

INDIA METEOROLOGICAL DEPARTMENT

QUESTION BANK

OF

FORECASTERS TRAINING COURSE (FTC)

FINAL EXAMINATION

BASED ON 176-191 BATCHES

(2013-2021)

**PAPER-V: SATELLITE METEOROLOGY
AND RADAR METEOROLOGY**

PART A AND B

INDIA METEOROLOGICAL DEPARTMENT
FORECASTER TRAINING COURSE (FTC)
FINAL EXAMINATION

PAPER –V : SATELLITE METEOROLOGY AND RADAR METEOROLOGY

PART A : Satellite Meteorology

Q.1 Fill in the blank or do as directed

1. ----- cloud has highest albedo.
2. ----- & ----- channel imageries are available during Day.
3. ----- channel imagery is not available during night.
4. ----- clouds appear white in IR images.
5. ----- Pixel in satellite represents clouds.
6. ----- sun synchronous satellites are needed to cross over equator at specific time.
7. -----, ----- are two Meteosat satellite derived products which are useful for day to day weather forecasting.
8. -----,-----,--- are operationally the most commonly used three INSAT satellite images.
9. μm region/band is known as window channel.
10. _____ hrs. Orbital period of GPS Satellites are in orbit around the earth.
11. imagery is best to observe very high clouds.
12. and imageries are used in Dvorak technique.
13. is the point on the orbit where the satellite is furthest from Earth.
14. is the time at which the orbital elements are observed.
15. is the line joining the perigee and apogee through the center of the earth
16. orbit is used for continuous monitoring of weather.
17. Wavelength region is used for satellite meteorology.
18.andimageries are most commonly used satellite imageries in Dvorak technique.
19. A circular orbit has eccentricity =.....

20. A set of ----- needed to specify a satellite orbit is called -----.
21. Active remote sensing makes use of sensors that detect reflected responses from objects that are irradiated fromgenerated energy sources.
22. ACWC stand for -----.
23. AHI is payload of -----satellites.
24. Analysis of weak system is more complex and subjective.
25. ATOVS stands for _____.
26. Biannual rotation of Yaw flip of INSAT 3D satellite by 180 degrees has been introduced to maintain the -----temperature.
27. Black pixels in satellite imagery represent clear sky.
28. BPSK stands for-----.
29. Carbon dioxide (CO₂) spectral bands at _____ and _____ microns give us information on the temperature structure of the atmosphere.
30. Cb clouds are tallest of all clouds (say T/F).
31. CCD stand for
32. Cloud top temperature in infrared imagery with height.
33. Clouds with very cold cloud top temperatures appear _____ in IR imagery.
34. Coastal boundaries are seen clearly in ----- imagery.
35. Currently _____ INSAT satellites are in operation to meet the meteorological requirements.
36. DAQLS stand for_____.
37. Data rate of CCD payload isMBPS.
38. Day time fog can be clearly identified in visible and _____ channel imagery.
39. Day time Fog can be easily traced in -----.
40. DRT stand for
41. Dvorak technique utilizes _____ types of imageries.
42. Eccentricity of planet moving in orbit is lies between --- to -----.
43. Eye in the cyclone is generally visible when cyclone intensity is -----than T2.5.
44. Fog can be easily traced using _____imagery during day time..
45. Fog is easily identified in ----- imagery.
46. GEO stands for.....
47. Geo-stationary satellite appears from earth.
48. GIIRS is a -----type of pay load on FY-4A satellites.

49. GPS can be used for ----- measurement.
50. GPS satellites Carries Atomic Clock on board and transmit two low power radio signals, L1=-----and L2 =-----.
51. Height of polar orbiting satellite _____ km.
52. HEM is acronym for _____ and IMSRA is acronym for _____
53. HEO stands for.....
54. High clouds can be easily traced using-----imagery.
55. IAPP stand for _____.
56. IASI is a -----type of pay load on METOP-A and METOP-B satellites Microwave remote sensing has poor -----resolution than IR remote sensing.
57. If the middle and upper atmosphere is saturated with water vapour then the water vapour imageries looks (bright/dark)
58. IMD is utilizing GPS system in ----- station.
59. In curved bands pattern, T number (intensity) is determined by the curvature of band around spiral.
60. In Dvorak technique maximum sustained wind corresponding to CI number 2.5 isknots
61. In patterns, convective cloud mass is moved away from the cloud system centre due to strong vertical wind shear.
62. In a physical retrieval -----scheme must be used.
63. In CDO pattern, centre lies in cloud free region.
64. In IR image processing, images are displayed such that the greater the radiance (temperature), the brighter the pixel. In satellite Meteorology, infrared images are normally -----.
65. In meteorological, operationally the most commonly used satellite imageries are
66. Information on water vapour content can be gained from a large number of H₂O lines between ---- and ----- microns.
67. Information on water vapour content can be gained from two water vapour (H₂O) lines at andGHz
68. Infra Red channel imagery is based on _____ property of the object.

