REGULATIONS SCHEME OF EXAMINATIONS, SYLLABUS AND MODEL QUESTION PAPERS

MASTER OF SCIENCE: METEOROLOGY

WITH

PG DIPLOMA IN AVIATION METEOROLOGY

BHARATHIAR UNIVERSITY
COIMBATORE 641 046

(w.e.f. 2008-09)

REGULATIONS SCHEME OF EXAMINATIONS, SYLLABUS AND MODEL QUESTION PAPERS

MASTER OF SCIENCE: METEOROLOGY

WITH

PG DIPLOMA IN AVIATION METEOROLOGY

FACULTY OF METEOROLOGY

AIR FORCE ADMINISTRATIVE COLLEGE
REDFIELDS, COIMBATORE 641 018

BHARATHIAR UNIVERSITY, COIMBATORE - 641 046

M.Sc METEOROLOGY
WITH PG DIPLOMA IN AVIATION METEOROLOGY

REGULATIONS

General

1. **Programme No.:**

2. **Programme Name:** MSc (METEOROLOGY) (with PG Diploma in Aviation Meteorology)

3. **Programme Code:** MSMET

4. **Approving Authority:** Air Headquarters & MOD, New Delhi.

5. **Eligibility for Admission:** **(a)** B.Sc. degree in any subject with Physics and Maths (at least till II year) as compulsory / allied subjects (10+2+3 pattern).

   (b) Minimum First Division (60% Marks in graduation).

6. **Duration:** 02 years (Comprising Four Semesters, with two semesters per year. There would not be less than ninety instructional days during each semester. Examinations will be conducted at the end of each semester.)

7. **Nature:** Full Time PG lab oriented with Project work

8. **Approved Intake Capacity:** As approved by Air HQ (On average 10 -15 subject to a maximum of 40 trainees)

9. **Scheme of Examination:** Scheme of examination shall be as given in page 3.

Distribution of marks

Core	1800
Diploma	400
Total marks	2200

Attendance Requirement to Appear in Examination

10. (a) A candidate will be permitted to appear for the University examination of any semester, if:-

    (i) The student secures not less than 75% attendance during the semester.

    (ii) The student earns a progress certificate from the head of the institution as having satisfactorily completed the course of study as required by these regulations and the conduct of the student has been satisfactory.

(iii) Provided that it shall be open to the Syndicate or any other authority, delegated with such powers by the Syndicate, to grant exemption to a candidate who has failed to earn 75% attendance prescribed, for a valid reason, subject to usual conditions.

(b) A candidate who has secured less than 65% but 55% and above attendance in any semester has to compensate the shortage in attendance in the subsequent semester, besides earning the required percentage of attendance in that semester and shall appear for the papers/subjects of both semesters, together at the end of the latter semester.

(c) A candidate who has secured less than 55% of attendance in any semester will not be permitted to appear for the regular examinations and to continue the study in the subsequent semester. He/she has to rejoin the semester, in which the attendance is less than 55%.

(a) A candidate who has secured less than 65% of attendance in the final semester has to compensate his/her attendance shortage in a manner as decided by the concerned Head of the Department after rejoining the same course.

11. **Restrictions to Appear for the Examinations:**

(a) A candidate having arrear paper(s) shall have the option to take the examination in any arrear paper(s) along with the subsequent regular Semester papers.

(b) Candidates, who fail in any of the paper(s) shall pass the paper(s) concerned within 5 years from the date of admission to the said course. If they fail to do so, they shall take the examination in the revised text/syllabus prescribed for the immediate next batch of candidates. If there is no change in the text/syllabus, they shall appear for the examination in that paper with the syllabus in vogue, until there is a change in the text or syllabus.

(c) In the event of removal of that paper consequent to change of regulation and/or curriculum after the 5 year period, the candidates shall have to take up an equivalent paper in the revised syllabus as suggested by the chairman and fulfill the requirement s as per Regulations / Curriculum for the award of the degree.

12. **Medium of Instructions:** The medium of instruction and examination shall be in English only.

<u>Examination Pattern</u>

13. The setting of question papers, examination, evaluation and processing of results would be done by the Bharathiar University (BU).

14. **Academic vs. Calendar Year:** The BU conducts the regular M Sc courses during the routine *Academic Year* commencing in July every year. However, on account of the regular intake of the officers (the students for the proposed M Sc programme) joining Indian Air Force twice a year i.e. in January and July every year, there would always be the possibility of having an additional M Sc programme during the *Calendar Year* commencing in January too (It is besides M Sc programme commencing in July). In nutshell, on routine basis, there could be two M Sc programmes, one commencing in January (the Calendar Year, as is done in the existing

Distance Education Programme of the university) and the other commencing in July (the Academic Year).

15. **Schedule of Examination:** Partly owing to the above mentioned reasons in Para 11 here and partly due to minor variations in the dates of the commencement / cessation of the training curriculum at this College (from one course to other), the dates for the proposed semester wise M Sc examination can not be fixed permanently. However, on an average, the **period for the examinations** for two sessions would be as follows:-

(ii) Academic year programme : Middle of December] **± Three weeks**

(iii) Calendar year programme: Middle of June.

16. **Passing Minimum:**

(a) A candidate shall be declared to have passed in a paper if he/she obtains not less than 50% of marks in that paper. A candidate shall be declared to have passed the whole examination if he/she passes in all the papers.

17. **Improvement of Marks in the Subject already passed**..: Candidates desirous of improving the marks secured in their first attempt shall reappear once within the subsequent semester. The improved marks shall be considered

18. **Classification of Successful Candidates:**

(a) A candidate who passes all the examinations in the first attempt within a period of two years securing 75% and above marks in the aggregate shall be declared to have passed with First class with Distinction.

(b) Successful candidates passing the MSc (Meteorology) degree examination, securing marks 60% and above, shall be declared to have passed the examination in first class. All other successful candidates shall be declared to have passed the examination in second class.

19. **Ranking:** A candidate who qualifies for the course passing all Examination in the first attempt within the prescribed for the course of study from the date of admission to the course and secures 1st or 2nd class shall be eligible for ranking and such ranking will be confirmed to 10% of the total number of candidates qualified in that particular subject to a maximum of 10 ranks.

20. **Conferment of the Degree:** No candidate shall be eligible for conferment of the degree, unless the candidate has undergone the prescribed course of study for a period of not less than four semesters at AFAC or in an associate institution approved by/affiliated to the University or has been exempted there from in the manner prescribed and has passed the examinations.

21. **Question Paper Pattern:**

(a) Maximum 75 Marks

Section A: Objective type of questions with no choice 10 x 1 = 10 (10 questions – 2 each from every unit)

Section B: Short answer questions of either / or type 5 x 5= 25 (05 questions – 1 each from every unit)

Section C: Essay- type questions of either / or type 5 x 8 = 40 (05 questions – 1 each from every unit)

Compulsory PG Diploma in Aviation Meteorology

22. The compulsory PG Diploma dovetailed with the M Sc. Meteorology shall be PG Diploma in Aviation Meteorology, The schedule of Examination will be as per para 15. The minimum pass marks will be as per para 16.

23. A candidate failing to secure the minimum marks prescribed shall be required to re-appear for the examination in that paper and obtain the minimum marks required for passing the paper. Restrictions for reappearance in the Exam will be as per para 11. Classification and confirmation of the diploma will be as per paras 18,19 and 20 respectively.

24. **Question Paper Pattern:**

(a) Maximum 75 Marks

Section A: Objective type of questions with no choice 10 x 1 = 10 (10 questions – 2 each from every unit)

Section B: Short answer questions of either / or type 5 x 5= 25 (05 questions – 1 each from every unit)

Section C: Essay- type questions of either / or type 5 x 8= 40 (05 questions – 1 each from every unit)

25. **Revision of Regulation and Curriculum:** The above regulations, scheme of examinations and curriculum will be in force without any change, for a minimum period of two years, from the date of approval of the regulations. The University may revise, amend or change the regulations and scheme of examinations, if found necessary.

BHARATHIAR UNIVERSITY, COIMBATORE - 641 046
M.Sc METEOROLOGY WITH PG DIPLOMA IN AVIATION METEOROLOGY

(FOR THE STUDENTS ADMITTED DURING THE ACADEMIC / CALENDAR YEAR 2008-09 BATCH & ONWARDS)
SCHEME OF EXAMINATIONS

SEM	SUBJECT AND PAPER		INSTRUCTIONAL HOUR PER WEEK	UNIVERSITY	
				DURATION IN HRS	MAX MARKS
I	Paper I	General Meteorology	5	3	100
	Paper II	Observation & Instruments	5	3	100
	Paper III	Synoptic Meteorology I	5	3	100
	Paper IV	Physical Meteorology I	4	3	100
	Paper V	Climatology & Statistics I	5	3	100
	Practical I	Instruments and Observational Practices	3	---	------
	Diploma Paper I	Aviation Meteorology I	3	3	100
II	Paper VI	Dynamic Meteorology I	6	3	100
	Paper VII	Synoptic Meteorology II	6	3	100
	Paper VIII	Satellite Meteorology I	6	3	100
	Paper IX	Climatology and Statistics II	5	3	100
	Practical I	Instruments and Observational Practices	--	3	100
	Practical II	Applied Meteorology & Lab Practices	4	3	100
	Diploma Paper II	Aviation Meteorology II	3	3	100
III	Paper X	Dynamic Meteorology II	5	3	100
	Paper XI	Satellite Meteorology II	5	3	100
	Paper XII	Physical Meteorology II	5	3	100
	Paper XIII	Numerical Weather Prediction	6	3	100
	Practical III	Analysis and Prognosis	6	--	----
	Diploma Paper III	Aviation Meteorology III	3	3	100
IV	Practical III	Analysis and Prognosis	3	6	100
	Project	Project	21	-----	200
	Diploma	Practical I	3	3	50
	Diploma	Practical II	3	3	50

Note: 1. The maximum marks of 100 in each theory paper of M Sc. Meteorology & PG Diploma in Aviation Meteorology include 25 marks for continuous Internal Assessment and 75 Marks for written exam.

SEMESTER I

DETAILS OF SYLLABUS
M.Sc METEOROLOGY

SEMESTER I
PAPER I

GENERAL METEOROLOGY

UNIT I

Science of Meteorology – An overview
Importance of weather in all fields of human activity, main function of the meteorological organisation, weather forecasting, what is it and how is it done; weather charts and how they are prepared, synoptic observations - how taken and transmitted; upper air observations - how taken and transmitted; recent advances in the field of meteorology.

UNIT II

Meteorological Organisations: World Meteorological Organisation, IMD and IAF Meteorological Organisation. The objectives, structure and working of the organisations.

UNIT III

Insolation - Unequal distribution of solar energy over the surface of the globe, Depletion of solar radiation, Variation of temperature with Altitude and Latitude, Radiative balance.

