Indian Maritime University

(A Central University, Govt of India)

Mar/Apr'26 SE

Programme Name: DNS

Semester: 2

Subject Code: UD11T6201

Subject Name: MARINE METEOROLOGY

Date: 09.03.2026	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. Which atmospheric layer is directly above the troposphere and is characterized by a temperature increase with altitude?

A. The stratosphere is found above the troposphere and is noted for a rising temperature
B. The mesosphere is higher and has a decrease in temperature with height
C. The tropopause is a thin boundary found between troposphere and stratosphere
D. The thermosphere lies much higher and shows a rapid rise in temperature

2. What effect does increasing latitude generally have on the amount of incoming solar radiation (insolation) received at Earth's surface?

A. Rising the latitude causes insolation to remain roughly unchanged throughout the year
B. Increasing the latitude causes the insolation received to generally decrease due to lower sun angles
C. At higher latitude, the insolation received will fluctuate at random during each year
D. Increasing the latitude causes the insolation received to generally increase with longer days

3. Which process is primarily responsible for the transfer of heat energy from Earth's surface to the atmosphere during calm, sunny days?

A. Convection involves heated air rising from the surface and transferring energy upward
B. Conduction transfers energy by direct contact between surfaces at ground level
C. Diffusion involves movement of molecules but is not the main method here
D. Sublimation describes solid water changing to gas, not heat transfer between ground and air

4. Which factor would cause the surface atmospheric pressure to rise in a given location?

A. Adding more air to the vertical air column above the location increases the pressure
B. A decrease in temperature at the ground has a much less significant effect on pressure
C. Rising evaporation rates mainly impact humidity, not directly surface pressure
D. A shift in wind direction alone typically makes little instant difference to pressure

5. What is the typical average value of atmospheric pressure at sea level expressed in millibars (mbar)?

A. A value of 950 mbar is lower than typical average sea level atmospheric pressure
B. The number 980.5 mbar is somewhat less than the average reference used worldwide
C. The value 1120 mbar is higher than is usually observed at sea level conditions
D. The average atmospheric pressure at sea level is about 1013.2 mbar globally

6. On a synoptic weather chart, which of the following statement is correct?

A. A warm front is shown as a red line with semicircles projecting toward its movement
B. A trough may appear as a dashed line running parallel to the main isobar lines
C. A boundary between two air masses given by a line of dots running adjacent to isobars is a front.
D. A cold front is marked by a red line with triangles indicating the advancing direction

7. In the context of clouds, what happens when the air rises and cools adiabatically?

A. When air rises and cools, it does not instantly evaporate and lower the humidity
B. When air cools adiabatically, it reaches saturation and clouds form at the dewpoint
C. Clouds may form even if ice crystals are absent, once saturation is reached
D. This rising air can lead to cloud formation and not exclusively fog development

8. Which wind regime is best described as prevailing winds blowing from the northeast in the Northern Hemisphere around 30–60° latitude?

A. Polar easterlies are winds moving from east to west at high northern latitudes
B. Trade winds blow steadily from the east near the equator toward the tropics
C. Westerlies in mid-latitudes typically flow from the west toward the east strongly
D. Monsoon winds are seasonal and reverse direction between land and ocean

9. What is the significance of condensation nuclei in cloud formation?

A. Condensation nuclei do not absorb sunlight to increase air temperature regionally
B. Condensation nuclei enable cloud formation but do not block supercooled water
C. They do not split droplets into smaller fragments during atmospheric processes
D. Condensation nuclei let water vapor condense and develop into cloud droplets easily

10. In the Beaufort scale for estimating wind force, what is primarily assessed to determine wind speed at sea?

A. The sea surface state including visible wave height and pattern formation is evaluated
B. Salinity sampled from the sea water is not relevant for wind speed assessment
C. The temperature changes at the surface are not used for Beaufort wind estimation
D. Directions of moving clouds overhead are unrelated to Beaufort wind measurements

Section B

Five Questions of 02 Marks each

11. Explain the interplay between the sun's position, latitude, and atmospheric processes in determining the amount of insolation received at different locations and times of the year.?

12. Discuss the physical principles underlying atmospheric pressure, the reasons for its variation with altitude, and describe how these properties are measured and interpreted in meteorology.?

13. Analyse the formation, structure, and movement of Tropical Revolving Storms (TRS), highlighting differences from temperate latitude depressions and the implications for marine navigation.

14. Elucidate the differences between Dry Adiabatic Lapse Rate (DALR) and Saturated Adiabatic Lapse Rate (SALR), and explain their significance in atmospheric stability and cloud formation.

15. Describe the major ship-borne meteorological instruments and their roles in collecting accurate weather data at sea.

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16A) Evaluate the navigational strategies a ship should employ when encountering a Tropical Revolving Storm (TRS), considering dangerous quadrants and practical rules for avoidance? (7 marks)

16B) Compare and contrast the characteristics, formation processes, and navigational challenges of monsoons and tropical revolving storms (TRS) in the Indian Ocean. (3 marks)

17A) Compare the processes of conduction, convection, and radiation in terms of how they contribute to the Earth-atmosphere heat exchange, and evaluate which is most significant for atmospheric temperature patterns. (3 marks)

17B) Explain how the properties and behaviour of water vapour in the atmosphere impact the formation of weather phenomena such as fog, clouds, or dew. (7 marks)

18A) Compare and contrast the weather sequences experienced during the passage of an idealized warm front versus a cold front. (3 marks)

18B) Justify the importance of understanding the characteristics of different air masses and their source regions for forecasting significant weather changes at sea. (7 marks)

19A) Examine the differences between anabatic and katabatic winds in terms of their formation mechanisms, regions of occurrence, and potential impacts on local climate. (5 marks)

19B) Given the relationship between waves, tides, and phases of the moon, explain why certain coastal regions experience extreme tidal ranges during specific lunar phases and how this knowledge benefits maritime navigation. (5 marks)

20A) Critically assess how the presence and movement of ocean currents affect the climate of landmasses and provide examples? (7 marks)

20B) How would the formation and movement of ocean currents affect the climatic conditions of coastal regions, and what would be the potential impact on shipping routes? (3 marks)

21A) Assess how the effectiveness of a ship's weather forecast can be improved through onboard meteorological observations and integration with synoptic and prognostic charts.? (7 marks)

21B) Discuss the role and services of international and national meteorological organizations, such as the WMO and IMD, in supporting maritime operations and safety.? (3 marks)

22.You observe a synoptic chart showing a consistent drop in isobar values over a region with closely packed isobars. How would you interpret the pressure system, expected wind direction, and possible weather phenomena in this area? (10 marks)

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