69. Infrared imageries is derived from the terrestrial radiations emitted in the ---- region.
70. Infrared sounding instruments provide information in ----- area.
71. INSAT 3D has advanced payloads of 6 channel _____ and 19 channel _____.
72. INSAT 3D is a type of satellite. (Geostationary/polar)
73. INSAT -3D is -----stabilized.
74. Ionospheric delays are estimated (or removed) by using _____ frequency receivers.
75. IR imagery is derived from _____ radiation at thermal-infrared wavelength _____.
76. Kalpana 1 has _____ payloads.
77. Kalpana-1 satellite is positioned atDegree East. lines at andGHz.
78. Low clouds can be easily traced using _____imagery.
79. Maximum intensity of the solar radiations lies in theband.
80. Measurement of ----- is done using Arkin's technique.
81. MEO stands for _____ .
82. Microwave region of the spectrum used for atmospheric remote sensing ranges from ----- to ----- GHz.
83. Microwave remote sensing has poor -----resolution than IR remote sensing.
84. MMDRPS is acronym for _____
85. MODIS scan the earth in _____ spectrum region.
86. Name of backup software used in IMDPS is
87. Night time Fog can be easily traced in -----.
88. Night time fog detection from MODIS is achieved by the ----- of 3.9 um and 11 um channels
89. Night time fog is determined by taking the difference between ----- and ----- --- channel brightness temperatures.
90. Night-time RGB is made by using _____, _____ and TIR-1 BT.
91. Night-time RGB is made by using _____, _____ and TIR-1 BT.
92. -----obtained from IR imagery is useful parameter to assess

93. OLR is obtained from Kirchoff's law (say T/F).
94. OLR is used as proxy to _____.
95. OLR stands for _____.
96. Perigee is the point on the orbit where the satellite is -----to Earth.
97. Pitch is the orientation of the space craft around the direction of its -----.
98. Planetary motion is governed by laws.
99. Presently, AWS Data transmission / reception is through _____ of INSAT-3A.
100. RAPID is acronym for _____
101. Remote sensing devices on weather satellites called _____.
102. Roll is the orientation of the space craft around the direction of its -----.
103. ROSA is one of the payload in----- polar orbiting satellite
104. ROSA stands for -----.
105. ROSA stands for _____ which is payload on Oceansat-2 and Megha-Tropiques satellites
106. SAN stands for -----
107. Satellite instruments measure _____ that the Earth and the atmosphere _____.
108. Shear pattern is observed in _____ (Initial / advanced) stages of cyclone.
109. Short wave infrared channel imagery is available for _____.(only Day/ 24 hrs)
110. SIDS stand for
111. Snow/Ice appears _____ in SWIR imagery.
112. SST is carried out in ----- channel.
113. Temporal resolution is measure of ----- coverage of ground by the remote sensing system.
114. The Advanced Microwave Sounding Unit (AMSU), a 20-channel radiometer, provides information on the ----- and ----- structure of the atmosphere.
115. The albedo of a perfect blackbody is -----
116. The brighter temperature difference of and channel is used to detect fog at nighttime.
117. The central frequency of Microwave ----- AND ----- used to drive Temperature profile from microwave sounder.

118. The central wavelength of the absorption band of O_3 is ----- microns, used to derive total Ozone in sounder of INSAT-3D.
119. The contrast of the pixels can be improved by applying suitable -----to bring out specific features in the imagery highlighted
120. The Cumulonimbus clouds have albedo nearly _____%.
121. The data rate ----- and RF frequency ----- at which VHRR of Kalpana-1 is operated.
122. The data rate of VHRR of INSAT-3A is _____ and RF frequency is _____.
123. The height of Geo stationary satellite above surface of earth is approximately ----
-----Km.
124. The INSAT-3A is a ----- satellite
125. The law of equal areas made by planet moving in elliptical orbit around sun refers to -----.
126. The name of recently launched geostationary satellite by JMA is -----.
127. The night time fog product is derived by using ----- and ----- channels BT.
128. The orbit of a planet/comet about the Sun is an ellipse with the center of mass at one focus.
129. The PMMS stand for -----
130. The proposed payloads on GISAT-1 satellite are Ocean Color Monitor (OCM-3), -
----- & Sea Surface Temperature Monitor (SSTM).
131. The range ----- of IR band used to drive Humidity profile from INSAT-3D Sounder.
132. The satellite winds are derived from ----- successive images.
133. The Short-Wave Infrared Band of INSAT-3D Imager is used to identify the -----
--, ----- and -----phase in cloud.
134. The transmission of DMDD system is through -----satellite
135. The type of enhancement is used to highlight convective and MCS is -----
136. The type of modulation ----- used to transmit IMAGER data of INSAT-3D from satellite to earth station.
137. The type of modulation----- used in CCD transmission.
138. The unit of solid angle is -----