The motions of the Earth - Sidereal and Solar day, Lunar and Solar tides, Lag of season, Sun/Moon rise/set.

Measurement of Time - LMT, Universal time, Differences in LMT, Time zones, the calendar. International Date Line.

UNIT IV

Physical Geography - Hydrological cycle, Water in the atmosphere, Evaporation and Condensation, Cloud and Rain.

The Earth and its interior - Location of a point on the Earth, Dimensions and structure and mass of the Earth, Lithosphere. Earthquake waves and Location, Moho discontinuity and Temperature of the interior.

UNIT V

Met Communications - Global Telecommunication System (GTS) -Main Trunk circuit, Regional and National networks.

Met Telecommunication Network In India - RMC and radio broadcast, AMSS.

Channels used in the IAF - TROPO (Simplex, Duplex), Direct Reception System (DRS), Met Message Handling System, Met GIS, IMT, reception through “Word Space receiver” and Internet.

REFERENCES:

1. WMO Training Manuals.
2. Manual of Meteorology for Air Crew - IAF Publication
3. Training Notes. Dept of Meteorology - AFA(Volume – 3)
4. General Meteorology – Byers HR.
5. Meteorology for Airman in India Part I – I Met D.

M.Sc Meteorology

SEMESTER I
PAPER II

OBSERVATION AND INSTRUMENTS

UNIT I

Surface Met Observations - Classification of station, Network, Type and time of observation, Surface Observation. Duties of Observer, Site of observatory and exposure of Instruments - Direct and self recording type, Stevenson Screen.

Codes – Synop code, station model, surface / ship codes, METAR / SPECI / SPECIAL

Measurement of Pressure - Definition, basic principle of Pressure measurement, Unit, Aneroid and Mercury barometer, Bar reduction Table, GPM, Calculation of QFE, QFF, QNH, Diurnal variation of Pressure, Barograph measurements.

Measurement of Temperature - Definition, Basic Principle of Temperature measurement, Various Thermometers, Defect and Remedy of Max & Min Thermometer. Reading & setting.

UNIT II

Measurement of Humidity - Basic principle of measurement of humidity. Instruments including Psychrometric measurements, Psychrometric tables, Errors.

Measurement of Surface Wind - Definition, unit, DR wind instruments, Beaufort scale, Diurnal variation of surface wind, Buy's Ballot's Law, Fohn wind, Land & Sea breeze, Katabatic & Anabatic wind, Measurement of surface wind speed and direction.

Measurement of Precipitation - Rain recorder – Self Recording (float type), Snow measurements, Intensity of precipitation.

UNIT III

Measurement of Visibility - Definition, visibility, Estimation, Landmarks, RVR, Definition, landmarks.

Meteors - Hydro, Litho, Electro and Photo meteors, Definition and Description.

Cloud Classification - Classification, Types, Genera/Etages, Features, Other clouds.

Cloud Observation and Measurements - Estimation of amount, Height of the base, its measurements, Ceiling balloon, Aircraft observations.

UNIT IV

Upper Air Observations

Introduction - Elements, Historical background, Importance to pilots.

Measurement - Uniform rate of ascent, Tail method. Theodolite, Site for PB ascent, LP generator, Hydrogen cylinder, Balloons, True north, Datum Point.

UNIT V

Computation by Pilot Balloon – Direction and Speed (Height & distance calculations) by Tail method (Drawing the trajectory), Height card, Inaccuracies, Rate of ascent, Free lift, Lift tables.

Radar- Wind Finding - RAWIN's radar methods.

Radiosonde – Design, Features, Ground equipment, Types, Errors.

REFERENCES:

1. Manual of Meteorology for Air Crew – IAF publication
2. Procedures for IAF Meteorological Procedures Edition-2002
3. Training Notes. Dept of Meteorology - AFA.
5. Guide to Met Instruments and Methods of Observation – WMO.
6. Meteorological Instruments – WEK Middleton & AF Spilhaus.
7. Handbook of Meteorological Instruments – HMSO London
8. Instructions to Observers – IMD Publications
9. Instructional Manuals on Various Instruments – IMD Publications

M.Sc Meteorology

SEMESTER I
PAPER III

SYNOPTIC METEOROLOGY I

UNIT I

Introduction - Definition and Evolution of synoptic map, Wind system and Scale of atmospheric motion.

UNIT II

Air Masses - Definition, Origin classification, Characteristics features, Movement, properties, Types – Polar, mid latitude, Arctic, Equatorial. Modification.

Air Masses over India

Tropical Continental, Tropical Maritime, Equatorial Maritime and Polar air masses over India. Polar Outbreak and cold wave conditions.

UNIT III

Fronts. Definition and characteristics of Cold, Warm and Occluded fronts.

Extra tropical Cyclones - Extra Tropical Cyclones, Geographical distribution, Cyclogenesis, Life cycles, Secondaries, Family anticyclones – types.

UNIT IV

Monsoons - Definition, Nature, Mechanics, Areas; Asiatic Monsoon.

UNIT V

Indian Monsoon

SW Monsoon - Period, Onset & Withdrawal, Pressure and Wind pattern, Heat low and Monsoon Trough, Rainfall distribution and Effect of Topography on rainfall distribution.

NE Monsoon – Period, Pressure and Wind pattern, Areas affected, Synoptic systems.

REFERENCES:

1. Compendium of Meteorology – WMO Publication Vol I – Synoptic Met.
2. Training Notes. Dept of Meteorology - AFA
3. Meteorological Monograph – Synoptic Meteorology No1/1976
SW Monsoon - YP Rao. IMD Publication
4. Tropical Meteorology - GC Asnani Vol I & II.
5. Monsoon Meteorology - Ramage.
6. A guide of Tropical forecasting - Maj Aitkinson.
7. Physics of Monsoon – RN Keshwamurthy

M.Sc Meteorology

SEMESTER I
PAPER IV

PHYSICAL METEOROLOGY I

UNIT I

Composition of Atmosphere - Composition of dry air, Aerosols, Air pollution, Weather and climate.

UNIT II

Solar Radiation –Sun, Solar radiation, EM spectrum, Short wave radiation, Flux, Insolation and Disposition

Terrestrial Radiation – Characteristics, Absorption of Terrestrial radiation, Radiative cooling and heating.

UNIT III

Mean Heat Balance – Introduction, Long and short wave components, Mean heat balance, Green house effect, Meridional temp gradient, Poleward transport of energy.

Atmospheric Moisture - Water in the atmosphere, Circulation of water in the atmosphere, Humidity and vapour pressure.

UNIT IV

Condensation, Fog and Clouds - Condensation, Dew point, Types of fog, Ground Frost, Cloud types and the physical processes resulting in cloud formation

Stability and Cloud Development – Lapse Rate, DALR, SALR, ELR, Stability / instability in the atmosphere, Topography.

UNIT V

Optical Phenomena – Rainbow, Mirage, Halo, Corona, Twinkling etc

REFERENCES:

1. Compendium of Meteorology: Physical Met Vol I - WMO Publication.
2. Cloud Physics - Rogers.
3. Physical Meteorology - Johnson.
4. Dynamical and Physical Met - Haltiner and Martin.
5. Physical Meteorology – Henry GH.
6. Theoretical Meteorology - Hess
3. Training Notes. Dept of Meteorology - AFA
8. Meteorology- Understanding the atmosphere- S A Ackerman, John A Knox

M.Sc Meteorology

SEMESTER I
PAPER V

CLIMATOLOGY AND STATISTICS

UNIT I

Scope of Climatology, Climate Control & Variability

Definition, climate & aviation. Elements and factors, and climatic control.

Climatic Classification

Koppen's and Miller's classification.
Equatorial, hot and tropical climate.

UNIT II

General Circulation - Global mean temperature and pressure distribution, ITCZ, STH, Hadley cell, their seasonal variations.

UNIT III

Indian Climatology

Seasons of India: Distribution of pressure, temperature, rainfall, upper winds, storm tracks, aviation hazards of all seasons in India.

UNIT IV

Climatology of Tropical Storms over Indian Seas – General Areas of formation, Tropical Storm Statistics over Indian seas, Movement and tracks (IMD Atlas), Aviation weather hazards.

UNIT V

Statistics

Statistics and its applicability in Atmospheric Science.

Collection and Presentation of data : Raw data, Array, Frequency Distribution : Grouped data; class interval ; class marks ; Cumulative frequency distribution ; Ogives; Skewness and kurtosis.

Central tendency: Arithmetic Mean Ungrouped and Grouped; Properties of AM; Geometric Mean and Harmonic Mean : Median ; Mode ; their relationship.

Dispersion; Objective : Measures of dispersion: Range ; Mean deviation ; Standard deviation

Meteorological Diagrams

Bar graph, wind roses, pie chart, scatter diagram.

REFERENCES:

1. An Introduction to climate – Trewertha.
2. Training Notes – Dept of Met, AFA - Vol III
3. Training Notes Vol IV - Dept of Met , AFA compiled by Wg Cdr IJ Banga
5. WMO compendium on climatology.
6. Statistics - Muray R Spiegel -Schaum Series.
7. Statistical Methods - SP Gupta.
8. Storm Tracks Atlas - - India Met Dept publication.

M.Sc Meteorology

SEMESTER I
PRACTICAL I

INSTRUMENTS AND OBSERVATIONAL PRACTICES

UNIT I

Measurement of Surface Observations and Cloud Observations

Plotting of Surface and Upper Air Charts

UNIT II

Upper Wind Measurement - Uniform rate of ascent, Tail method, Pilot balloon Theodolite, site for PB ascent, LP generator, Hydrogen cylinder, Balloons, True north; Night Ascent.

UNIT III

Computation by Pilot Balloon – Direction & Speed (Height & distance) calculations by tail method (Drawing the trajectory), Height card, Rate of ascent, Free lift, Lift tables.

UNIT IV

Inspection Schedule & Standardisation – Periodic inspection (by Met Sec) Schedule & Checks & Periodic inspection (by I Met D) Schedule, Checks and Standardisation.

UNIT V

Installation, Care, Maintenance, Inspection and Standardisation of Individual Instrument – Barometer and Barographs, Thermometer and Thermographs, Wind Instruments – Wind vane and Anemometers, Psychrometers, Raingauge and Autographic Instruments.

REFERENCES:

1. Manual of Meteorology for Air Crew: IAF Publication.
2. Procedures for meteorological services in IAF 2002 Edition.
3. Training Notes – Dept of Met, AFA - Vol III
4. Guide to Met Instruments and Methods of Observation – WMO.
5. Meteorological Instruments – Middleton & Spilhaus.

PG DIPLOMA IN AVIATION METEOROLOGY (COMPULSORY)

THEORY I

AVIATION METEOROLOGY I

UNIT-I

Aviation Weather Codes – Metar / Speci, Meteorological Routine Report, Weather Symbols and RAREP

UNIT –II

Met Observations for Aviation

Pressure Measurement - Bar reduction Table, Pressure Altitude, D – Value, QNH QFE and QFF.

