INDIA METEOROLOGICAL DEPARTMENT

QUESTION BANK

OF

FORECASTERS TRAINING COURSE (FTC)

FINAL EXAMINATION

BASED ON 176-191 BATCHES

(2013-2021)

PAPER-IV: CLIMATE SCIENCE, HYDROMETEOROLOGY AND ADVANCED STATISTICS

PART A, B AND C

INDIA METEOROLOGICAL DEPARTMENT

FORECASTER TRAINING COURSE (FTC)

FINAL EXAMINATION

PAPER –IV : CLIMATE SCIENCE, HYDROMETEOROLOGY AND ADVANCED STATISTICS

PART A : CLIMATE SCIENCE

Q1 Fill the blanks

1. ------ contributes maximum to greenhouse effect.
2. ------- is a major mode of climate variability. (Heat low, ENSO, tropical cyclone)
3. -------- is the best tool to simulate climate.
4. _____ is an interface or transition zone between two air masses of different density.
5. _____ is common features of the Antarctica atmosphere.
6. _____ is the primary cause of run off.
7. _____ Climates prevail over much of South America Continent.
8. _____ is the ratio of sensible heat flux to latent heat flux (heat flux to ET) lost by a surface to the atmosphere by the process of conduction and turbulence.
9. _____ is a major mode of climate variability. (Heat low, ENSO, tropical cyclone).
10. _____is primarily influential in controlling the phenological stages of flower formation and timing of flag leaf appearance.
11. ----------is a planetary-scale winds and pressure, features that appear in the time-averaged state
12.
13. _____is the process of turbulent transfer as well as of energy transformation.
14. …….. is termed as winter pole of Northern Hemisphere .

    a)Less than 3 days b) 3-10 days c) 10 to 30 days d) Greater than 30 days
15. Abbreviation of MME is ---------
16. Absolute vorticity is maximum at the poles and …….. at the equator

17. Amount of dry matter produced by a crop per unit of water transpired is called as_____.
18. An extensive portion of atmosphere that has acquired some sort of equilibrium with the surface into its contact over a large area is designated as _____.
19. An interface or transition zone between two air masses of different density is designated as _____.
20. An ---------- event usually starts around May or Jun, intensifies in thefollowing months and peaks between Aug and Oct and thenrapidly decays.
21. Full form of PDO is ----------.
22. As per the new LRF strategy the first stage forecast for the all India summer monsoon rainfall is issued in --------- and second stage forecast is issued in ----------.
23. Based on the homogeneity in the summer monsoon rainfall, presently India has been divided in to ----------, ----------, ----------, and ----------
24. Climate change is ---------.
25. Climate change is always due to human activity---- (true / false).
26. CMIP3 models are -------- models while CMIP5 are --------- models.
27. CMIP5 models are run for different ---------.
28. Coastal …… and northern …….. are among the driest places on earth component.
29. Concept of MAI used for climatic classification by ----------
30. Continual recycling of water between the land, the oceans and the atmosphere is known as the_____.
31. Coriolis force arises from conservation of angular momentum (Y/N)
32. During the period 1988-2002, the LRF for the monsoon season rainfall over the country as a whole was issued using ---------- models.
33. Evaporation is the opposite of ----------.
34. Father of Agrometeorology in India is ----------
35. Frequency of cyclones over the Indian Ocean has -------- (Increased/Decreased).
36. Frequency of extremely heavy rain fall events over India has -------- (Increased/Decreased).
37. Fronts that are passing over a station are called stationary fronts. (True/False)

38. Glaciers are considered to be most sensitive …….. of climate change

39. Icelandic low …….. during the positive of NAO

40. IMD issues medium range weather forecast to AMFUs on _____ and _____.

41. IMD's Long Range Forecast for Southwest monsoon is issued in ……. stages

42. In an El-Nino event anomalous warming in SSTs are first observed over ----(eastern / western) parts of equatorial Pacific Ocean)

43. In ENSO, El Nino is oceanic component & Southern Oscillation is atmospheric

44. In long range forecast weather parameters are expressed in terms of -------

45. Irregular quasi-cyclic changes, the period of which may vary from about 3 to 8 weeks is known as _____.

46. In northern hemisphere, the Arctic, North Atlantic and North Pacific oceans act as ---- Modulators

47. In the negative phase of IOD, monsoon will be active over---------- parts of India (Most/less).

48. In the positive phase of IOD, western South Indian Ocean has _____ (low / high) OLR values.

49. In winter, precipitation is _____ over entire continent of Asia.

50. India has ------ no. of agroclimatic zones as per ICAR NARP and -------- no. of AMFUs.

51. Indian summer monsoon rainfall is deficient when,
    a) All India Rainfall is less than 0% of Long Period of Average
    b) All India Rainfall is less than 10% of Long Period of Average
    c) All India Rainfall is less than 20% of Long Period of Average
    d) All India Rainfall is less than 5% of Long Period of Average

52. IOD stands for Indian Ocean ----------.

53. ISMR is projected to be more in future ---(False / true)

54. It is easy to identify cold fronts than warm fronts. (True/False)

55. Kuroshio is termed as the strongest ……...

56. Labrador current is situated near ……...

57. Mean annual temperature over India has risen by--- (0.6/1.4).0C during 1901-2010 period.

58. NAO modulates climate of northern extra tropics maximum during ------- (winter, summer, whole year).

59. Nino – 3,4 SST Anomaly tendency is one of the predictors of …….. of Long Range Forecast issued by IMD.

60. Northern Region of Africa is a source of _____ type of air mass.

61. NPO is to some extent an reverse condition of NAO.

62. Over Europe, isotherms run generally parallel to lines of latitude except in winter, when the influence of Gulf Stream causes a profound _____ gradient.