139. The width of one scan line in North- South direction of sounder pay load is -----
--- km
140. Thermal-IR remote sensing based upon ----- radiation from the object.
141. Thunderstorm can be easily detected using ----- imagery.
142. Time required for a satellite to complete one scan is calledresolution of satellite.
143. To obtain more accurate signature of discrete objects, spectral resolution shall be of-----band width.
144. Tropical cyclone eye is visible in INSAT satellite imagery only when intensity is greater than equal to T number
145. Tropospheric delay = Hydrostatic Delay+_____.
146. VHRR stands for _____.
147. Visible channel of sounder is used to identify-----pixel.
148. Visible imagery is best satellite imagery to detect level clouds.
149. Water vapor channel is sensitive to the _____ part of the atmosphere.
150. Water vapor imageries _____ electromagnetic radiations in the absorption band _____ micrometer.
151. Water Vapour absorb and reradiate electromagnetic radiations in the the absorption band μm .
152. Water vapour channel gives information about _____ troposphere.
153. Water vapour content can be gained from a large number of H₂O line between ----
-- to ---- microns.
154. Water vapour weighting function picks nearhPa layer.
155. Water vapour winds are generated on the basis of _____present in the atmosphere.
156. Water vapour winds are generated on the basis of -----present in the atmosphere.
157. Wave length of WV channel _____micro-meter.
158. We are getting the information without touching the object physically this is known as -----sensing.
159. Weighted Mean temperature of the vertical atmosphere $T_m=55.8+0.77* \underline{\hspace{2cm}}$.
160. What is the full form of DRT
161. Wind vectors may be derived from ---- satellites.
162. Yaw is the orientation of the space craft around the direction of its -----.

163. Zenith total delay is a sum of ----- and -----.

Q.2 Mention True or False for the following statements and justify the answer

With brief reasons.

1. All 19 channels of the INSAT-3D sounder payloads are in IR region as it is Infrared sounder.
2. All geostationary orbits must be geosynchronous, but not all geosynchronous orbits are necessarily geostationary.
3. All geostationary satellites are Geosynchronous.
4. All the satellites are dependent on sunlight for scanning.
5. Apogee is point on the orbit where the satellite is farthest from earth.
6. At equal temperature (assuming same emissivity for land and sea) then land and sea can be easily discernible in Infrared imagery.
7. Atmospheric Profile derived from the sounder for 1x1 pixels.
8. Black pixel in satellite imagery represents cloudy sky.
9. C.I No is always higher than T Number.
10. Cb clouds can be identified in visible, infrared and water vapour imagery imagery.
11. CCD data transmission is based on BPSK modulation.
12. Celera software is used to back up the data in IMDPS system.
13. CI number is always higher than final T-number.
14. Cirrus types of clouds are the best single line tracers.
15. CSC is also known as focal point of all clouds.
16. CTT is used to assess the height of the cloud.
17. Cyclones can be continuously monitored using polar orbiting satellites.
18. Data rate of HRIT lie between 10 kbps to 256 kbps.
19. Data rate used in LRIT transmission lie between 10KBPS to 256KBPS.
20. Digital IR imagery can be used for Dvorak's method.
21. DMDD signal are transmitted through INSAT-3C satellite.
22. Down-converto is device used to step up RF-frequency of receiver.
23. DTH based DCWDS transmission and reception involve two stage transmission reception process.
24. Dvorak has expressed his views that analysis of weak system ($T < 2.5$) is more complex and more subjective.

25. Dvorak has expressed his views that analysis of weak system ($T < 2.5$) is more complex and more subjective.
26. Dvorak Technique directly measure wind and, pressure associated with TC intensity.
27. Dvorak technique is a subjective method to determine the intensity of cyclone.
28. Dvorak technique makes use of AMV products for cyclone classification.
29. Eccentricity for parabolic trajectory is one.
30. Edusat Ext-C band and INSAT-4B KU band are used for DTH based DCWDS.
31. Eye is an example of active remote sensing.
32. Fog and snow may not be distinguished in IR imagery.
33. Fog is detected using water vapour imagery.
34. GEO is most suited for global coverage.
35. Geostationary satellites are fixed over poles.
36. Geostationary satellites are placed in low earth orbits.
37. Geostationary satellites are suitable to monitor cyclones.
38. GPS is used only for IPWV estimation.
39. High clouds are filtered out in Visible channel imagery.
40. High value of TPW in clear air indicates prior to the development of heavy precipitation and flash floods.
41. Himawari-8 is recently launched geostationary meteorological satellite by JMA.
42. If inclination of orbit is greater than 90° then it is called a prograde orbit
43. In a physical retrieval, radiative transfer equation must be used.
44. In CDO pattern, centre lies in cloud free region.
45. In Dvorak technique, Model Expected T number (MET) and Pattern T number (PT) are same.
46. In EYE Pattern, center lies in cloud free region.
47. Infrared imageries are best to detect low clouds.
48. Infrared imagery is available during day & night.
49. Infrared sounding instruments can provide information below the cloud.
50. Infrared sounding instruments provide very high quality information in cloud-free areas.
51. INSAT -3A is uses three payloads.
52. INSAT 3D / INSAT 3DR are active type of satellites.
53. INSAT 3DR is active type of satellite.