Visibility Measurement for Aviation - Definition: Visibility, Prevailing visibility, Reporting Procedure of visibility, Directional variation in visibility

Measurement of Wind - Measurement of Surface wind and Direction , Reporting procedure. Reporting procedures in respect of variation in direction and speed.

UNIT – III

Aviation Weather Hazards – Definitions: Thunder Storm Thundery Conditions, Dust Storm Dust Raising Winds, Smoke, Gust, Gale, Squall.
Aviation Weather Hazards of Pre-Monsoon, SW Monsoon season,
.

UNIT- IV

Aviation Weather Hazards: Definitions: Fog, Mist, Shallow Fog,
Aviation Weather Hazards of Post Monsoon and Winter season

UNIT- V

Communication Network for exchange of aeronautical data.
ROBEX, METNI, VOLMET, TROPO, SIMPLEX, DUPLEX, Direct Reception System
IAF Wide Area Net Work

REFERENCES:

1. Meteorology for Air Crew : IAP 3201
2. Procedures for IAF Meteorological Services. 2002 Edition
3. Manual on Meteorological Services for Aviation in India. Edition 2005.

SEMESTER II

M Sc METEOROLOGY

SEMESTER II
PAPER VI

DYNAMIC METEOROLOGY – I

UNIT I

Mathematics - Vector Analysis (Definition, Vector Algebra, Scalar & Vector Product, Triple Product, Vector Differentiation & Integration, Gradient, Divergence & Curl). Application in Meteorology. Co-ordinate Systems, Cartesian, Spherical, Cylindrical and Natural Co-ordinates. Function and Limits. Ordinary and Partial Differential Equations, their linear-solutions of first and second order equations.

UNIT II

Kinematics of Fluid Flow - Resolution of Linear velocity field and Invariance of its components. Streamlines, Trajectories and Streak-lines. Stream Functions and Blaton's Equation.

Kinematics of Pressure Field - The motion of Isobars, Troughs, Ridges, Pressure Centres and Isallobars. Intensification and Deepening of pressure centres. Application of Kinematic formulae to forecasting.

UNIT III

Equation of Motion - Absolute and Relative motion. Fundamental and apparent forces in atmosphere. Equations of Motion in different Coordinate systems. Scale analysis of Equation of Motion.

Classification of Horizontal Frictionless Flow - Geostrophic flow. Inertial flow & Cyclostrophic flow. Gradient flow. Geostrophic wind scales.

Ageostrophic Flow - Role of Ageostrophy in Weather Development. Factors associated with Horizontal Acceleration and Ageostrophic Flow. Local Contribution, Down Wind Contribution and Vertical Contribution.

UNIT IV

Vertical Variation of Wind - Thermal wind. Vertical variation of the Geostrophic wind. The relation between thickness lines and Isotherms. Local Temperature variation. Changes in stability and horizontal thermal advection. Interpretation of Hodograph. Barotropic and Baroclinic Atmosphere.

UNIT V

Equation of Continuity - Conservation of Mass and Dine's Compensation. Equation of Continuity in different systems and in Pressure Co-ordinate. Scale analysis of Equation of Continuity

REFERENCES:

1. Dynamical and Physical Meteorology - Haltiner & Martin.
2. Weather Analysis & Forecasting - S Petterssen.

3. Compendium of Meteorology Vol I - WMO publication.
4. An introduction to Dynamical Meteorology – JR Holton.
5. Elements of Dynamic Meteorology – Gordon.

M Sc METEOROLOGY

SEMESTER II
PAPER VII

SYNOPTIC METEOROLOGY II

UNIT I

Introduction to General Circulation - Scales of Atmospheric Motions. Longitudinally averaged flow and Longitudinally varying flow.

Constraints on Theory of General Circulation - Law of Conservation of Heat, Law of Conservation of Angular Momentum, Law of Conservation of Mass, Law of Conservation of Moisture (or Water Vapour).

General Circulation Models- Classical Model,Fletcher 4 cell model and Asnani $3^1/_2$ model.

UNIT II

Tropical Meteorology

ITCZ – Definition, Global Picture of ITCZ, its formation, General Features and structure and Characteristics,

Movement and structure of ITCZ - Over East Central Pacific and Arabian Sea, ITCZ over Indian region, Weather associated with ITCZ
Role of ITCZ in Heat Transfer, ET, NHET & SHET. Disturbances in ITCZ. Easterly waves,Depression and Cyclonic storms their Formation, Movement and decay.

UNIT III

Monsoon Meteorology

Onset and progress of SW Monsoon - Cross Equatorial flow ; Onset Vortex and Off shore vortices., Onset criteria and normal dates of onset , Progress of monsoon.

Semi-Permanent Systems
Heat low, its formation, and structure.; Monsoon Trough, its structure and associated weather. Monsoon Lows and Depressions; its formation, movement, structure, rainfall pattern : Land lows, their formations, Movements, decay and structure. Tibetan High. Mid-Tropospheric Cyclones. Tropical Easterly Jet. Koteswaram Low and Low level jet

Monsoon Condition
Active, Weak and Break monsoon. Withdrawal of monsoon. EL-NINO & ENSO their effects on SW Monsoon. Variability of monsoon

Long Range Forecasting of Monsoon - Parametric Model, Multiple regression Model,
Power Regression Model.

UNIT IV

Mid-Latitude Meteorology - Western Disturbances, their formation, movement and associated weather. Active and inactive Western disturbances. Induced low, their formation, movement and associated weather.

Western Depression - Formation, structure, movement and associated weather. Troughs in westerlies, their structure, movement and associated weather.
.
Jet Stream - Definition, Classification of Jet Stream, Characteristics of Jet Stream, Jet Stream over Indian region and Seasonal Variation, Jet Stream and associated Aviation Weather Hazards.

Interaction of Mid-latitude and Tropical Weather systems - Meaning of Interaction, Interaction during Summer and Winter season over Indian region

UNIT V

Mesoscale Meteorology - Sea and Land breeze. Anabatic / Katabatic winds. Pre-monsoon Dust / Thunderstorms over India. Dust haze and Dust raising winds. Fog and Mist.

REFERENCES:

1. Compendium of Meteorology – WMO Publication Vol I – Synoptic Met.
2. Weather Analysis and Forecasting - S Petterssen Vol I & II.
3. SW Monsoon – Met Monograph - YP Rao.
4. Tropical Meteorology - GC Asnani Vol I & II.
5. Monsoon Meteorology - Ramage.
6. Tropical Meteorology - Reihl.
7. Mesoscale atmospheric circulation - BW Aitkinson.
8. A guide of Tropical forecasting - Maj Aitkinson.
9. IMD Forecasting Manuals.
10. Physics of Monsoon – RN Keshwamurthy.
11. Jet Stream Meteorology - Reiter.

M Sc METEOROLOGY

SEMESTER II
PAPER VIII

SATELLITE METEOROLOGY I

UNIT I

Introduction to Remote Sensing
Sun and Atmosphere, Remote Sensing System, Why Observe Earth from Space, Remote Sensing – A Historic Perspective, Indian Remote Sensing Programme

Evolution of Satellite Meteorology
Introduction, Overview, History and Evolution, Data Need for Meteorological Studies, Indian Scene

UNIT II

Orbits for Meteorological Satellites
Introduction, Orbital Mechanisms, Orbital Elements

Atmospheric Radiation, Definitions and Radiation Laws
Electromagnetic Spectrum, Quantum Nature of Radiation, Plank's Black Body Radiation, Stefan Boltzman's Law, Wein's Displacement Law, Kirchoff's law, Rayleigh-Jeans Approximation. Emissivity, Absorbtivity, Reflectivity and Scattering, Absorption by Gases, Rayleigh Scattering by Air Molecules, MIE Scattering, Terrestrial and Solar Radiation Spectrum.

UNIT III

Electro Magnetic Energy and Radiation
Introduction. Electromagnetic Waves, Electromagnetic Spectrum

Absorption and Emission by the Atmosphere
Transmittance, Selective Absorption and Emission by Various Constituents of Atmosphere, Atmospheric Windows.

Fundamentals of Radiometry
Measurement Geometry- concept of solid angle, Radiometric Quantities, Surface characteristics for Radiometric Measurements, Observation Geometry in Remote sensing

UNIT IV

General Characteristics of Visible and Infra red Imageries
Introduction. Picture Resolution, IR data obtained by Scanning radiometers, Spatial resolution of the scanning radiometers, Comparison of Infra red and visible images

Interpretation and Processing of Satellite Cloud Imageries - Fundamentals of Image Characteristics, Brightness of Clouds, Structure, Shape, Size, Pattern and Texture, Basic principles and Interpretation of VIS, IR and WV imageries, Problem areas in Interpretation of Visible and IR imageries.

UNIT V

Atlas of Cloud types, Cloud formations and Underlying Surfaces
Convective Clouds, Stratiform Clouds, Cirriform Clouds and Cloud Associations

Meso-scale Cloud Patterns and Forms
Cloud Element. Cloud Line, Cellular Clouds, Striations

Sub Synoptic Cloud patterns
Vortices in Stratus and stratocumulus, Vortices in Cumulus and Cumulonimbus, Squall Lines and Cumulonimbus Clusters

REFERENCES:

1. Images in Weather Forecasting – Baddar MJ., et.al.
2. Satellite Meteorology An Introduction – Stanley Q Kidder & Thomas H Vondar Haar.
3. The Use of Satellite Pictures in Weather Analysis and Forecasting: WMO Technical Note No. 124.
4. Fundamentals of remote sensing – George Joseph.
5. Satellite Meteorology – RR Kelkar

M Sc METEOROLOGY

SEMESTER II

PAPER - IX
CLIMATOLOGY AND STATISTICS II

UNIT I

Physical Climatology;
Radiation; Earth sun geometry; Solar radiation; Terrestrial Radiation; Heat and water balances.

Large scale effects of surface boundary on climatology
Ocean; Atmosphere Ocean interacts; Cryosphere and continents.
Walker circulation and El-Nino

UNIT II

Regional Climatology

Pakistan; Bangladesh; Sri Lanka; Nepal; Ocean regions; and Himalayas.

UNIT III

Local Climatology

Effects of Coastal zone; land and sea breeze; mountain and other ; water bodies; Urban climate; Heat island

UNIT IV

Statistics

Theory of probability:
Definition; Events; Additive and Multiplicative Laws of Probability
Conditional probability; Bayes' Theorem

Theoretical Distributions
Binomial Distribution: Poission Distribution ; Normal Distribution; Standard Normal Distribution : Application in Atmospheric Science

UNIT V

Correlation Analysis
Introduction; Types; Methods of Study; Karl Pearson's Coefficient of Correlation; Merits and limitations; Coefficient of Determination;
Probable error.