63. Over Australia, heavy summer rains of the north are of _____ origin and winter precipitation over southern coast is of _____ type.

64. Quantity of biomass produced per unit of intercepted radiation (g/MJ) is called as_____.

65. Rainfall of Gujarat is showing ---------- trend (increasing/decreasing).

66. Rising trend in time series of minimum temperature indicates ------ (presence of increased/ decreased green house gases).

67. Savannah forests occur over the regions between the wet …… and subtropical …….

68. Simultaneous formation of two fronts is called frontolysis. (True/False)

69. Southern lights is a glow observed in the night sky near the …….

70. Southern Oscillation is an atmospheric phenomenon whereas EL Nino is an -------- phenomenon.

71. Southwestern Asia is a ……. region with long and hot summers.

72. Sublimation is a process of direct ……. form solid state.

73. Southwestern Region is arid to semiarid area, known as a _____ and does not have extreme temperature as land area involved is much smaller.

74. The air masses in North America are affected to a large extent by the mountain ranges.

75. The all-India summer monsoon rainfall is _____ (variable/stable) in the long-term sense i.e. over a period of 100 years or more.

76. The basic balance equation of water vapour is given by $\frac{dq}{dt}$ = _____ + _____

77. The first operational LRF of Indian summer monsoon rainfall was issued on --------.

78. The first operational LRF of Indian summer monsoon rainfall was issued on --------.

79. The forecast period is defined as ----------

80. The forecast period of the Long range forecast is ----------

81. The hottest weather in South America occurs in ……..

82. The Indian monsoon rainfall and Kharif crop yield have a ---------- correlation.

83. The inter annual variability of SW monsoon is _____ compared to that of NE monsoon over India.

84. The IPCC has published four Assessment Reports during the years ------, ------, ------, and ------ .

85. The main source and sink of water vapour are _____ and _____

86. The monsoon season rainfall averaged over the country as whole shows _____ (increasing / decreasing / no significant) trend

87. The period between the issue time of the forecast and the beginning of the forecast validity period is called _____.

88. The ratio of kinetic energy to total potential energy i.e $\Phi \frac{K}{(+I}$ = ____, showing that the Kinetic energy is a very small fraction of the total energy in the atmosphere.

89. The regions receiving higher rainfall exhibit _____ variability.

90. The seasonal predictability of the Indian summer monsoon rainfall is limited by the influence of ---------- on the mean monsoon circulation.

91. The slope of warm front is gentle than that of a cold front. (True/False)

92. The spatial variability of the monsoon rainfall is very _____.

93. The three large scale see saw oscillations in the global pressure patterns identified by Walker are ----------, ----------, and ----------.

94. The variability of monsoon resulting on account of the spells of active and break monsoon activity is known as _____ variability.

95. The weak monsoon conditions are associated with _____Southern oscillation index.

96. Transfer of water from plants to atmosphere is known as_____.

97. Validity of Long Range Forecast is _____

98. Variability of Northeast monsoon is --------- than Southwest monsoon (more/less)

99. Walker circulation is an example of -----circulation.

100. Weather and climate of India is dominated by --------- & ---------- monsoons.

101. When air remains over a homogenous area for a sufficiently longer time, it acquires the characteristics of the area is called as_____.

102. Humans are creating climate change by burning large amounts of ____

103. The gases, especially _____act like a blanket and restrict the rate at which Earth's surface can radiate heat to space.

104. Protect, Retreat and _____these are three steps of adaptation to rising sea level

105. Trend (°C /100 YEARS) for the period 1901 to 2018 in mean temperature anomalies was highest (positive) for _____season.

106. The standard deviation of inter annual variability of all India southwest monsoon rainfall is …….. (%)

107. Periodicity of quasi biweekly oscillation is ……

108. Two phenomena that has strong teleconnection with the northeast monsoon are……. and …….

109. _____ activity is observed in the central plains of North America.

110. One Climatic feature related to wind of the Antarctica continent is _____.

Q2 State whether True or False with reason

1. Aerosols in the atmosphere partially counter affect the warming induced by Green house gases (True / False).
2. All India Summer Monsoon Rainfall during the period has significantly decreased----(true/ false).
3. Asia is the world's largest and most diverse continent, covering about 36 percent of the land area on Earth.
4. Atlantic Polar front develops in Winter
5. Average Temperature of Venus is very much higher than that of earth.(T/F with brief reason)
6. Antarctica, first explored by R. Amundsen in 1922.