54. Ionospheric delay in GNSS can be removed by using calculating amount of water vapour in atmosphere.
55. IR imageries are available all times.
56. IR sounder is used to drive the profile of cloudy regions.
57. IR spectrum are sensitive to ozone between 5 to 8 micron.
58. It is impossible to derive the Atmospheric Motion Vectors (AMVs) in cloud free areas.
59. Kalpana satellite was a polar type of satellite.
60. Keplerian orbit is merely an idealized approximation.
61. LEO is most suited for global coverage.
62. Life cycle has no relevance with size of cloud.
63. Low clouds appear darker than fresh snow in visible imagery.
64. Low stratus is a stratiform cloud.
65. Lower the altitude of a satellite, more the time it takes to travel around the earth.
66. Microwave can provide the very high vertical resolution which the infrared sounders cannot deliver.
67. Microwave sounder is used at geostationary satellite to drive profile of the atmosphere.
68. Model Expected T.No. depends on Pattern T.No.
69. MODIS is one payload on Suomi NPP satellite.
70. MODIS profile resolution is better than NOAA sounding.
71. Most of the radiations in water vapour channel originates in upper Troposphere.
72. NWP forecast is used as first guess to drive the OLR product from sounder.
73. Oceansat-II scatterometer data are useful for early detection of cyclogenesis.
74. OLR is also used as one of the parameters for declaring on-set of monsoon over Kerala.
75. OLR does not measure the earth's radiation budget.
76. OLR is a proxy parameter for convective activity.
77. OLR is used as a one of the parameter declaring onset of monsoon over Kerala.
78. Only mid-upper level winds are observed in water vapour channel based wind product.
79. Passive satellites scan the earth only during day time.
80. Passive sensors are dependent on emission from natural sources.
81. Polar orbiting satellites are generally used for the monitoring of cyclone.

82. Polar orbiting satellites are generally used for the monitoring of different severe weather systems.
83. Polar satellites appear stationary with respect to earth.
84. Polar satellites are used for Cyclones monitoring and tracking.
85. Polar satellites are useful in tracking thunderstorms.
86. Polar satellites can see entire planet in 24 hours whereas Geostationary cannot.
87. Radiance received from the earth surface in the visible channel can also be used for surface temperature measurement provided if it is a window channel.
88. Radiations from the lower atmosphere contributes maximum in water vapour channel (5.7 -7.1 μ m).
89. Remote sensing in visible spectrum is useful at night.
90. Remote sensing is indirect method of observation.
91. SAPHIR pay load of MEGA TROPIQUES is a Microwave sounder used to derive humidity profile.
92. Satellite remote sensing uses both active and passive remote sensing as per requirement.
93. SEVIRI is imager type of payload on GOES-16 satellite
94. Sounders are used for measuring vertical profile of atmosphere.
95. Sunlint refers to the state of ocean.
96. Surface features cannot be seen in water vapour channel because it is not a "WINDOW" channel.
97. SWIR channel of INSAT-3D/3DR can be used during night time for detecting night time fog.
98. Temperature profile are derived from INSAT-DR sounder at all type of pixel.
99. The 10-bit radiometric resolution system used in INSAT-3D Imager gives 256 grey levels.
100. The basic function of Antenna Feed is to convert Electromagnetic Wave to electromagnetic signal.
101. The basic function of down converter is converting from IF to RF.
102. The Field of Regard of INSAT 3D imager is 10x10 degree.
103. The gray shades in visible imagery mainly depend upon the albedo of the underlying surface.
104. The Pattern T-No (PT) is independent of the Model Expected T number.
105. The RF frequency of INSAT-3A is in C-band.

106. The shear pattern of cyclone is observed at the mature stages.
107. Thunderstorm monitoring is done using polar satellites as they offer better spatial resolution.
108. TIR-2 is a clear window channel of INSAT-3D imager payload.
109. To drive day time SST, Brightness temperature of MIR band is used along with IR 1BT and IR-2BT.
110. Tropical Rainfall Measuring Mission Microwave Imager (TMI) on board on TRMM satellite, rainfall estimation is best suitable for land.
111. Visible channel is used for determining CMV's in Kalpana-1.
112. Weighting function for water vapour channel peaks near 600hPa
113. What are the main features of a cyclone that can be observed using RADAR? Give a brief in fixing the centre.
114. White pixel in satellite imagery represents clear sky.
115. Write General Block Diagram of RADAR. Explain one line function of main blocks. What is Range normalization?
116. WV imagery is available round the clock.

Q.3 Answer any two of the following :-

1. As the atmosphere becomes dry, then the height of the weighting function Increases.
2. BD enhancement is used for hurricane/tropical cyclone.
1. Describe main steps for determining T-number using Dvorak Technique.
3. Describe the Basic principles of satellite imagery interpretation
4. Describe the basic principles of satellite remote sensing.
5. Describe the block diagram of earth station being used to receive meteorological satellite.
6. Describe the corrections applied during satellite data processing.
7. Describe the different patterns of cyclones.
8. Describe the elements and their function of Data Receiving/Acquisition and quick look display system.
9. Describe the four geophysical properties that relate organised cloud patterns to tropical cyclone intensity.