Regression Analysis
Introduction; Difference between Regression and Correlation Analysis; Regression lines; Applications in Atmospheric science

References :

1. Training Notes – Dept of Met- Vol III
2. Climate of South Asia – GB Pant & K Rupa Kumar
3. Concepts in climatology – PR Crowe
4. General Climatology – Critchfield.
5. International Geophysics Series–Vol28 Urban Climate–Helmut E Landsberg
6. WMO compendium on climatology.
6. Statistical - Schaum Series.
7. Statistical Methods - SP Gupta.
8. Statistical methods in the Atmospheric Sciences – Wilks Daniel S.

M Sc METEOROLOGY

SEMESTER II
PRACTICAL II

APPLIED METEOROLOGY & LAB PRACTICES

UNIT I

Modern Meteorological Equipment - Concept and working of --- DRS, Met GIS and MMHS (Discussion in respect of various Hardware components, and Precautions required).

UNIT II

First line maintenance, Fault reporting and Trouble shooting of the equipments referred to at unit I.

UNIT III

Calculation of Meteorological parameters using Meteorological Software: TACAN ; PB Software ; Wind tendency software ; Astronomical data soft wares

UNIT IV

Policies on Equipment, Publication – Provisioning , demand , issue and inventory
Handling of Hydrogen Cylinders and generators.

UNIT V

Administration Meteorological office IAF : Setting Up of Met Observatory, and communication facilities for Meteorological office.
Establishment and conduct of observational and forecasting services during hostilities.

REFERENCES:

1. Manuals on DRS and Met GIS
2. Procedures for IAF meteorological procedures: Edition 2002
3. Policy Letters and Met Services Instructions by Air Headquarters : IAF

PG DIPLOMA IN AVIATION METEOROLOGY

SEMESTER II

PAPER - II
AVIATION METEOROLOGY II

UNIT I

Introduction - Importance of Meteorology in Aviation. Met Elements in Aviation. Met Data requirements for Airfield Siting, Route Planning, Landing / Take-off, Cruise and Diversion. Met Organisations: WMO, ICAO, DGCA, IMD, IAF Met Org, Types of Met Sections. Review of procedures in Regulatory documents, PANSMET, IAP 3202, Aviation Codes, MSI,etc. Met Publication and Equipment Policy.

UNIT II

Altimetry - Definitions. Principle of Altimeter. ICAN Altimeter and Radio Altimeter. Errors of Altimeter. Setting Procedures. Alticor and D-Value.

UNIT III

Current Weather Observations – Metar/ Speci ; Conditions for issue of Speci
Meteorological Routine Report/ Special Reports.
Accuracy requirement for weather Element Observation for Aviation

Aircraft Observations and Reporting: Obligation of States, Aircraft observations, Routine Aircraft observations, Special Aircraft Observations and Reporting of Air reports. .

UNIT IV

Aviation Forecast – Forecast for Take-off and Landing. Trend type landing Forecast Local Forecast, Area Forecast, Reliability and accuracy of forecast.

Warnings - Cautionary Reports, Weather Warnings and. Gale warnings of IAF:
Storm Warnings. Aerodrome Warnings; SIGMET, and Wind Shear Warnings.

UNIT V

Thunderstorm – Conditions favourable for formation, Trigger Mechanism for formation, Life cycle, Structure, Aviation Weather Hazards.

REFERENCES:

1. Hand book of Aviation Meteorology - HMSO publication 1960.
2. Manual of Meteorology for Aircrew . IAF Publication
3. Procedures for IAF Meteorological Services. 2002 Edition
4. India Meteorological Dept Manual on Meteorological Services for Aviation in India. 3rd edition 2006
5. Tropical Meteorology –GC Asnani
6. ICAO publication – Annex 3 .

SEMESTER III

M Sc METEOROLOGY

SEMESTER III
PAPER X

DYNAMIC METEOROLOGY - II

UNIT I

Circulation and Divergence - Physical meaning and significance of divergence, Divergence Theorem. Divergence in various Co-ordinate Systems. Circulation, its relation with Vorticity, Solenoids. Circulation Theorem and its applications.

UNIT II

Vorticity - Vorticity in different Co-ordinates and its interpretation. Relative and Planetary Vorticity. Vorticity theorem and relationship between Divergence and Vorticity. Computation & Application of Vorticity in weather forecasting.

UNIT III

Introduction to Development Theory - Sutcliff's, Patterson's and Bjerknes - Holmboe theories.

UNIT IV

Waves in Atmosphere - Different types of waves in the atmosphere. Rossby waves and derivation of Velocity Formula. Divergence patterns associated with Long & Short waves.

UNIT V

Vertical Motion in Atmosphere - Importance of Vertical motion in Weather Development. Computation of vertical velocity by Kinematics, Adiabatic and Continuity equation. Vorticity theorem methods and their relevant merits.

REFERENCES:

1. Dynamical and Physical Meteorology - Haltiner & Martin.
2. An Introduction to Dynamical Meteorology – Holton.
3. An Introduction to Theoretical Meteorology – Hess.
4. Elements of Dynamic Meteorology - A.H. Gordon.
5. An Introduction to Dynamical Meteorology - Haltiner & Williams.
6. Numerical weather prediction – Haltiner.
7. Weather Analysis and Forecasting - S Petterssen (Vol I & II).

M Sc METEOROLOGY

SEMESTER III
PAPER XI

SATELLITE METEOROLOGY II

UNIT I

Estimation of Meteorological Parameters - Remote sensing of surface and vertical profile of temperature, Split channel method. OLR measurements. Precipitation Estimation by Visible-Infrared methods. Wind Measurement from Cloud Features (CMVs)

UNIT II

The Earth's Surface - Land surface features: Snow cover, Desert and vegetation areas.

Sea surface features - Sun glint, Ocean current, Sea Surface temperature gradients.

Cloud systems - Associated with cold and warm air masses, fronts, cut-off lows, anticyclones, ridges and vorticity fields. Locating upper level pressure patterns such as troughs / ridges (both synoptic and planetary scale) with the help of satellite imageries.

UNIT III

Tropical Cyclones: - Evolution, intensity and forecasting techniques

UNIT IV

Tropical Disturbances Affecting Indian Region (cloud features, life cycle, movements etc): ITCZ (NHET/SHET) and Easterly waves, Monsoon Depressions / other types of monsoon clouds, Diurnal and seasonal changes in cloud cover over tropics and Squall lines.

Topographically Induced Convective Cloud Patterns: Convection associated with Land breeze, Convection associated with sea breeze, Convective storm low-level outflow and arc cloud lines. Outflow boundaries and new thunderstorm development.

UNIT V

Satellite Imageries in relation to Extra Tropical Systems: Frontal vortices, Estimation of Evolution and Movement of Extra Tropical Cyclones and Fronts , Western Disturbances, Interaction between tropical and mid-latitude systems

Locating Jet Streams from Satellite Imageries: PFJ, STJ, TEJ. Locating turbulence associated with jet stream and Jet stream axis.

REFERENCES:

1. Images in Weather Forecasting – Baddar MJ., et.al.
2. Satellite Meteorology An Introduction – Stanley Q Kidder & Thomas H Vondar Haar
3. The Use of Satellite Pictures in Weather Analysis and Forecasting: WMO Technical Note No. 124
4. Fundamentals of remote sensing – George Joseph

M Sc METEOROLOGY

SEMESTER III
PAPER XII

PHYSICAL METEOROLOGY II

UNIT I

Atmospheric Stability - Thermodynamics of dry and moist air. Use of Pressure Co-ordinate in Thermodynamic Diagrams. Various Thermodynamic Diagrams and their desirable properties. Tephigram, its interpretation and Evaluation of unreported quantities. Conservative properties of Air Mass. ELR, DALR, SALR, Equilibrium States, Parcel Method, Vertical Acceleration of the parcel and its application. Stability Analysis from Tephigram. Conditional, Latent and Potential Instabilities. Slice Method for stability. Diurnal variation of the Lapse rate.

UNIT II

Cloud Physics - General aspects of cloud and precipitation formation. Condensation Nuclei. Growth of water droplets. Microphysical properties of clouds. Bowen's Model. Growth by Condensation and Coalescence. Ice phase Nucleation, Ice Nuclei, Diffusional growth on Ice Nuclei, further growth by Accretion and Aggregation. Different types of precipitation processes including Bergeron Process and weather modification.

UNIT III

Atmospheric Electricity - Fair Weather Electric field of the atmosphere. Ions and Ionizing radiation, Conduction current, diurnal variation of electric field and conductivity. Thunderstorm electrification, its observation and theoretical aspects. Thunderstorm detection systems at airfields. Thunderstorm as a mechanism for maintaining the fair weather electric field.

UNIT IV

Radar Meteorology - Propagation of Electromagnetic waves in the atmosphere and their Attenuation. Basic principles of Microwave Radar, their types and characteristics, Back scatter of waves on the basis of Rayleigh & Mi- Scattering theory. Application of Radar in Meteorology, characteristics of Radar Echoes, Doppler Radar, Radar Net work and introduction to MST radar.

UNIT V

Ocean - Atmospheric System - Features of oceans, static and dynamic properties of temperature and density of sea water. Ocean tides, currents and circulation. Nature and characteristics of Ocean Atmospheric system. Micro circulations. Heat exchange, thermal behaviour of the ocean atmospheric system and Climatic response to EL-NINO.

Seismology - Earthquakes, Waves and Epicentre. Micro-seism and Meteorology as detectors for Cyclonic storms and U/G Nuclear tests.

REFERENCES:

1. Compendium of Meteorology Physical Met Vol I - WMO Publication.
2. Cloud Physics - Rogers.
3. Physical Meteorology - Johnson.
4. Dynamical and Physical Met – GJ Haltiner and FL Martin.
5. Physical Meteorology – Henry GH.
6. Radar Meteorology – Battan.
7. Tropical Meteorology – GC Asnani.
8. Upper Atmosphere and Waves – Tom Beer.
9. Theoretical Meteorology - Hess

M Sc METEOROLOGY

SEMESTER III
PAPER XIII

NUMERICAL WEATHER PREDICTION

UNIT I

General - Introduction & Historical background, Need of NWP, Lack of analytical method for solving equations, General Limitations, Limitations over Tropics.

UNIT II

Model structure - General characteristics & differentiation between various types namely hydrostatic and non-hydrostatic, Grid and Spectral, Boundary conditions, Vertical and horizontal solutions.

UNIT III

Dynamics - Primitive equations, coordinates and variables, Type of equations.

UNIT IV

Numerics - Various finite difference schemes, Grid designs, Test of consistency, Accuracy, convergence and stability.