7. Angular momentum is the component of angular momentum vector that is perpendicular to the earth's polar axis.
8. Climate change and climate variability are same---- (false / true).
9. Climate change has been happening since past 200 years---- (false / true).
10. Climate change is always due to human activity---- (true / false).
11. Compared to dynamical models, statistical models are complex and expensive to run.(T/F with brief reason)
12. Coriolis effect is a consequence of the principle of conservation of angular momentum.
13. cP air does not exist over South America.
14. Dendroclimatology is the study of Deep ocean sediments.
15. Describe NAO phenomenon. How does this phenomenon affect the Indian monsoon?
16. During ElNino Trade winds strengthen. (Yes/No)
17. Dynamical crop simulation models, applicable universally were initiated to overcome statistical models.
18. East Antarctica is colder than West Antarctica.
19. Cutting of forest responsible for reduction of earth'stemperature
20. Methane is responsible for half of the total greenhouse effect.
21. Today current levels of carbon dioxidein the atmosphere are higher than at anytime during the last 6 50 000 years
22. Extratropical cyclones have less intensity than mid-latitude cyclones 3. Atlantic Polar front develops in Winter
23. Global warming has different feedback mechanisms.
24. In modeling climate, the vertical profile of the atmosphere is unevenly gridded.
25. In recent years, rise in annual minimum and maximum temperatures, is of the same order.
26. Indian Summer Monsoon Rainfall has shown a significant decreasing trend (true / false).
27. IOD is an index measured as a difference in Temperature. (Yes/No)
28. IPCC stands for Indian Policy on Climate Change

29. ISMR has not shown any significant trend---- (false / true).
30. Important factor that determines the climate of an area is the amount of energy it receives from the sun.
31. Long range predictability is better in tropics compared to extra tropics.
32. Long term ISMR data have not shown any significant trend---- (false /true).
33. Long term positive radiative forcing will enhance temperature of the earth. ---- (false / true).
34. Northern region of Africa experiences strong radiational cooling.
35. Northwest Pacific coast area over North America has more precipitation.
36. Over India, there is significant change in different category of rainfall events over smaller spatial scale.
37. Over Antarctica, average monthly temperatures are all well below 0˚C
38. Over Australia continent, extreme minimum temperatures are not as low as those recorded in other continents.
39. Proxy data means approximation of the available different instrumental data
40. Radiative forcing is the change in net irradiance
41. Rainfall during the monsoon season, over east central parts of India has decreased.
42. Rainfall samples over Indian region are showing more acidic characteristics.
43. Show that in hydrostatic equilibrium the potential energy and internal energy are proportional to each other.
44. Show that the total potential energy in the atmosphere is proportional to the square of the speed of sound.
45. Southern Oscillation Index is negative during La Nina.
46. Some part of African Continent is found in the sub-tropical zone.
47. The atmosphere must transfer energy from equator to pole to maintain pole equator temperature Gradient.
48. The atmospheric circulation over a region can be influenced by changes in the sea surface temperature over oceans far away from the region.
49. The ensemble prediction helps in representing uncertainties in the initial conditions.

50. The NAO is most noticeable during the summer with maximum amplitude and persistence near the pole.
51. The observed recent global warming was caused by natural external forcing such as solar radiation and volcanic eruption.(T/F with brief reason)
52. The regions receiving higher rainfall exhibit lesser variability and vice versa.
53. The spatial variability of summer monsoon rainfall on a smaller scale is higher than that on the regional scale.
54. The water cycle bigger than hydrologic cycle
55. The winter and spring snow cover over Eurasia is inversely correlated with the Indian summer monsoon rainfall.
56. There are three stages in life cycle of an extra tropical cyclone.
57. What is QBO is a local oscillation. (Yes/No)
58. Winter temperature in the Arctic are unusually high
59. Weak surface inversions are common features of the Antarctica atmosphere.
60. Afternoon/evening maximum of rainfall is observed over oceanic area.
61. Low frequency intra-seasonal oscillation is predominant in above-normal monsoon years.
62. The all India summer monsoon rainfall has been showing a decreasing trend from 1960 onwards.
63. In southern winter over Australia all parts of continent are dry except the southernmost parts.
64. Sahara Desert in North Africa is arid.

Q2 Answer the following

1. Describe the climatic features of any one of the following continents

   a)Africa b)North America c) Australia

2. What is ENSO? Describe in detail the Southern Oscillation and the global consequences.
3. What do you mean by the variability of monsoon? Discuss the inter annual variability of Indian Southwest monsoon detailing the decadal and long term trends.