10. Describe the importance of satellites derived products. Discuss the methods used for deriving any two such products.
11. Describe the INSAT-3D Meteorological Data Processing System (IMDPS) with block diagram and function of each sub system.
12. Describe the principles used in obtaining satellite imageries. Discuss basic characteristics used in their identification.
13. Discuss chief characteristics of identifying the clouds.
14. Discuss the importance of geophysical parameters related to cloud patters in Dvorak's technique.
1. Do we need any advancement in our current operational satellite or it is sufficient to addressed all weather issues completely ? Comment on it.
15. Explain basic characteristics of satellite imagery?
16. Explain few satellite products which can be utilized during onset of monsoon over Indian region.
17. Explain the Multi -Mission Meteorological data Receiving and processing system along with its block diagram
18. Explain the OLR product, its unit and how it is derived from INSAT-3D Imager Payload data.
19. Explain the various processing steps/corrections used in INSAT-3D satellite data processing with block diagram.
2. Geo physical products derived from Insat-3D /3RImager play an important role for monitoring synoptic scale weather systems.
20. How intensity of low pressure systems are classified in term of T no.
21. How low clouds, fog and snow are differentiated in VIS imagery.
2. Insat -3D/3R images /products can be utilised for Impact based weather forecasting.
3. Is there any importance of satellite data assimilation in NWP models ?
22. It is impossible to derive the Cloud Motion Vectors (CMVs) in cloud free areas.
23. Mention basic principle of obtaining VIS, IR & WV imageries.
24. Multi-channel SST will increase the accuracy as compared to Single channel.
25. Name of Geophysical products derived from INSAT-3D Imager Payload.
26. Name the Atmospheric Motion Vectors (AMV) derived from INSAT 3D imager and steps used in their derivation.

27. Name the four type rainfall products derived from INSAT-3D/3DR Imager payload and write the steps for derivation of any two.
28. Spatial resolution of Sounder Payload channels is 30X30 Km.
29. State and explain the physical properties of the target object that are used in VIS and IR remote sensing.
30. The surface features are seen in water vapour imageries.
4. Visible image (insat-3D/3R) importance in weather monitoring.
31. What are the merits and demerits of visible imagery?
32. What are the merits of visible over IR imageries?. How do you distinguish land and ocean in visible channel?
33. What are the ten steps in Dvorak technique to determine the intensity of the cyclone?
34. What is atmospheric sounding? How many types of retrieval approaches can be used? Explain one of them.
35. What is IAPP. What is the inputs and outputs of IAPP
36. What is IR sounding and methods? Explain one in brief.
37. What is the difference between Imager and Sounder. Why does Window channels not been used for atmosphere profile.
38. Why Cb cloud is clearly identified in both VIS as well IR imagery.
39. Why visible imagery is better for tropical cyclone analysis
40. Write a detailed note on current Indian operational LEO satellites.
41. Write a note on Dvorak technique. State its limitations.
42. Write a note on the use of Visible and IR1 channels for cloud monitoring. State the fundamental principles of satellite imagery interpretation.
43. Write a note on use of satellite imagery with their characteristics. Mention basic principles of image interpretation.
44. Write a short note on INSAT-3D satellite and its products and explain one of them.
45. Write down the limitations of Dvorak technique.
46. Write down the main characteristics and uses of Visible, Infrared and water vapour imagery.
47. Write in details about the basic principles used for the interpretation of satellite images
5. Write name of two Insat deriver products useful in oceanographic applications.

48. Write short notes on Meteosat derived products.
49. Write the Channels of INSAT-3DR Imager and its advantages over Kalpana-1 VHRR.
50. Write the name different approaches used to solve the inverse problem to retrieve the profile from sounder data with their advantages and draw backs. Which approach is used for INSAT-3D sounder processing?
51. Write the names of the components of Data Reception System of IMDPS and explain their functions briefly.

Q.4 Write short notes on any two of the following :-

1. Advantages of new DTH based DCWDS over old type DCWDS.
2. Advantages of visible channel of a Geostationary satellite.
3. Channels of INSAT-3DR Imager and its advantages over Kalpana-1 VHRR.
4. derivation of IPWV from GPS.
5. DMDD system with block diagram.
6. Explain the basic principles used in satellite image interpretation. What are the important points to be followed to interpret any satellite image? What is the importance of Visible and Infrared Imagery?
7. Explain the difference between Microwave and Infra-red (IR) sounding.
8. Explain the orbital elements needed to specify a satellite orbit.
9. Explain the satellite attitude needed to specify a satellite orientation in orbit.
10. Four primary cloud patterns used in Dvorak technique.
11. Ground receiving and processing system of NOAA/METOP/MODIS at IMD.
12. Satellite imagery interpretation.
13. Advantages of IR sounder over microwave.
14. Image enhancement techniques.
15. IMDPS of INSAT 3D.
16. Intensity of tropical cyclones using Digital IR technique.
17. Limitations of Dvorak technique.
18. Measurement of atmospheric temp. and humidity.
19. Microwave sounder in Geo-stationary satellite, Comments?
20. MMDRPS

21. Name the types of cyclones. How the intensity of cyclones is decided in these types of cyclones using satellite imagery. What are the Limitations of Dvorak technique?
22. Primary cloud patterns in Dvorak's method.
23. Some satellite derived products and their uses.
24. Sunlint and classification of clouds.
25. What is digital communication and name the modulation used in digital communication.
26. Write a short notes on IMAGER payload of INSAT-3D.
27. Write a short note on derivation of IPWV from GNSS/GPS.
28. Write a short note on IAPP retrievals.
29. Write a short note on principle remote sensing and its type.
30. Write a short note on UTH product derived from INSAT-3D Imager payload.
31. Write a short note on water vapour imagery.
32. Write short note on DTH based DWDS receiver.
33. Write short note on visible imagery.
34. Write short notes on current Indian LEO mission.
35. Write the advantages of Imager payload of INSAT 3D over the VHRR payload.
36. Write the advantages of INSAT-3D over Kalpana-1 satellite.
37. Write the differences between active and passive type of remote sensing.
38. Write the differences between polar and geostationary satellites.
39. Write the recipe of day time and night time micro physics RGB image of INSAT 3D imager.