UNIT V

A detailed treatment of the following with respect to their importance in NWP, their strengths, limitations and employability:-

Vertical Coordinates, Vertical Resolution ,Horizontal Resolution, Domain & Boundary Conditions

REFERENCES:

1. Numerical Weather Prediction – Haltiner GJ.
2. ECMWF Tutorial Notes – Downloaded from Internet.
3. Numerical Weather Prediction and Dyn Meteorology – Haltiner and Williams.
4. Introduction to Dynamic Meteorology – Holton JR.
5. A Documentation of FSU Limited Area Model – Krishnamurthy TN, Kumar A, Yap KS, Davidson D and Sheng J.
6. An Introduction to Numerical Weather Prediction Techniques - Krishnamurthy TN and Bounoua L.
7. Numerical Methods used in Atmospheric Models – Mesinger F and Arkawa A.
8. Operational Numerical Weather Prediction at IMD, New Delhi – Sarkar RP and Bedi HS.

M Sc METEOROLOGY

SEMESTER III
PRACTICAL III

ANALYSIS AND PROGNOSIS

UNIT I

Basic principles of Analysis including principles of continuity: Analysis of Surface, Upper air and Derivative charts**.**

UNIT II

Forecasting of Basic Weather Elements: surface Winds, Visibility, clouds, Temperature.

UNIT III

Computation of Derived Quantities - Analysis of Tephigram, Identification of Isobaric layers and Stable layers. Stability Indices. Latent and Convective Instability. Determination of CCL, LCL, MCL, Freezing level, Relative Humidity,etc. Calculation of u & v Components of wind, Vergence, Vorticity and Vertical velocity. Movement and intensification of Weather Systems

UNIT IV

Techniques of forecasting - Prediction of Thunderstorm / Dust Storm, Fog / Mist / Haze, Dust Haze / DRW and Low Clouds.

UNIT V

Interpretation of Satellite Imageries for forecasting

Utilisation of NWP Products and Internet downloaded information for Weather Forecasting

REFERENCES:

1. Training Note – Dept of Meteorology, AFA, Vol 3
2. Training Notes Faculty of Meteorology, Air Force Administrative College Vol 4
3. Weather Analysis and Forecasting - S Petterssen (Vol I).
4. Images in Weather Forecasting - Bader *et al.*
5. Tropical Meteorology – GC Asnani.
6. Principles of Meteorological Analysis – Saucier W.J.

DIPLOMA IN AVIATION METEOROLOGY

SEMESTER III
PAPER- III

AVIATION METEOROLOGY - III

UNIT I

Flight Procedures/ Briefings - Pre-flight information. Information at the time of briefing. In-flight Weather information. Post flight Weather information and Debriefs. VIP/VVIP Flight briefings. Documentation including Chart form of documentation. Aircrew Mass Briefing procedures.

UNIT II

Operations of Aircraft - Meteorological requirements for different types of Aircraft and Air operations: Effect of Air density, Humidity, Turbulence and Winds on aircraft performance. Meteorology and Flight Safety.

UNIT III

Special Weather Phenomena - Jet streams. Clear Air Turbulence. Mountain waves. Icing Contrails. Dust haze/Dust raising winds. Fog/Mist/Haze. Definition: features and their effects on aviation

UNIT IV

Special Aviation Observations - Automatic Current Weather Recording System. RVR. Ceilometer & LRF. Weather Radar, Doppler Weather Radar and Wind Profiler.

UNIT V

Aeronautical Climatology - Airfield Weather Summary. Route Weather Summary (Indian). Route Weather Summary (Foreign).

REFERENCES:

1. Nowcasting – Browning.
2. WMO Tech Notes on CAT, Mountain Waves, Icing, etc.
3. Smithsonian Tables.
4. Hand book of Aviation Meteorology - HMSO publication 1960.
2. Manual of Meteorology for Aircrew . IAF Publication
5. WMO Tech Note No 95 on Aeronautical Met.

SEMESTER IV

DETAILS OF SYLLABUS
SEMESTER IV

1. This is a full one - semester programme comprising of three basic elements for Semester IV of M Sc (Meteorology) and practical I and II of Diploma in Aviation Meteorology:-

   (a) Project Work in any of the basic or applied field of Meteorology.
   (b) Viva Voce Examination.
   (c) Practical III (MSc Meteorology) Exam.

2. Practical I & Practical II exam for the Diploma in Aviation Meteorology will also be conducted at the end of this Semester, the syllabus for which is given below

3. During this Semester the candidates would be required to work at the field unit where they are positioned. Besides gaining the field experience of relatively advanced stage as part of internship, the students would be expected to produce a **Project work** on a topic in the field of Meteorology, assigned by the College (Faculty of Meteorology). The candidates will submit the project in the form of a thesis which will be assessed along with the VIVA VOCE at the end of the Semester IV at AFAC along with other Practical examinations mentioned at Para 1 & 2 above.

DIPLOMA IN AVIATION METEOROLOGY

PRACTICAL I

UNIT I

Aviation Weather Codes Coding and De-Coding: Metar/Speci ; Trend type Landing Forecast : Terminal Aerodrome Forecast.

UNIT II

Exercises in issue of Local forecast, Terminal Aerodrome forecast and Trend type landing forecast.

UNIT III

Exercises in issue of Wx warning; Cautionary Met report; Gale warning; SIGMET; Aerodrome warning.

UNIT IV

Exercise in issue of Route forecast within the country / Ex – India.

UNIT V

Preparation of astronomical tables (Sun rise/set Moon rise/set , Azimuth of the Sun etc) for aviation purpose

DIPLOMA IN AVIATION METEOROLOGY

PRACTICAL II

UNIT I

Nowcasting technique.

UNIT II

Place Specific Objective forecasting techniques – for important Aviation Weather Hazards like Thunder storm Dust Storm, Squall, Poor Visibility (Fog, Mist,).

UNIT III

Area Forecast: Forecasting for all seasons and all meteorological divisions of India.

UNIT IV

Map Discussion and prognostication of weather systems of all four seasons using conventional Methods.

UNIT V

Running Numerical Weather prediction Models.

References:

1. Manual on Meteorological Services for Aviation in India. Edition 2005.
2. Procedures for IAF Meteorological Services. 2002 Edition.
3. Meteorological Services for International Air Navigation. Annex-3 ICAO publication. Edition 2004.
4. Manual for MM5 and WRF Models.

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER I
PAPER I: GENERAL METEOROLOGY

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10Marks)

1. Meteorologica was written by Galileo.
2. Weather Satellites are forecasting tools.
3. WMO Head Quarters is in USA.
4. Dte of Meteorology at Air HQ is headed by DDGM.
5. Decrease of temperature with altitude in the troposphere is known as inversion.
6. International Date Line runs almost along 0° longitude.
7. Latent heat of evaporation is smaller than that of melting.
8. Temperature increases roughly at a rate of 1° C/Km towards the centre of the Earth.
9. New Delhi is one of the WMCs.
10. DRS is a satellite communication system.

SECTION B **(5X5 = 25)**

11. (a) Write a short note on GTS.

OR

(b) List the communication means available to exchange Met data between the IAF and IMD.

12. (a) Discuss the role of water in the atmosphere.

OR

(b) What are earthquake waves?

13. (a) What is 'lag of season'?

OR

(b) What are 'geological clocks'?

14. (a) Enumerate the objectives of IMD .

OR

(b) Explain briefly about the Role of IMD in Aviation.

15. (a) What are the fields of application of the science of Met.

OR

(b) Discuss the role of WMO.

SECTION C **(5X8 = 40)**

16. (a) Discuss AMSS.

OR

(b) Explain the various Met Communication facilities of the IAF.

17. (a) Describe the various precipitation processes.

OR

(b) Write a brief note on the structure of the interior of the Earth.

18. (a) Explain the various motions of the Earth and their consequences.

OR

(b) What do you understand by depletion of solar radiation?

19. (a) What are the functions of a Station Met Flight?

OR

(b) Describe the WWW programme of the WMO.

20. (a) Discuss the different branches of Met.

OR

(b) Elaborate the influences of technical development in Met.

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER I
PAPER II: OBSERVATION AND INSTRUMENTS

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10Marks)

1. METAR mean Aviation routine weather report.
2. Pressure reduced to mean sea level as per ISA is known as OFE.
3. By comparison of Wet bulb and Dry bulb temperature RH is calculated.
4. In Beaufort scale, in stage 6 the wind speed is 22-27 kt.
5. RVR is reputed when the horizontal is 200m.
6. Cloud amount SCT is reported for 5-6 oktas of cloud.
7. The chemical used for preparation of hydrogen gas is Caustic soda and Iron.
8. Hydrogen cylinders are filled to a pressure of 120 atmosphere.
9. Free lift is the net buoyancy of the Met balloon.
10. Hygrister is used in Radiosonde for sensing temperature.

SECTION B **(5X5 = 25)**

11. (a) Define the following:
    (i) QFE
    (ii) QFF

    OR

    (b) Plot the station model for 0300 UTC surface observation.

12. (a) Briefly explain about self recording (Float Type) rain gauge.

    OR

    (b) Specify the difference intensity of precipitation.

13. (a) Define visibility? Explain the procedure of estimation of visibility.

    OR

    (b) Write the different procedure of measuring cloud heights.

14. (a) What are the different types of Met Balloons used for upper air observation ?

    OR

    (b) Write the procedure of setting of theodolite before PB ascent?

15. (a) Briefly explain about Radiosonde observation.

OR

(b) Explain the following:

(i) Free Lift
(ii) Rate of ascent

SECTION C **(5X8 = 40)**

16. (a) What are the parameters to be furnished for procuring Bar Reduction Table from IMD?

OR

(b) Explain the defect and remedies of Max and Min thermometers.

17. (a) Explain the working of DR wind instrument.

OR

(b) Write short note on:

(i) Land and Sea Breeze.
(ii) Katabatic and Anabatic wind.

18. (a) What do you understand by 'Electro meteors' ? Explain different types of thunderstorm.

OR

(b) Describe cloud classification based on 'Genera' and Etage'

19. (a) Explain filling of hydrogen gas from hydrogen cylinder.

OR

(b) Explain the procedure of preparation of hydrogen gas by L P generator.

20. (a) Short note on the following:

(i) RAWIN's radar method.
(ii) Inaccuracies in computation of PB.

OR

(b) Discuss about computation of PB observation.

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER I
PAPER III: SYNOPTIC METEOROLOGY I

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10Marks)

1. TS is a Mesoscale system
2. Pressure value has a direct relationship with wind.
3. Isotherms show kinks depending on land and sea distribution.
4. Sub Polar low is a 'source region'.
5. Warm front is a region of instability.
6. The mean life span of an extra tropical cyclone is 4-6 hours.
7. Monsoon is a large scale land and sea breeze.
8. Areas of steady wind almost throughout the year is called monsoon region.
9. STJ is observed as south as Nagpur during SW monsoon.
10. NE monsoon causes 70 % of annual rainfall over India.

SECTION B **(5X5 = 25)**

11. (a) Discuss the use of synoptic met in forecasting.
OR
(b) List the various wind systems of the globe.