4. In modeling climate, the vertical profile of the atmosphere is uniformly gridded.
5. Southern Oscillation Index is negative during La Nina.
6. Dendroclimatology is related to the study of Tree rings.
7. Proxydata means approximation of the available different types of data
8. Carbon dating is a radiometric dating.
9. Climates in entire African Continent in area north & south of the equator are similar.
10. What is QBO?
11. What is bioclimatology? Mention the areas where applied Climatology is used.
12. Vertical profile of temperature in the lowest layers of atmosphere.
13. What is the westerly burst? Describe its role in the formation of an El-Nino event.
14. Hence or otherwise briefly describe the delayed Oscillator theory of El Nino events.
15. Write water balance and net radiation equations. Write in detail about the role of temperature in crop growth and development.
16. Write short note on "Observed climate change scenario in India"
17. Briefly explain different monthly and seasonal forecasts for southwest monsoon rainfall presently issued by IMD.
18. Discuss statistical and dynamical approaches used for LRF by bringing out merits and demerits of each of these approaches.
19. Write briefly about the trend observed in the all India minimum temperature series (annual).
20. Give some probable reasons for the observed significant decreasing trend in monsoon rainfall over Chattisgarh.
21. What are significant findings of analysis of observations of BAPMoN stations?
22. Write briefly about trend in observed extreme meteorological events over India
23. Classify forecasts based on their period of validity. Specify areas of application of each of these forecasts.
24. Write down the names of the 8 parameters used in the new statistical ensemble forecasting system for season rainfall over the country as a whole introduced by IMD in 2007.

25. Classify forecasts based on their period of validity. Specify areas of application of each of these forecasts.

26. What is inter annual variation of Indian summer monsoon rainfall? How is it related to the crop production?

27. Discuss statistical and dynamical approaches used for LRF by bringing out merits and demerits of each of these approaches.

28. Discuss Crop Weather Calendar.

29. Describe different components of AAS bulletin. How is it disseminated?.

30. Discuss about the trend in the depression /Deep depression over Bay of Bengal during the monsoon season vis a vis sub divisional monsoon rainfall trend over India?

31. What is 'Walker Circulation'? How does it affect the ISMR?

32. Write about contribution of maximum and minimum temperatures, in the rise of mean annual mean temperature over the country as a whole (India) during the past hundred years.

33. Write briefly about status of discomfort over India during summer months.

34. Direct and indirect effects of weather on crops.

35. What are radiation use efficiency (RUE) and water use efficiency (WUE)?

36. What are the methods to evaluate crop weather relationship? What is the formula for simple linear regression?

37. What are the different types of methods using for Seasonal Forecast?.

38. Explain merits and demerits of the methods.

39. Explain briefly about IMD's operational ensemble forecast model.

40. How temperature influences crops? What is growing degree days?.

41. Write briefly on high temperature influence on crops?

42. What is break monsoon? Describe the variations in monsoon rainfall in association with break monsoon.

43. What is ElNino? Briefly describe the variability of southwest monsoon in association with ElNino.

44. What is 'Reverse Walker Circulation? How does it affect the ISMR? Describe its structure of the 'Walker circulation' in El-Nino /Normal years.

45. Describe role of the NAO in modulating ISMR.

46. Explain briefly about IMD's operational ensemble forecast model used for Indian Summer Monsoon Rainfall.

47. What are the different methods using for Seasonal (Long Range) Forecast? Explain merits and demerits of the methods.

48. What is LaNina? Briefly describe the variability of southwest monsoon in association with ElNino.

49. Write about current status of climate change over India.

50. Write an account of trends in monsoon rainfall over different regions of India

51. Discuss about the trend in the depression /Deep depression over Bay of Bengal during the monsoon season vis a vis sub divisional monsoon rainfall trend over India?

52. Write about direct and indirect effect of weather on crops.

53. Write about temperature threshold with examples

54. Write in detail about the effect of temperature on crops. Write also about high temperature effect on crops with examples.

55. Write in detail about role of IMD in agroclimatic classification.

56. Explain weather over Antarctica continent w.r.t. 1) solar radiation, 2) Temperature, 3) Surface inversion, 4) Wind and 5) Precipitation.

57. Explain briefly climate of Asia.

58. Explain solar cycle and Sun spots?

59. What is that common term which suggests the conversion of potential energy to kinetic energy and vice versa?

60. Write briefly about status of discomfort over India during summer months.

61. Write the simplified general balance equation for the total water substance in the atmosphere averaged over time.

62. Write a brief note on the isotopes that are used to reconstruct past climate.

63. Which proxies are used to reconstruct monsoon rainfall on millennium timescales?

64. Explain the Wind and Pressure Systems during winter and summer seasons over any one of the following region

    a. North America Continent b. Europe Continent
    c. Arctic and d. Antarctic Polar Region

65. How long does it take to complete an earth's elliptical cycle around the Sun?

a. 26,000 year b) 40,000 year c) 100,000 year d) 10,000 yeas

66. Which of the following processes can ultimately affect global climate?
    a. plate tectonics
    b. volcanic eruptions
    c. meteorite collisions
    d. precession
    e. all of the above

67. Name the various Milankovitch Cycles.

68. What are the typical values of NEE? (in unit of □mole CO2/m2/sec)

    a. +100 to -100
    b. +25 to -25
    c. +5 to -15
    d. 0 to -10

69. Which time of the day the (negative) CO2 flux is expected to be maximum?

    a. Early morning
    b. Morning
    c. Noon
    d. Evening

70. Which of the wind component is used to determine the CO2 fluxes?

    a. U wind
    b. V wind
    c. W wind
    d. All of the above

71. Which one of the environmental parameter shown below is the most important for photosynthesis?

    a. Rainfall
    b. Radiation
    c. Relative humidity
    d. Soil temperature

72. Which one of the following isotopic records in natural archives are used to estimate past temperature?

    a. 13C/12C
    b. 18O/16O
    c. 15N/14N
    d. 42Ca/40Ca

73. The isotopic fractionation takes place due to

    a. Physical processes
    b. Chemical processes
    c. Biological processes
    d. All of the above