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PAPER –V : SATELLITE METEOROLOGY AND RADAR METEOROLOGY

PART B : Radar Meteorology

Q1 Fill in the Blank/ True and False

1. scattering approximation is used in Weather Radars detecting atmospheric waves, while Bragg scattering approximation is used in Oceanic Radars detecting sea surface waves.
2. 1 micro watt = _____ dBm
3. 79 dBm is equal to kilowatts.
4. A bright band in the Radar display indicates decaying thunderstorms (True/False)
5. A circle shaped echo with enhanced Z around radar in widespread stratiform precipitation indicates _____
6. A hook echo is a characteristic signature of _____ [Hail / Tornado]
7. A wind profiler is a sensitive Doppler radar, designed to point (nearly) vertically and operate on Ultra High Frequency (UHF). [T/F]
8. An increase in gain is accompanied by a decrease in beam-width and is achieved by increasing the antenna size relative to the wavelength. [T/F]
9. Angular Resolution of RADAR is depends on Range of Target and Half Power Beam Width. [T/F]
10. Antenna gain of DWR Kolkata is about -----dB.
11. At times, echoes resembling geographical locations (coast lines/structures / cities / country) are captured by Radar probing due to the presence of _____ propagation condition in atmosphere .
12. ATM(Air Traffic Management) Radars operate in _____-Band.
13. Attenuation of radar signal increases with wavelength. Whether the statement is True or False?
14. Higher PRF reduces maximum unambiguous Velocity: False, Higher PRF reduces maximum unambiguous range [T/F]

15. Back scattering mechanism in MST radars are due to _____(Mie/Rayleigh/Bragg).
16. Bending of EM waves towards the earth is called
17. Bright band occur below the Level
18. Bright bands are usually detectable in _____ precipitation and in wide spread precipitation situations.
19. C-band radar are economic than S-band radar.[T/F]
20. Cloud patch observed in DWR with 50 dbZ or more reflectivity indicates the formation of hail in cumulonimbus clouds.[T/F]
21. Considering the wavelength of X-band radar as 3 cm, the most probable size of the antenna would be meter.
22. Cyclone Detection radars are usually _____ band.
23. dBm ismeasure of power ratio with reference to one milli-watt (mW).
24. dBm is an absolute measure of power.[T/F]
25. Derive the relation for maximum unambiguous velocity.
26. Detection of extended ground targets is known as _____
27. Doppler dilemma is expressed by the equation_____.
28. Doppler weather Radar computes radial velocity of target from _____
(Phase difference, Amplitude difference, Travel time)
29. Doppler Weather Radars have benefit over the conventional Radars due to it's product.
30. Dual Polarized RADAR rain estimates are better than single polarized RADAR [T/F]
31. Duplexer used in Radar is for _____.
32. DWR has generates additional products than CDR[T/F]
33. DWRs can measure the true velocity of the target.(True/False)
34. Explain the utilization of Max_Z product from DWR. Atleast five applications.
35. For a Right Circular Polarized transmission back scattered returns from rain is _____[Left/Right] circular.
36. For a weather (rain) echo the radar reflectivity factor, Z is give by the equation _____.
37. For heavy rain the Horizontal reflectivity is more than Vertical reflectivity of a Dual Polarized Radar(True/False)
38. For oceanographic studies _____ band Radars are deployed.
39. For oceanographic studies like currents _____(VHF/UHF/HF) Radars are used.

40. For Range normalization, return echo intensity of Radar is multiplied with square of Range to view intensity of echo irrespective of Range.(True/False)
41. Gain of antenna having beam width of 0.5° is _____
42. Higher PRF reduces maximum unambiguous Velocity[T/F]
43. If Diameter of the scattering particle is near to wave length of RADAR _____ scattering happen.(Rayleigh/ Mie / Law of Refraction).
44. If the bright colour patch (dBZ > 40) is seen in maxZ product of any Doppler Weather Radar up to 8 km height, the cloud being observed is most probably Cloud.
45. The main rain product of DWR is _____.
46. IMD has installed a number of S-band Radars in entire coastline to observe and track the disastrous weather systems, mainly thein a Laser-Optical disdrometer, the drop size is determined by the _____ of dimming of signal and the fall velocity by the _____ of dimming of signal.
47. In a RADAR system the transmitter of the radar is more sensitive than the receiver.[T/F]
48. In an Electro Magnetic Wave the orientation of the _____ field is defined as the orientation of electromagnetic field and this is called as “polarization”.
49. In elastic scattering, the wavelength (frequency) of the scattered radiation is the same as the incident radiation, which leads to and Mie scattering in the medium.
50. In Polarimetric Radar the E components of the transmitted wave is _____ (perpendicular to earth, parallel to Earth, both parallel and perpendicular to earth).
51. In Raleigh scattering the intensity of scattering is proportional to _____ of diameter of scattering particle. (square, fourth power, sixth power)
52. In super-refraction, the radar beam height is _____ than the radar indicates.
53. Increasing ETOP indicates _____ [Increasing /Reducing] tendency of convective cell.
54. The upper air wind product of DWR IS _____.
55. Ka Band radars are normally preferred for space borne applications because of its _____.

