Mountain Winds by Variations in the surface Energy Budget, Disturbances of the daily cycle by Larger Scale Flows, The Four Components of the Mountain wind system, Diurnal Mountain Winds in basins, Diurnal Mountain winds over Plateaus, Other Local Thermally Driven Wind systems) 16 hrs

Precipitation and Orography: Lifting mechanisms (Terrain-forced mechanisms and convective mechanisms); Orographic Precipitation (Seeder-Feeder mechanism, Upslope Condensation, Orographic Convection). 7 hrs

Mountain Waves: Waves (Atmospheric Waves, Gravity Waves, Standing Waves, Mountain Waves); Features (Introduction, Cap Clouds, The Vertically-Propagating Waves, Breaking Waves, Downslope winds, Rotors, Rotor Clouds and Trapped Lee Waves), Climatology (Location, Tropical Mountaiin Waves, Areal Extent of Mountain Waves, Time of Year, and Time of Day) 8 hrs

Hydro-meteorological Data and Forecasting: Hydro-meteorological measurements, Hydro-meteorological data processing, Concept and types of weather forecasting, Weather forecasting methods, Satellite in weather forecasting, Weather forecasting for mountaineering expedition. 14 hrs

Text Book

- C. David Whiteman, 2000: Mountain Meteorology, Fundamentals and applications, Oxford University Press

Reference Books

- Roger G. Barry, 2008: Mountain Weather and Climate, Cambridge University Press.
- J. F. Griffiths, Handbook of Agricultural Meteorology, 1994: New Work, Oxford University Press. Academic Publication.

Micrometeorology

Course Title: Micrometeorology

Course Number: MET 304 Full Marks: 50

Nature of Course: Theory Pass Mark: 17.5

Course objectives: Micro meteorology course is designed to provide the students with depth knowledge on different aspects of energy balance on the various surface of the earth.

Course content

General Introduction: Introduction micrometeorology, definition of surface boundary layer, relation between micrometeorology and microclimatology, scope of micrometeorology.

5 hrs

Radiation process: Definition of spectrum of radiation, effect of temperature on radiation, Introduction of short wave radiation and long wave radiation, black body radiation, definition of albedo, radiation energy at the outer boundary of atmosphere, depletion of solar radiation in the atmosphere, scattering and diffusion process of radiation, Rayleigh law of scattering.

15 hrs

All wave net radiation: Calculation and measurement of long wave radiation on the earth surface, definition of emissivity, introduction of greenhouse effect, measurement of short wave radiation from the atmosphere, definition of net radiation, measurement of all wave net radiation, total heat balance on the Earth's surface, conversion of mass flux into energy flux.

15 hrs

Ground heat flux and temperature: Surface air temperature, temperature variation on the earth's surface, soil temperature, temperature gradient and rate of temperature variation, derivation of ground heat flux at land surface, conduction of heat flux into the soil layer and determination of soil conductivity, soil moisture and its measurement, surface moisture and its measurement, soil moisture saturation process, relative humidity and specific humidity.

10 hrs

Evaporation: Evaporation from the earth surface, estimation of evaporation, measurement of temperature and relative humidity, relation between relative humidity and saturation vapor pressure, daily, monthly and seasonal variation of evaporation.

10 hrs

Stability criteria of atmosphere: Stable and unstable conditions in atmosphere, wind flow near the earth's surface, viscosity and shearing stress, surface shearing stress, wind shear and drag coefficient, difference between dynamic and kinematic viscocity, turbulent layer of atmosphere, introduction of friction velocity and roughness length, vertical wind profile in the absence of buoyancy. 10 hrs

Turbulent transfer of heat fluxes from the land surface: The Monin-Obukhov Length and Richardson Number, Relation to determine Richardson Number and its application, turbulence in atmosphere, sensible and latent heat fluxes, the ratio of diffusivity, night time turbulent heat fluxes, measurement of temperature and water vapor fluctuation.

10 hrs

Text Book

- Ronald B. Stull, 1988: An Introduction to Boundary Layer Meteorology, Kluwer

Reference Books

- J. F. Griffiths, Handbook of Agricultural Meteorology, 1994: New Work, Oxford University Press. Academic Publication.

- R. E. Munn, 1966: Descriptive Micrometeorology, Academic Press.

Weather Analysis and Forecasting Practical

Course Title: Weather Analysis and Forecasting

Course Number: MET 302 Full Marks: 50

Nature of Course: Practical Pass Mark: 20

Practical 1: Surface coding and decoding

Practical 2: Surface map plotting and analysis

Practical 3: Upper air coding and decoding

Practical 4: METAR, SPECI, TAF, SIGMET

Practical 5: Preparation of Synoptic weather chart of different pressure level for specific cases

a) Just before the onset of monsoon
b) Severe thunderstorm case
c) During the peak of monsoon
d) During dry winter
e) During westerly disturbances

Practical 6: Collection of Satellite images (IR, visible and water vapor) for cloud pictures of same cases as of no 5.