74. Name 5 proxies for paleo-climate studies.

75. What is half-life of Radiocarbon (C-14)?

76. Define climate change

77. Define green house effect

78. Name green house gases

79. List any 3 causes for global warming

80. Describe IPCC

81. What are indictors of global warming ?

82. IPCC Reports

83. What are extratropical cyclones? In what way they differ from tropical cyclones ?

84. Describe NAO phenomenon. How does this phenomenon affect the Indian monsoon?

85. What is 'Walker Circulation'? Describe its relation with Equatorial Pacific Ocean SSTs.

86. What is Indian Ocean Di pole? Mention its role and SHET's role in affecting the monsoon.

87. What is that common term which suggests the conversion of potential energy to kinetic energy and vice versa?

88. What is climate change? Discuss various possible causes of climate change.

89. What is the westerly burst? Describe its role in inducing Kelvin and Rosby waves . Hence or otherwise briefly describe the delayed Oscillator theory of El Nino events.

90. What is an air mass? Give an account of different types of fronts.

91. Deterministic and Probabilistic Long Range Forecasts

92. Describe briefly any three modes of climate variability. How do these modulate monsoon rainfall over India?

93. What is the westerly wind phenomenon? Describe its role in inducing Kelvin and Rosby waves in the Pacific Ocean and subsequently reversing Walker Circulation.
94. Explain briefly the Climate of Antarctica Continent.
95. Briefly explain the Climate of Asia Continent.
96. The regions receiving higher rainfall exhibit lesser variability and vice versa.
97. Write a brief note on various proxy sources used to reconstruct the past climate.
98. Importance of Applied Climatology
99. Define climate change and Enlistany 6 Indicators of Climate change
100. Define Global warming andEnlist any 6 factors causing climate change
101. Enlist different theories used to study climatic fluctuations
102. Ensemble technique based new statistical forecasting system for the seasonal prediction of SW monsoon rainfall over the country as a whole.
103. What are El-Nino and La Nina events? How is an El Nino event defined?
104. Tornado activity is observed in the central plains of North America
105. Ice core study has enabled to re-construct global temperature through:
    a. The analysis of pCO2
    b. The analysis of water isotopes
    c. The analysis of methane
    d. The analysis of all the above parameters
106. If the local meteoric water line at a given place is having the same slope but higher intercept to that of the GMWL then it represents:
    a. Rainwater has undergone substantial evaporation
    b. Rainwater was produced mainly from the moisture derived from the ocean
    c. Significant amount of rainwater was produced from the moisture generated through local evaporation
    d. None of the above
107. When distilled water is prepared through evaporation and subsequent condensation then the distilled water produced would be isotopically:
    a. Heavier than the original water present in the evaporative pan
    b. Lighter than the original water present in the evaporative pan
    c. Same as that of the original water present in the evaporative pan
108. The isotopic values of surface water in Bay of Bengal is:
    a. Very similar to that of the surface water in the Arabian Sea

b. Less that of the surface water in the Arabian Sea
c. Greater than that of the surface of the Arabian Sea

109. The d-excess of rainwater is:
a. Directly proportional to SST and RH
b. Indirectly proportional to SST but directly proportional to RH
c. Directly proportional to SST but indirectly proportional to RH
d. Indirectly proportional to SST and RH

Q4. Write short notes

1. Indian Ocean Dipole
2. North Pacific Oscillation
3. Paleoclimatology
4. Influence of ground surface on microclimate
5. Why shape of the weighting function peak in the middle?
6. Beam filling problem in microwave.
7. Remote sensing of ocean parameters
8. What is climate change? Discuss various possible causes of climate change.
9. What is the westerly burst? Describe its role in inducing Kelvin and Rosby waves .Hence or otherwise briefly describe the delayed Oscillator theory of El Nino events.
10. Write in brief about Growing Degree Days. Enumerate role of temperature in crop production.
11. Write the energy equations for the rate of change of total potential energy, kinetic energy, latent energy and the total energy and illustrate with the help of diagram the meaning of various source, conversion and sink terms of energy cycle
12. Influence of ENSO on Indian Summer Monsoon Rainfall.
13. Crop Weather Calendar.
14. Agromet Advisory Service (AAS).
15. Properties of wind profile close to the surface.
16. Wind profile equation for short crop.
17. Roughness parameter and zero plane displacement with diagram.
18. Wind profile equation for tail crop.
19. Downscaling
20. Climate feedbacks.

21. Weather , climate and climate change.
22. Describe green house effect with suitable diagram.
23. Factors responsible for global warming.
24. Multi Model Ensemble Prediction
25. IMD's dynamical forecasting system for LRF.
26. What are major modes of climate variability?
27. Extra Tropical Cyclone (ETC)
28. The Hydrological Cycle
29. Define Airmass. Describe Atlantic Polar front & Mediterran Front
30. Crop weather calendar
31. Geographical distribution of Fronts and Frontal zones.
32. What is mean by Kelvin Waves and Rossby Waves?
33. Write a short note on El Niño.
34. Write a short note on MJO.