56. Lidar (Light Detection and Ranging) is a remote sensing method that uses light in the form of a pulsed laser to measure the exact distance of any target upon the Earth such as clouds.[T/F]
57. LIDAR is the acronym for _____.
58. LIDARS can be operated both Day & Night _____(True/False)
59. Limitation of Radar observations beyond the range of 500km is mainly due to _____.
60. Magnetron is generally not used in DWR due to its _____(Life is less , Less Frequency stability, cannot handle high frequencies)
61. Max Z is a PPI product.(True/False)
62. Maximum power transmitted from DWR is-----.
63. Maximum Unambiguous velocity measured by DWR is-----m/s.
64. MaxZ, VP2 and are the main products generated by DWRs which are specifically useful for aviation forecasting.
65. MST Radar (Mesosphere–stratosphere–troposphere Radar) is a type of designed to measure winds and other atmospheric parameters up to altitudes of 100 km or more.
66. MST Radars operates in _____ band.
67. Non-polarimetric radars measure only the horizontal dimension of cloud and precipitation particles.[T/F]
68. One of the important limitations of a weather radar is that its range is limited because of earth curvature..... True/False.
69. Polarimetric radars enables _____.
70. RADAR is the acronym for _____.
71. RADAR reflectivity for ICE particle is less than Water droplet of same Diameter.[T/F]
72. Radars make very accurate wind velocity measurements when tropical cyclones being observed is at the distance of 350 km or more from Radar station.[T/F]
73. Range of PRF for DWR is from -----Hz to-----Hz.
74. RF Attenuation is _____(lesser/higher) in lower frequencies.
75. S band Radar frequency Range is between
76. Satellite borne Radars are normally _____(L-band/S-band/mm-band)
77. Scanning at a constant elevation is known as _____
78. Size of Parabolic antenna used for X- Band RADAR is smaller.[T/F]

79. The reflectivity is related to drop size by the equation _____ with unit _____
80. The amplifying device used in DWR is-----.
81. The back scattering cross section of Target is proportional to _____ Power of Diameter of the target(6th Power / Fourth Power/ 10th Power)
82. The diameter of the antenna used with S band radar with 1 deg beam width is
83. The duration of long pulse is----- μ s.
84. The equation connecting RADAR reflectivity and liquid water content is Marshall Palmer equation [T/F]
85. The expression for maximum unambiguous velocity is given by _____
86. The main advantage of a Dual Polarized DWR over a single polarized DWR is _____.
87. The max. range of radar is-----km.
88. The maximum power transmitted from S- Band DWR is about
89. The maximum unambiguous velocity of an S-band DWR with PRF 1000 Hz is _____.
90. The MDS of a radar receiver is about-----dBm.
91. The most common wavelength used for RF transmission in X-band Radars is Centimeter.
92. The second trip echoes displayed in a radar reflectivity image are generally _____ shaped.
93. The SI unit of Radar reflectivity factor (Z) is
94. The software used in DWR manufactured by M/s Gematronik is -----.
95. The unambiguous velocity of an S-band radar with PRF 1200 Hz is _____
96. The unit of reflectivity factor shown in DWR images is _____.
97. The unit of reflectivity is _____.
98. The usability of a weather radar is limited to a range of 600 Km because of _____.
99. The velocity towards the radar is displayed in colour.
100. The wavelength of S - Band radar is-----.
101. To avoid velocity folding the Doppler Weather Radar is operated at staggered PRF(True/False)
102. Very High Frequency (VHF) Radars has frequencies _____(lesser/higher) than S-Band Weather Radar.

103. Warm, dry air advection over cooler water surface leads to bending of EM waves below the travelling path and referred as
104. Weather LIDARS find applications in _____.
105. Weather Radars operates in _____ (Microwave/Radiowave) frequencies.
106. Wind Profilers can measure both wind and temperature patterns of Atmosphere _____(True/False)
107. X Band Radar is used for Cyclone tracking.(True/False)
108. X Band Radars are economical than S band Radars- True, due to their smaller size and less energy consumption[T/F]
109. X Band Radars are economical than S band Radars[T/F]
110. Zdr values for a perfect spherical targets will be _____.
111. Zero watt power is equal to zero dBm power in logarithmic scale.[T/F]
112. Present IMD Cyclone Detection DWRs operate in
a) X-band b) L-band c) C-band d) S-band
113. The received useful signals in MST radars at ST are due to _____.
a) Mie Scattering b) Bragg Scattering c) Rayleigh Scattering d) None of these
114. Weather LIDARS find applications in _____.
a) Cloud & Aerosol studies b) Detecting Atm. Temperature c) Wind d) All of these
115. Non-rain bearing clouds can be observed using _____.
a) S band RADAR b) C-band RADAR c) Ka-band RADAR d) None of these
116. Doppler Weather radar got its name due to
a) Doppler dilemma for its limitations
b) Invented by Christian Doppler
c) Applies Doppler principle
d) All of the above
117. The maximum detectable un-ambiguous range of RADARs is out of
a) Earth curvature
b) Transmitted power & Receiver Sensitivity
c) Operated Pulse Repetition Frequencies
d) All of the above
118. IMD uses its DWR network for also fog detection and alerts [True/False]