12. (a) What is air mass? List the major air masses of the world.
OR
(b) What is the significance of cross equatorial flow?

13. (a) Discuss occluded front.
OR
(b) What are family of cyclones?

14. (a) What are 'secondaries' and their influence on 'primary'?
OR
(b) What are the various ways of defining monsoon region?

15. (a) What is onset and withdrawal of monsoon?
OR
(b) Write a short note on the mean distribution of rainfall during the SW monsoon.

SECTION C **(5X8 = 40)**

16. (a) Describe the various scales of atmospheric motions and their importance.

OR

(b) Discuss the evolution of synoptic meteorology.

17. (a) Enumerate the features of global mean temperature distribution.

OR

(b) Explain the various air masses affecting Indian sub continent.

18. (a) Describe the weather associated with warm front.

OR

(b) Pictorially depict a frontal system highlighting various significant features.

19. (a) What are the areas affected by SW Monsoon?

OR

(b) Describe Monsoon circulation as large scale land and sea breeze effect.

20. (a) Compare and contrast Topical Cyclone and ETCs.

OR

(b) Briefly discuss the salient features of the NE monsoon.

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER I
PAPER IV: PHYSICAL METEOROLOGY I

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10Marks)

1. Nitrogen is the major constituent of the atmosphere.
2. Ozone is concentrated around 50 Km altitude.
3. Solar radiation is long wave radiation.
4. Radiative balance is achieved by longitudinal transport of energy.
5. General circulation contributes to polar transport of energy.
6. Water is present in all three states in the atmosphere.
7. For condensation to take place, condensation nuclei are must.
8. DALR is greater than SALR.
9. Rainbow occurs due to 'reflection'.
10. Cb clouds are convective clouds.

SECTION B **(5X5 = 25)**

11. (a) What are aerosols and how they are classified?
OR
(b) Discuss the effect of air pollution on life on the Earth.

12. (a) What are the characteristics of solar radiation?
OR
(b) What are the characteristics of terrestrial radiation?

13. (a) What is Greenhouse effect and its effect on global warming?
OR
(b) A short note on the role of general circulation.

14. (a) Discuss the physical processes leading to cloud formation.
OR
(b) Discuss the effect of topography on instability.

15. (a) What are the types of fog?
OR
(b) How is dew point preferred over RH in Meteorology?

SECTION C **(5X8 = 40)**

16. (a) What are the variable constituents of the atmosphere more relevant to Meteorology?

OR

(b) How is the atmosphere classified based on temperature and composition?

17. (a) Describe the processes of disposition of solar radiation.

OR

(b) Highlight the features/characteristics of terrestrial radiation that are exploited in satellite meteorology.

18. (a) Discuss how mean heat balance is achieved.

OR

(b) What are the various ways of measuring atmospheric moisture?

19. (a) What are the various cloud types?

OR

(b) Describe various conditions of stability of the atmosphere.

20. (a) Describe the life cycle of a TS.

OR

(b) Explain various atmosphere optical phenomena.

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER I
PAPER V: CLIMATOLOGY & STATISTICS I

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10Marks)

1. Climatic elements control the physical conditions.
2. In Koppens classification S represents season.
3. Temperature gradient is higher in the winter hemisphere.
4. Hadley cell results in cross equatorial flow.
5. Steepest pressure gradient over the Indian region is observed during winter.
6. Pre monsoon is known as fair weather period.
7. Tropical storms over Indian seas are common during SW Monsoon.
8. Intensity of tropical cyclone is decided based on damage it causes.
9. Mean is preferred over median, in general.
10. 3 mean = 2 median- 3 mode.

SECTION B **(5X5 = 25)**

11. (a) Describe the basis of Koppen & Millers classification.
OR
(b) Bring out the importance of climatology to aviation.

12. (a) What are the elements of climatology?
OR
(b) Discuss the role of ITCZ in the tropical weather.

13. (a) What are aviation weather hazards of Post Monsoon.
OR
(b) What are the Jet steams observed over Indian region?

14. (a) What are the features favourable for the formation of cyclonic storms?
OR
(b) Discuss the use of IMD manual on tropical storm tracks.

15. (a) Calculate Mean, median and mode of the given set of temperature and comment on the salient features of climate.
OR
(b) What are the uses of geometric and arithmetic mean?

SECTION C **(5X8 = 40)**

16. (a) What are the properties of Standard deviation?

OR

(b) Tabulate the given set of data with suitable class intervals and make a frequency distribution graph.

17. (a) What are the factors of climatology? Discuss.

OR

(b) Describe the role of topography on climatology?

18. (a) List the salient features of the mean global temperature distribution.

OR

(b) Describe the mechanism leading to seasonal changes.

19. (a) Show the MSL mean pressure pattern of SW monsoon.

OR

(b) Write a short note on the semi permanent systems of SW monsoon season?

20. (a) Describe the main features of the structure of tropical cyclones.

OR

(b) Explain various methods used to predict the track of storms.

MODEL QUESTION PAPER

PG DIPLOMA IN AVIATION METEOROLOGY

SEMESTER I
PAPER I: AVIATION METEOROLOGY

Date: Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10Marks)

1. In Aviation Weather Code (METAR) the dry bulb and dew point temperature are reported in decimals.
2. Tendency, DCG in RAREP code means decreasing.
3. One knot is equal to 0.61 meter per second.
4. Variable wind with more than 03 knots cannot be reported.
5. When the wind speed is between 22 kts to 40 kts and visibility is reduced to 200 to less than 500 m in dust storm it is termed as sever dust storm.
6. Dust Raising Wind is reported when the wind speed is 20 kts or more and visibility is less than 1000 m.
7. In mist the visibility is 1500 m or less with RH more than 75%.
8. In moderate fog visibility is 1000 m to less than 2000 m with relative humidity less than 80%.
9. SIMPLEX and DUPLEX are IMD communication network.
10. Direct Reception System receives only satellite pictures.

SECTION B (5X5 =25)

11. (a) Write the conditions when CAVOK is reported.

OR

(b) What are the information available in a RAREP code.

12. (a) How surface wind direction and speed is measured and reported? Explain.

OR

(b) Define the following:-

(i) Visibility (ii) Prevailing visibility

13. (a) Differentiate between the followings:-

(i) Thunderstorm and thundery conditions.
(ii) Dust storm and Dust Raising Wind.

OR

(b) Write short note on the followings:-

(i) Smoke (ii) Gale (iii) Gust (iv) Squall

14. (a) Define fog & Mist and write down the visibility criteria for these.

OR

(b) Discuss the different types of fog.

15. (a) Discuss about the TROPO communication network.

OR

(b) Write about the DRS.

SECTION C **(5X8=40)**

16. (a) Write the criteria for issue of Speci for wind and visibility.

OR

(b) Write in detail about TREND forecast.

17. (a) Explain the following:-

(i) QNH (iii) Pressure altitude

(ii) QFF (iv) D-value

OR

(b) Describe the reporting procedure of visibility.

18. (a) Write in details the aviation weather hazards of pre monsoon season.

OR

(b) Write in details the aviation weather hazards of SW monsoon season.

19. (a) Write in details the aviation weather hazards of post monsoon season.

OR

(b) Write in details the aviation weather hazards of winter season.

20. (a) Discuss in details about the IAF WAN.

OR

(b) Describe about ROBEX, METINI and VOLMET.

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER II
PAPER VI: DYNAMIC METEOROLOGY I

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10)

1. The divergence of the curl of any quantity is zero.
2. In the inertial winds, the radius increase with the increase in latitude.
3. Cyclonic flow is super – geostrophic
4. Cloud amount is vector quantity.
5. Horizontal temperature gradient results in thermal wind.
6. Warm core high pressure systems intensity with height and slope towards colder region.
7. If we consider components of deformation and divergence zero streamlines will be all hyperbolas.
8. A centre of low pressure is said to deepen, when its central pressure decreases.
9. The mathematical relationship that expresses conservation of mass for a fluid is called energy equation.
10. Negative relative divergence is associated with anticyclone model.

SECTION B (5X5 = 25)

11. (a) Define function and list out the different types of function?

Or

(b) Write short notes on Co-ordinate systems?

12. (a) Define the following

(i) Streamlines.
(ii) Trajectory.
(iii) Streak lines.

Or

(b) What do you understand by the intensification &weakening and deepening & filling of a system?

13. (a) Show that geostrophic winds are horizontally non divergent.

Or

(b) Write down the Gradient Wind Equation and identify various terms

14. (a) Explain the Role of tropopause in the formation of Jet stream.

Or

(b) Show that Warm core lows weakens with height.

15. (a) Write short notes on Dines Compensation law.

Or

(b) Prove that the fractional rate of change of density following the motion is equal to the velocity convergence.

SECTION C **(5X8=40)**

16. (a) For what value (or values) of 'x' are vectors A & B perpendicular to each other, when :- $\vec{A} = x\,\hat{i} - 2\,\hat{j} + \hat{k}$ and $\vec{B} = 2x\,\hat{i} + x\,\hat{j} - 4\,\hat{k}$

Or

(b) The position vectors of two points P & Q are given as r1 = 2 i + 3 j - k & r2 = 4 i + 3 j + 2 k. Find the vector PQ and its unit vector.

17. (a) Show that a low pressure area which is moving in *x* direction with a speed less than the wind field in it will have maximum curvature of the trajectory on the pole ward side of system and the minimum at equator ward side and curvature of stream line and trajectory will remain positive.

Or

(b) Explain Stream function and drive Blaton equation.

18. (a) Find out the component of Cof and show that why a cloud mass or system associated with westerly wind flow sustains for a large period and large distance than that of E'ly flow?

Or

(b) With the help of gradient wind equation, show that in case of regular high there is a maximum limit of Vgr.

19. (a) Explain with the help of suitable diagrams how the Thermal Wind concept can be used in identification of sectors of stability / instability at a station

Or

(b) Explain Barotropic and Baroclinic Atmosphere.

20. (a) Write the Continuity Equations in (x,y,z) and (x,y,p) coordinates. Which form is more convenient to use for meteorological purposes?

Or

(b) Show that the local rate of change of density (i.e., mass per unit volume) is equal to the mass convergence (per unit volume).

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER II
PAPER VII: SYNOPTIC METEOROLOGY II

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10 Marks)

1. Hadley cell represents indirect circulation

2. MCZ is more prominent during break monsoon season over land region.

3. Western Depression is a warm core system and warm air entering into the system weakens the depression.

4. Maximum rainfall occurs in the southwest sector of the induced low.

5. In case of active Western disturbance, the trough in westerlies is 5-7 degree east of the surface/low-level system.

6. The field of maximum rainfall in the south west sector of a monsoon depression is an indication of imminent recurvature.