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PART B : HYDROMETOROLOGY

Q1 Fill the blanks

1. _____ in meteorology are waves in a stream of air when the wind moves over mountains.
2. A catchment area is separated from its neighbouring areas by a ridge called _____.
3. Snow cover is a …….. water reservoir. The snow keeps on accumulating during ……months when water demand is relatively less.
4. ---------- Techniques used by Flood Meteorological Offices (FMOs) of IMD for computing river sub-basin-wise AAP.
5. Sub-basin-wise QPF is issued by FMOs for the purpose of -------- Forecast. (Riverine Flood /Flash Flood/Urban Flood)

6. According to WMO (based on the data 1980-2007), Globally about 90% of economic losses is due to the --------Hazards (Hydro-meteorological/Earthquake/Epidemic, insects)
7. _____ model do not consider spatial variability within the catchment.
8. _____ is influenced by soil properties, land cover, hill slope, vegetation, and storm properties such as rainfall duration, amount, and intensity.
9. A snow crystal is a ..... made of ice, water, air and impurities.
10. .....is formed when snow is sufficient to persist till the next spell of snowfall.
11.
12. …….is the movement of liquid water from soil to aquifers, streams, rivers, oceans and……..from snowpack and icecaps to the atmosphere is the movement of water.
13. …….is the movement of water from a liquid to a vapor state……..is the phase change of water from a vapor state to a liquid state.
14. Albedo of a surface is defined as ratio of …… radiation by the surface to the …… radiation falling on the surface.
15. A day is called rainy day if the rainfall of that day equals or exceeds ____.
16. A hydrograph is a graph of the flow in a stream over a period of ____.
17. A hyetograph is a graph representing
18. Albedo of old snow cover is _____ (more/less) than the fresh snow
19. Albedo of Dry Snow is approximately: _____.
20. Albedo of snow is high on _____ (fresh/old snow cover)of snow is low for _____ (dry/wet) snow.
21. Condensation is _____ process (endothermic/exothermic).
22. Condensation requires relative humidity to be _____ than 100%
23. Contour of constant rainfall is called _____.
24. Density of snow is _____ (more/less) than water.
25. Drought is _____ (a part of natural climate variability/ impact of climate change).
26. Dry snow is _____ (more/less) denser than wet snow.
27. Evaporation requires relative humidity to be _____ than 100%

28. For getting intensity of rainfall it is preferable to have _____Instrument for measuring rainfall.
29. Geological unit which can store and supply significant quantities of water is called_____.
30. Geological unit which can store and supply significant quantities of water under the ground is called _____.
31. Hydrological floods response time is _____ (more/less) than the meteorological flood.
32. Heavy rain over long periods (days) in the upper catchment leading to rising water levels and flooding is called _____ flood.
33. In Depth Area Duration analysis rainfall depth is plotted against _____ for each ___.
34. In Depth Area Duration analysis rainfall depth is plotted against _____ for each _____.
35. Infiltration means transport of water from ____ to _____.
36. Infiltration rate will be equal to _____ when precipitation is less than infiltration capacity.
37. Initial losses of rainfall in rainfall runoff relation are due to _____ and _____.
38. Latent Heat of snow: _____.
39. Length of day is an important/not important constraint on transpiration.
40. Loss of water of the plants to the air is known as _____.
41. Maximum rainfall received over the Tamilnadu is during _____ season.
42. Meteorological flood is generally defined in _____ (larger/smaller) time scale than hydrological flood.
43. Orographic lift occurs when an air mass is forced from a low elevation to a _____.
44. Percolation means transport of water from ____ to _____.
45. QPE is the _____ (realized/expected) amount of liquid precipitation accumulated over a specified time period over a specified area.
46. QPF is issued by _____ .(FMOs/ MCs)
47. Rainfall hydrograph is defined as _____.
48. Rainfall hydrograph is the plot of ____ with time.
    (a) rainfall intensity over an area
    (b) rainfall intensity with duration
    (c) rainfall intensity with time

(d) rainfall volume with time

49. Rainfall is measured in unit _____.
50. Rainfall resolution of India came in year:_____
51. Runoff is that portion of precipitation that flows from a drainage area _____the land surface. (on/ below)
52. Snow cover area is expected to be maximum ---------- (during the winter season/ by end of winter season).
53. Snow Cover Properties may be classifiedon the basis of: a) _____ (b) _____ and (c) _____.
54. Snow pole is used for _____ of snow.
55. Snow surface temperature generally refers to the temperature of snow layer _____ below the top surface.
56. Snow surface temperature is measures at: _____.
57. Spatial resolution of CARTOSAT1 is: _____.
58. Spatial resolution of CARTOSAT2 is _____.
59. Specific heat of snow is fairly ____ (constant/variable) while thermal capacity of snow is _____(constant/variable).
60. Specific Heat of snow: _____.
61. The ____ of mean snow depth may be recorded as water equivalent of snowfall.
62. The accuracy of rainfall measured in a raingauge is correct up to __ decimal place.
63. The process in the atmosphere in which water changes from a liquid to a gas is known as ____.
64. The process in the atmosphere in which water changes from a solid to a gas is known as ____.
65. The process in the atmosphere in which water changes to gas in temperature below boiling point is known as ____.
66. The process of evaporation in the plant is known as _____.
67. The process which transport water from soil to aquifers is known as _____.
68. The process in which water vapor eventually forms water droplet is called _____.
69. The relation between return period and probability of a extreme event is _____.