Q2 Answer the Following

1. Briefly explain any 4 hydrological products of Doppler weather radar.
2. Briefly mention the limitations of Weather Radars.
3. Define dBm? Express 86dBm in Kw.
4. Define gain and beam width of an antenna and give the relation between them.
5. Define radar cross section (σ) and how it describes the Radar detectability of any object.
6. Define radar cross section.
7. Derive Radar range equation for an extended target?
8. Derive relations for “Unambiguous range” and “Unambiguous velocity” and establish Doppler Dilemma.
9. Derive the Radar equation.
10. Discuss the structure and evolution of Squall Lines in Doppler Weather Radar imageries to identify the squall lines and associated severe weather.
11. Do you agree whether antennas with a large beam width are preferred over narrow beam antennas for any weather radar system? Justify your answer (yes or no).
12. DWR is better than analog radar, justify the answer shortly.
13. Elaborate the way Radars can be used for Severe Weather Warning.
14. Give two wind products of Doppler weather radar.
15. How rain is measured in a Doppler weather radar?.
16. Klystron is preferred over Magnetron in DWR. Why?
17. Name three hydrological products of Doppler weather radar.
18. Name various base products of Dual Polarized Doppler Weather radar.
19. The antenna gain of a radar antenna is 36 dB. What does it mean.?
20. The power of a transmitter is 93 dBm Express it in Kilowatts?
21. Two types of pulses are used in DWR. What are their widths?
22. What are the advantages of Doppler Weather Radar over a conventional weather radar?
23. What are the base products derived from DWR. Write their units.
24. What are the basic products in DWR?
25. What are the main features of a cyclone that can be observed using RADAR? Give a brief in fixing the centre.
26. What are the various classes/types of echoes seen on radar screens.
27. What are the various parameters of rainfall that can be measured by a Disdrometer.
28. What is a bright band?
29. What is Doppler Dillema? Discuss its significance.

30. What is the application of SRI product in forecast?
31. What is the device used for emission of the power in DWR?
32. What is the difference between PPI and MAX products derived from DWR?
33. What is the significance of VVP-2 product
34. Why X band radars become obsolete in IMD?
35. Why clouds of height less than 10 km cannot be seen by DWR beyond 600 km?
36. Write a short note on radar precipitation estimation.
37. Write a short note on the various features of a cyclone that can be observed by Doppler weather radar.
38. Write Doppler principle in E.M.waves and expression for maximum unambiguous velocity.
39. Write down the Radar equation for distributed targets and explain the terms involved.
40. Write General Block Diagram of RADAR. Explain one line function of main blocks. What is Range normalization?
41. Write Range equation for radar. What are the terms used in this equation, specify.
42. Write the bands of frequencies used in DWR of IMD and mention their applications.
43. Write the names of three derived products from DWR?
44. Write the radar equation for an extended target and expand each term.
45. Write the reflectivity products derived from DWR

Q3 Short Notes

1. As a weather forecaster provided with a DWR workstation/images, explain what are all the DWR products you would use and for what benefit.
2. Briefly explain about the 3 base moments generated by Doppler weather Radar?
3. Define dBm? Express 86dBm in Kw.
4. Derive radar equation
5. Derive relations for “Unambiguous range” and “Unambiguous velocity” and establish Doppler Dilemma.
6. Derive the relation for maximum unambiguous velocity.
7. Discuss max. unambiguous range and velocity and write Doppler dilemma.
8. Discuss the significance of VVP-2 picture for the prediction of the thunderstorms.
9. Draw the block diagram of radar and explain various parts

10. Draw the RADAR basic block schematic, with a short description on four of its major
11. Explain Doppler dilemma using Doppler shift. How velocity ambiguity can be solved?
12. Explain Doppler Dilemma?
13. Explain the Max_Z and CAPPI_Z products from DWR and write their significance.
14. What are the advantages of DWR over conventional radars?
15. What are the base products derived from DWR. Write their units.
16. What are the limitations of DWR ? What precautions need to be taken while utilizing DWR products.
17. What are the main features of a cyclone that can be observed using RADAR? Give a brief in fixing the centre.
18. What are the parameters that are to be observed while tracking a cyclonic storm on a weather radar.
19. What are the various classes/types of echoes seen on radar displays.
20. What is Doppler Dillema? Discuss its significance.
21. What is Max-Z product? Write its significance in Nowcasting.
22. Write any 10 technical specifications of DWR
23. Write any 10 technical specifications of DWR Kolkata.
24. Write Doppler principle in E.M.waves and expression for maximum unambiguous velocity.
25. Write five important informations obtained from Max. Z.
26. Write General Block Diagram of RADAR. Explain one line function of main blocks. What is Range normalization?
27. Write Range equation for radar. What are the terms used in this equation, specify.
28. Write the advantages of Doppler weather radar over a conventional weather radar.
29. Write three derived products from Reflectivity used in Hydrological purpose. Write their applications in Meteorology.
30. Write two advantages and two disadvantages of RADARs over other meteorological observing systems [viz. Surface, Upper-Air, Satellite].