7. Easterly waves are more prominent in the lower troposphere during Southwest monsoon season.

8. Longest break in south west monsoon develops in the month of July.

9. Lower temperature over Arabian Sea and Bay of Bengal lead to good monsoon.

10. Weather in case of MTC is symmetrical all around the system.

SECTION B (5X5 = 25)

11. (a) What do you understand by General Circulation? State the constrains of general circulation.

OR

(b) Discuss the salient features of general circulation.

12. (a) Enumerate the main features of the structure of ITCZ.

OR

(b) Enumerate the genesis parameters favourable for the formation of tropical cyclones.

13. (a) Explain the techniques for predicting the movement of a tropical storm.

OR

(b) Define monsoon depression? Discuss the structure, associated weather and movement.

14. (a) Enumerate the features of TEJ and Tibetan High.

OR

(b) Write the conditions favourable for onset of monsoon over Kerala.

15. (a) Briefly discuss the formation, structure and the weather associated with the monsoon depression.

OR

(b) Enumerate the conditions favourable for the break in monsoon.

SECTION C (5X8= 40)

16. (a) Explain longitudinally varying flow and enumerate its features?

OR

(b) Discuss the various scales of atmospheric motions? Define general circulation and constraints associated with it?

17. (a) Discuss the evolution of general circulation.

OR

(b) Discus Walker circulation.

18. Write Short Notes

(a) Active and Inactive WDs

OR

(b) Jet stream.

19. Write Short notes on

(a) Effect of mid latitude westerly systems on SW monsoon

OR

(b) Formation of cold core to warm core in Tropical cyclone.

20. (a) Write down the weather pattern over India during the break monsoon.

OR

(b) Explain the techniques for predicting the movement of a tropical storm.

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER II
PAPER VIII: SATELLITE METEOROLOGY I

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10 Marks)

1. INSAT 3A is launched in the year 2003 is positioned at 96°E over the equator.
2. Oceansat-1 is an Indian remote sensing Satellite.
3. A minimum of five parameters are required to fix the position of any satellite.
4. Solar irradiance peaks at 0.46μ in the visible spectrum.
5. The IR radiation emitted by the earth peaks at 6.67μm.
6. MW spectrum is not useful for meteorological observations.
7. The absorption of water vapour in the atmosphere is insignificant.
8. The basic principles of IR and VIS imageries are same.
9. Fog is easily detectable in an IR image.
10. Cellular clouds are more common over continental regions.

SECTION B (5x5=25)

11. (a) Write short notes on "Indian remote sensing programme"

Or

(b) List the ancient Indian satellite useful for meteorological studies along with the year of launch.

12. Define the following terms

(iv) Emissivity
(v) Absorptivity
(vi) Reflectivity

Or

(d) State all the three Kepler's Laws.

13. (a) Write short notes on "Selective Absorption".

Or

(b) Explain about transmittance

14. (a) Write in short about picture resolution.

Or

(b) What are the differences between the IR and VIS image.

15. Write short notes on

a. Cloud element

Or

(b) Striations

SECTION C **(5x8=40)**

16. (a) Explain in detail the data need for Meteorological studies.

Or

(b) Why remote sensing of atmosphere is useful for meteorological studies.

17. (a) Explain in detail about Plank's black body radiation.

Or

(b) Explain all the orbital elements of the satellite

18. (a) Write in detail about emission by various constituents of atmosphere.

Or

(b) Explain about atmospheric windows.

19. (a) Explain the basic principles of interpretation of interpretation of VIS, IR & WV images.

Or

(b) How would you logically identify the CB with the IR, VIS & WV images?

20. (a) Explain the differences between open and the closed cells.

Or

(b) Explain the sea surface features associated with sun glint to use how to make use of glint for met analysis.

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER II
PAPER IX: CLIMATOLOGY AND STATISTICS II

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10 Marks)

1. In radiation energy is transferred by means of electromagnetic waves.
2. The major contribution to the Albedo of the earth comes from reflection of the solar beam to space by clouds.
3. The Maximum rainfall during monsoon occurs over Baluchistan in Pakistan.
4. In post monsoon season, NW sector receives the Max rainfall in Srilanka.
5. Land breeze occurs during night time.
6. Orientation of mountain range has an effect on climate of the place.
7. Probability of occurrence of an event on Tuesday & Saturday is 1 / 49.
8. Two or more events are called mutually exclusive if both of them occur simultaneously.
9. Poission distribution is the limiting case of Binomial distribution where neither p nor q is small and N is large.
10. Poission distribution is a theoretical distribution for continuous variable.

SECTION B (5x5=25)

11. (a) Write a short note on Walker Circulation.

Or

(b) Write a short note on El-Nino.

12. (a) Discuss some of the important characteristics of climate over Nepal.

Or

(b) Discuss some of the important characteristics of climate over Srilanka.

13. (a) What do you understand by 'Urban Climate '? What are the main features of it?

Or

(b) Explain how the water bodies modify the climate of a place.

14. (a) State the assumptions for applicability of Binomial distribution write the expression for normal distribution and standard normal distribution and indicate the meaning of terms.

Or

(b) Climatological data for the last 50year reveal that Dal Lake froze over 10 years. What is the probability that it will freest at least two times in the nearest decade? Briefly give the reason for using the distribution function you have chosen to use.

.

15. (a) From Climatological data it is found that in the last 100years, Coimbatore experienced hail on 02 occasions. Find the probability that hail will occur at least once in the next 2 decades at Coimbatore.

Or

(b) What do you understand by cost of determination? How does it differ from Correlation Coefficient? Define Rank correlation?

SECTION C (5x8=40)

16. (a) Briefly discuss atmospheric ocean interaction.

Or

(b) What do you understand by the long short wave radiation? Explain the green house effect.

17. (a) Briefly discuss the salient features of Pakistan climate.

Or

(b) Briefly discuss the salient features of Bangladesh climate.

18. (a) What do you understand by the land and sea breeze? Explain in detail.

Or

(b) Explain heat island bring out its causes, diurnal variation, vertical variation and its consequence.

19. (a) Obtain the Normal equations in respect of regression line y = ax + e using least square method.

Or

(b) Following are the rainfall data for the month in respect of two neighbouring meteorological observatories. Using Correlation co-efficient comment on the relationship of the RR episode between the two stations.

Observatory A	100	200	300	400	500	600	700
Observatory B	30	50	60	80	100	110	130

20. (a) Write down the regression equations X on Y and Y on X. From the following data obtain the two regression equations.

X	6	2	10	4	8
Y	9	11	5	8	7

Or

(b) Find the regression equations for the following two series. What is most likely value of X when Y = x and most likely value of Y when X = 22

MODEL PAPER

PG DIPLOMA IN AVIATION METEOROLOGY

SEMESTER II
PAPER – II: AVIATION METEOROLOGY II

Date:_____ Time: 3 Hrs Max:75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10)

(1) In Trend forecast, change group 'TEMPO' is permissible.

(2) RVR is reported when visibility is less than 2000m.

(3) Every special observation is to be appended with TREND.

(4) Sky condition MOC is represented as BKN.

(5) Local forecast in IAF is issued covering an area of 50 NM radius around the airfield.

(6) QFE is atmospheric pressure reduced to datum level.

(7) Alticore and D-value are one and the same.

(8) CAVOK means SKC.

(9) On the sea level synoptic chart QNH is plotted.

(10) Weather warning cannot be issued one hour or more prior to the expected inclement weather.

SECTION B (5X5=25)

11. (a) Write down the criteria for issue of weather warning and CMR for the following:-

(i) Clouds
(ii) Surface wind

OR

(b) What are the types of forecasts issued in the IAF? Discuss TAF.

12. (a) List the means of communication for getting Met data for operational requirements

OR

(b)List the factors you would take into account before issuing local forecast in the morning.

13. (a) Discuss the principles of Altimeter? What are the types of errors that can occur in an altimeter?

OR

(b) Enumerate the pre-flight information to be given to a Met section for obtaining a Route forecast.

14. (a) What are the effects of Surface Wind and Density on aviation.

OR

(b) List the criteria for issuing Trend forecast for Visibility and Clouds..

15. (a) What are the basic ingredients essential for the formation of a thunder storm? Enumerate the features that trigger a thunder storm.

OR

(b) Explain the following features during a mature stage of a thunder storm

(i) Air Motions.
(ii) Temperatures.
(iii) Hydrometeors.

SECTION C **(5X8=40)**

16. Write short note on

(a) (i) Transition level and transition altitude.
(ii) QNH and QFE

OR

(b) (i) Type of met section in IAF
(ii) World weather watch.

17. (a) Discuss the Aviation weather hazards associated with Thunderstorm.

OR

(b) List the factors you would take into account before issuing local forecast in the morning.

18. Write short notes on any four. (Not more than 100 words)

(a) Altimeter errors
(b) Trend Forecast
(c) SIGMET or AIRMET
(d) Effect of density in aviation.
(e) Usage of group $V_XV_XV_XV_XD_V$ in METAR.
(f) Usage of group $d_nd_nd_nVd_xd_xd_x$ in METAR.

19. Write short notes on the following (not more than 50 words):-

(a) Low Level Jet.
(b) Local and Area forecasts.

OR

(c) SPECI conditions for visibility and low clouds.
(d) Importance of Meteorology in Aviation.

20. (a) What are the effects of surface wind on Aviation?

Or

(b) Discuss the variation of density with latitude and how this variation affects aircraft operation?

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER III
PAPER X: DYNAMIC METEOROLOGY II

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10 Marks)

1. An indirect solenoidal circulation converts potential energy of mass distribution of the fluid to kinetic energy of the circulation.

2. Direct solenoidal circulation decreases the baroclinity of the atmosphere.

3. Curved flow can not have zero relative vorticity.

4. For mid latitude synoptic systems the relative vorticity is small compared to the earth's vorticity.

5. Petterssen assumed LND at 500hPa.

6. In predominantly zonal flow the latitude term of Sutcliffe development equation is important.

7. The Long waves move slowly and have warm trough and cold ridges.

8. Vertical Transverse Waves propagate horizontally and are composed of vertical displacement.

9. Adiabatic method of computing vertical motion can be applies only when gpm and temp data is available.

10. Kinematic method of computing vertical motion employs the assumption of non adiabatic motion.

SECTION B **(5X5 = 25)**

11. (a) Define Circulation and show its relationship with vorticity.

Or

(b) Explain the physical meaning of divergence.

12. (a) Obtain Div/Conv distribution patterns in case of an elliptical cyclone with major axis along N-S with the help of Simplified Vorticity Theorem.

Or

(b) Write down the application of vorticity in weather forecasting.

13. (a) Show the most favourable area for the formation or development of a surface system in a confluent trough.

Or

(b) What are the assumptions Sutcliff made for his development theory?

14. (a) Define different types of atmospheric waves and give the example of each wave?

Or

(b) Show the divergence pattern associate with long and short wave.

15. (a) What is the importance of the vertical motion in weather development?

Or

(b) Write down the different methods of computation of vertical motion and their relevant merits.