70. The return period of an event can be obtained if the probability of occurrence of the event is known _____ (Yes/No).
71. Thermal Capacity of snow: _____.
72. Time response of Hydrological drought is _____ (More/less) than meteorological drought.
73. To see the trough/Cyclonic circulation associated with Western Disturbances, Relative vorticity at 500 hPa should be positive or negative……..
74. Urban areas requires _____ (less/more) density of raingauge network than coastal areas.
75. Which would be more likely to activate as an ice nuclei _____ [Silver Iodide (AgI) OR Clay Particle]

Q2 State whether True or False with reason

1. Albedo of snow is highly variable.
2. All the meteorological sub-divisions of India received maximum rain during southwest monsoon season.
3. Any one of PMF, SPF or return period can be used for Inflow Design Flood (IDF) or Design storm for the safety of any size of dam.
4. Area is not important to compute the average Met Sub Division rainfall.
5. Arithmetic mean method is better than the area weighted methods of getting areal rainfall.
6. Arithmetic mean method is the best method for getting areal rainfall.
7. Both Specific Heat and thermal capacity of snow are always constant.
8. Complete duration series is a subset of partial duration series.
9. During southwest monsoon season all the parts of the country receives 70-80% of annual rainfall.
10. Drought is a part of natural climate variability.
11. Evaporation is an exothermic process.
12. Calculation of District rainfall statistics is area weighted average of rainfall.
13. Remote sensing satellite can give a precise picture of snow cover over river basin.
14. Snow on southern slopes melts more rapidly than that on northern slopes.
15. Flood occurs in India during monsoon season.

16. For snow cover estimation geostationary satellite is more useful than remote sensing satellite.
17. For the uniformly spaced raingauge over a basin arithmetic mean and area weighted methods of getting areal rainfall give almost same result
18. In hydrological cycle components are not interconnected.
19. In Southern Hemisphere snow on southern slopes melts more rapidly than that on northern slopes.
20. In isohyetal analysis the contour intervals are necessary to be equal.
21. In hydrological cycle wind helps in spatial distribution of rainfall.
22. In Northern Hemisphere snow on southern slopes melts more rapidly than that on northern slops.
23. State Degree-Day Method for snow melt and give reasons for the assumptions of the method.
24. Infiltration capacity of a particular soil is constant and is independent of time.
25. Time duration of Meteorological draught is more than the Hydrological Drought.
26. Runoff is generated by the process of infiltration excess only.
27. Snow cover area is expected to be maximum by end of August / September and minimum by end of February.
28. Infiltration process is only responsible for reducing the water volume from the total precipitation available for runoff.
29. It is not necessary to report zero rainfall in the data tabulation sheet when there is no rainfall.
30. Meteorological flood is defined on seasonal scale where as hydrological flood is weekly or further smaller scale.
31. Most violent turbulence occurs in two regions to the lee of mountains, (a) Near the ground and (b) Near the tropopause.
32. Monthly rainfall of a station is the average of rainfall all the days of that month.
33. Monthly rainfall of a station is the average of the rainfall occurred over the station of all the daily rainfall of that month.
34. Normal ratio method and arithmetic mean method will give different values for estimating rainfall at missing point.
35. Non-uniformity of the distribution of precipitation gauge data can produce biases in areal estimates of precipitation.
36. Present flood forecasting models are lumped type.

37. Quantitative Precipitation Forecast (QPF) is the expected amount of rainfall accumulated over a specified area.
38. Rainfall hyetograph can be obtained from rainfall mass curve and vice versa.
39. Response time of hydrological drought is less than agricultural drought.
40. Return period of extreme rainfall events can be obtained from annual extreme rainfall series.
41. Return period of extreme rainfall events can be obtained from past data.
42. Snow melts slowly on higher elevation and more rapidly on lower elevation.
43. The 1/10th of mean snow depth may be recorded as water equivalent of snowfall.
44. There is no difference between QPE and QPF.
45. Total immunity from flood is feasible.
46. Unit hydrograph is same for every river basin.
47. Snow to water ratio is always 10:1 : True/False
48. Define hydrological cycle. Describe the three physical processes involved in the hydrological cycle.
49. Water vapour in the atmosphere accumulated only from liquid water form of the earth surfaces.
50. Define meteorological and hydrological flood. Describe different causes of flood.