SECTION C (5X8 = 40)

16. (a) Write down the Circulation theorem and explain various terms.

Or

(b) With help of circulation theorem explain the sea and land breeze phenomena.

17. (a) Write the Vorticity Equation in Cartesian coordinates and identify various terms. How it is better to use pressure as vertical coordinate in place of height?

Or

(b) Discuss the contribution of Twisting / Tipping / Tilting Term in the Vorticity Theorem.

18. (a) Write down the Sutcliff's development equation and explain various term.

Or

(b) Write down the Patterson"s development equation and explain various term

19. (a) Derive the velocity formula for Rossby waves.

Or

(b) Write down the difference between long and short waves.

20. (a) Explain the computation of vertical motion with help of continuity equation.

Or

(b) Explain the computation of vertical motion with help of vorticity theorem method.

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER III
PAPER XI: SATELLITE MET II

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (5x1=05 Marks)

1. Split window technique is an objective method.
2. Sun glint is an indication of calm sea conditions
3. Dvorok technique of estimation of intensity of cyclone is an objective method
4. Max rainfall is experienced in the western sector of a monsoon depression.
5. When polar jet stream crosses an area of open and closed cells, then jet axis is located at its boundary between open and closed cellular patterns.

Fill in the blanks (5x1=05 Marks)

6. For OLR calculations, the wavelength range considered is_____.
7. The aim of Dvorok Technique is to estimate _____and _____intensity of tropical cyclone.
8. Mountain snow can be can be recognised from _____ pattern in the satellite imageries.
9. The TEJ is more prominent over _____ Indian region.
10. STJ is located on the_____side of large Cirrus band in IR image.

SECTION B (5X5 = 25)

11. (a) Explain "Split Window Technique".

Or

(b) Explain "OLR measurements and its importance in Meteorology.

12. (a) Write shorts notes on cloud associated with cold air mass.

Or

(b) Write short notes on how surface features are seen in VIS / IR images

13. Write short notes on:-

(a) Banding Features.

Or

(b) Central Dense Overcast.

14. Describe the following as seen in satellite imageries

    (a) ITCZ

    Or

    (b) Easterly Waves

15. (a) Explain how turbulence can be identified in satellite imageries

    Or

    (b) Explain the features of STJ in satellite imageries.

SECTION C **(5X8 = 40)**

16. (a) Write in detail about Sounding and explain how the vertical profiles of temperature

    Or

    (b) What are the different types of precipitation measurement techniques? Write in detail about Arkins Method.

17. (a) Explain in detail about formation and developmental sequence of cold front.

    Or

    (b) Explain how upper air trough and ridges can be located with the help of satellite imageries

18. (a) Explain in detail “Dvorok Technique”

    Or

    (b) Explain how intensify or enhanced IR imagery can be used for Tropical Cyclone intensity

19. (a) Explain the cloud features of monsoon depression as brought out by Bhaskara Rao and Moray

    Or

    (b) Explain how satellite imageries can be used for monsoon onset studies.

20. (a) Write in detail the Life Cycle of a Mid Latitude Cyclone

    Or

    (b) Explain how the satellite imageries are useful for refinement of upper air analysis.

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER III
PAPER XII: PHYSICAL METEOROLOGY II

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10 Marks)

21. Counter lapse rate over a region denotes the atmospheric temperature decrease with height over a certain layer.

22. If an inversion exists with a high lifting condensation level, the status clouds can be quite persistent.

23. Heterogeneous nucleation is said to occur when the condensation nucleus is ice surface.

24. Cloud droplets can remain in liquid state up to -45℃.

25. Under fair weather conditions the earth is negatively charged and atmosphere is positively charged.

26. Lightning discharge in troposphere are associated with high ion concentration.

27. Doppler weather radar operates only in S-band at 5 cm wave length.

28. It is possible to derive wind speed in a cloud from Doppler weather radar but not wind velocity.

29. Agro is used to measure the temperature and density profile of oceanic water.

30. Subduction earthquakes are ineffective in generating Tsunami and they occur where lighter oceanic plates.

SECTION B **(5X5 = 25)**

31. (a) What do you understand by atmospheric stability? Briefly describe the different types of stability seen in the atmosphere.

Or

(b) Briefly describe the various causes for vertical lifting in the atmosphere.

32. (a) Discuss the curvature effect in the growth of cloud droplets.

Or

(b) Discuss briefly the different types condensation nuclei in the atmosphere.

33. (a) Describe the weather electric field of the earth.

Or

(b) Describe the electrical structure of the thunderstorm.

34. (a) Write the radar equation. What does each term denote? What are the various scopes employed in a weather radar.

Or

(b) Enumerate the types of echoes that can be obtained in a conventional and Doppler weather Radar.

35. (a) Explain the global circulation of the ocean.

Or

(b) What do you understand by ENSO?

SECTION C **(5X8=40)**

36. (a) What are thermodynamic diagrams? Explain the main features of tephigram and the parameters derived from it. Describe the computation of any two stability indices from a given tephigram.

Or

(b) Define the different types of lapse rates and how would you calculate them? What are the uses of these lapse rates in inferring stability characteristics of the atmosphere?

37. (a) Briefly explain the theories of precipitation. What do you understand from the term cloud modification? Briefly explain the techniques used to modify warm and cold clouds.

Or

(b) List various theories of droplet and crystal growth in clouds. Briefly discuss any two of them.

38. (a) Enumerate various electric discharges in the troposphere. Describe lightning discharge.

Or

(b) Explain the role of thunderstorm as a mechanism for maintaining the fair weather electric field.

39. (a) Briefly discuss the types of scattering of waves in the atmosphere? What are the different types of radar and their wave lengths? What are the uses of radar in weather forecasting?

Or

(b) Write a short note on Radar net work and MST Radar.

40. (a) Describe the thermal profile of water in ocean. How is it used for SONAR?

Or

(b) What do you understand by earth quakes? Write a essay on Tsunami?

MODEL QUESTION PAPER

M Sc METEOROLOGY

SEMESTER III
PAPER XIII: NUMERICAL WEATHER PREDICTION

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (5x1=05)

1. Global Models are generally high resolution Models.

2. Grid spacing has direct impact on a model's ability to resolve features of different scales.

3. In Model terrain elevation gradients are over estimated.

4. In η Co-ordinate system the Horizontal Surfaces are terrain following.

5. Isentropic Co-ordinates system depicts PBL processes well.

Fill in the blanks (5x1=05)

6. Horizontal resolution is defined as _____ in grid point & _____ in Spectral Model.

7. In Spectral Model each data is assumed to be sum total of _____.

8. In Spectral Model the minimum wave length that can be represented is _____.

9. For T-80 model the equivalent grid spacing is _____ km approximately.

10. Spectral model have coarser representation of _____.

SECTION B (5X5 = 25)

11. (a) What is NWP? What is the need for NWP?
Or
(b) What are the limitations is dealing with weather phenomena in tropics.

12. (a) Differentiate Hydrostatic from over hydrostatic models.
Or
(b) Differentiate between Grid and Spectral models

13. (a) What are primitive equations? Enumerate the equations.
Or
(b) What are the different types of Co – ordinate systems?

14. (a) List the types of finite difference schemes used in NWP?

Or

(b) What do you understand by central difference scheme?

15. (a) What do you understand by vertical resolution? How does it impact forecast variables?

Or

(b) What are domain and Boundary conditions?

SECTION C (5X8= 40)

16. (a) Briefly describe the historical overview of NWP.

Or

(b) Enumerate the reasons for failure of early NWP efforts.

17. (a) What are the factors affecting models ability to resolve met features? Elaborate.

Or

(b) Elaborate the effects of inadequate model depicted terrain on the model prediction.

18. (a) What are prognostic and diagnostic equations? How do we use these in the forecast process?

Or

(b) List the basic equations and explain their utility in any meteorological process.

19. (a) Derive the central difference formula from Tylor Series.

Or

(b) What do you understand by CFL criteria and computational stability?

20. (a) Compare and contrast σ & η Co – ordinate systems

Or

(b) What are hybrid co-ordinate systems? List the advantages and limitations of θ - σ vertical co-ordinate system.

MODEL PAPER

PG DIPLOMA IN AVIATION METEOROLOGY

SEMESTER III
PAPER – III: AVIATION METEOROLOGY III

Date:_____ Time: 3 Hrs Max: 75 Marks

SECTION A

State true or false if false give the correct statement (10x1=10)

1. Aerodrome forecast issued by IMD will cover an area of 100 NM.

2. In case of VIP flights, briefing is to be done 2-3 hours before the ETD.

3. In T-3 form, 0˚C isotherm would be shown as single dark continuous line in Red.

4. STJ forms where vertical temperature gradient is maximum.

5. CAT is significantly less at tropopause.

6. While flying from a colder region to a warmer region, assuming that the underlying surface has uniform pressure, the altimeter will under read.

7. STJ over India is more marked during summer season of Southern Hemisphere.

8. The RVR would be reported, when the vertical visibility is 2000 m or less.

9. Weather graphs of last five years are to be included in the unit Aviation Weather Summary.

10. Route weather Summaries are prepared month wise for all the months.

SECTION B (5X5= 25)

11. (a) What are the actions taken by the Met Officer prior to conduct of Met briefing?

OR

(b) Enumerate the meteorological information used for briefing of VIP/VVIP flights.

12. (a) Explain how wind shear affects the aircraft operations?

OR

(b) Explain the importance of temperature in aviation.

13. (a) What are Jet Streams? And enumerate the Jet streams that affect the Indian Region.

OR

(b) Write short notes on STJ.

14. Write short notes on

(a) RVR

OR

(b) Wind Profiler

15. (a) Explain the importance of Airfield Weather Summary.

OR

(b) What is the utility of Route Weather Summary?

SECTION C **(5X8=40)**

16. (a) Explain in detail the conventions to be used for preparation of Tabular Forecast.

OR

(b) Explain in detail about Chart form of Documentation.

17. (a) Write in detail about the importance of weather in various types of air operations in modern warfare.

OR

(b) Explain how meteorology plays an important role in Flight safety.

18 (a) What are Contrails?
(b) Explain the physics of Contrails formation.
(c) Explain with diagram the various levels where contrails are
(i) Not possible.
(ii) Contrails possible.
(iii) Contrails are certain to form.

OR

(d) Define CAT, it's mechanism of formation, its characteristics and incidence over Indian region.

19. (a) What do you understand by AWOS? What are its various components? How can they revolutionise weather reporting in IAF?

OR

(b) Define visibility? When is RVR reported? What are the equipments used to report RVR? Explain its principle of operation.

20. (a) Assuming pre monsoon seasonal weather pattern write the route weather summary in respect of upper winds for levels 5000', 10000 and 15000', weather, clouds and visibility for the route between Calcutta – Madras.

OR

(b) Write down the weather conditions over the international route Myanmar- Singapore during pre monsoon and Monsoon season.