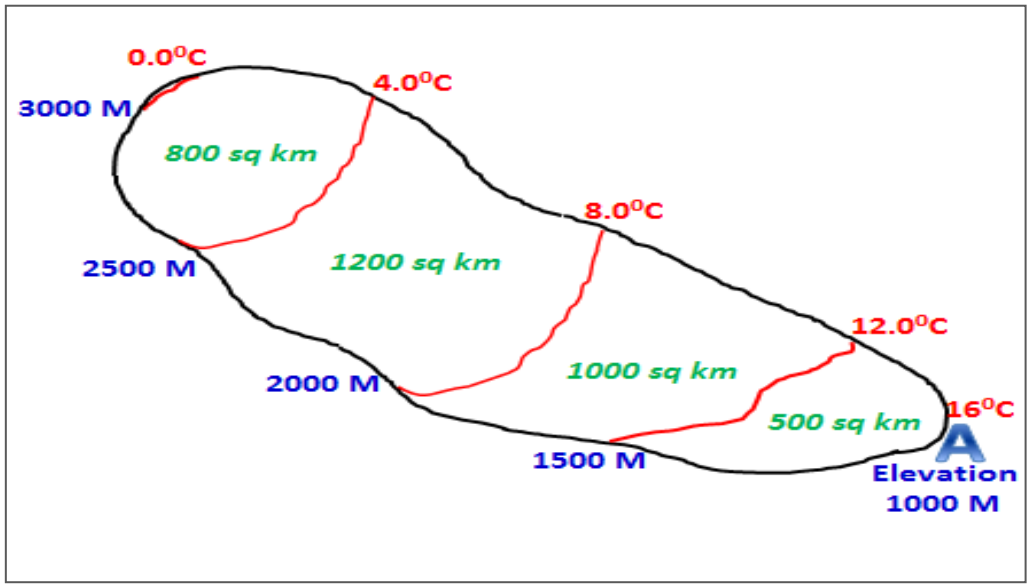
Q2 Answer the Following

1. Albedo of Dry Snow is approximately
2. Arithmetic Mean of all station rainfall data available in the state.
3. Average movement of Western Disturbances and induces systems are …….per day.
4. Both the above method will lead to same results.
5. Define albedo of a surface. Discuss how albedo varies with types of snow.
6. Define areal rainfall. Describe Thiessen polygon method for getting areal rainfall over a drainage basin.
7. Define Drought. Describe different types of drought based on the impact along with their time response.
8. Define Quantitative Precipitation Forecast (QPF).
9. What is GLOF?
10. Give an example for Man Made Flood.

11.
12. Define drought. State and explain different types of droughts.
13. Define Lee Waves & Rotors, in which regions of the mountains, most violent turbulence occurs explain with cause
14. Define orographic lift and its effects?
15. Define point rainfall. Describe the normal ratio method to find the value of rainfall at missing point.
16. Define rotor, in which region of the mountain produce most violent turbulence associated with rotor?
17. Define snow cover. Discuss the two types of snow cover contributing to water resource by way of melting.
18. Mention few basic types/shapes of ice crystal. State the factors on which the shape of the ice crystals depend on.
19. Define Statistical Series. State and define three types of statistical series used in rainfall analysis.
20. Define Western Disturbance and induced lows, what is general movement of these systems in a day ?
21. Describe briefly about the measurements of precipitation. Also mention different types of precipitation measurements and their uses for different application.
22. Differentiate between point rainfall and areal rainfall. Explain Thiessen polygon method of getting areal rainfall from point rainfall. .
23. Discuss the three methods for computation of point rainfall at a missing point.
24. District Area weighted average rainfall.
25. For calculation of average rainfall for a state which method is more appropriate:
26. For estimation of snow cover Polar Orbiting Satellites are always preferred over Geostationary Satellites: True/False
27. Latent Heat of snow
28. Precipitation station X was inoperative for part of a month during which a storm occurred. The respective storm totals at three surrounding stations A, B and C were 98, 80 and 110 mm. The normal annual precipitation amounts at station X, A, B and C are, respectively, 800, 1008, 842 and 1080 mm. Estimate the storm precipitation for station X.
29. Rainfall resolution of India came in year
30. Snow surface temperature is measures at

31. Snow to water ratio is always 10:1 : True/False
32. Spatial resolution of CARTOSAT2 is
33. Specific Heat of snow
34. State three elements based on which snow cover properties can be classified. Mention about the simple free hand experiment by which free water content of snow can be used to classify different types of snow.
35. The computation of an isohyet map of a 2000 ha basin following a 6 hr storm gave the following data. Determine the average precipitation for the basin.
36. Thermal Capacity of snow
37. Write a short note on Statistical series of data.
38. Write short note on Standard Project Storm (SPS) and Probable Maximum Precipitation (PMP)
39. Methods of calculation of areal rainfall
40. To see the trough/Cyclonic circulation associated with Western Disturbances, Relative vorticity at 500 hPa should be positive or negative……..
41. What are the methods for getting areal rainfall from point rainfall? Explain any two of them.
42. What are the physical processes of hydrological cycle? Explain briefly each of it.
43. What is orographic lift?
44. Define hydrological cycle. State different liquid-transport and vapour transport Phases of the hydrologic cycle.
45. Define hydrological flood. What is main case of flood? Discuss in brief about the main Components responsible for the flood.
46. What is point rainfall? Explain different methods for estimation of missing point rainfall data.
47. Which one would be more likely to activate as an ice nuclei; Silver Iodide (AgI) or Clay particle.
48. Write down the equation for estimation of 'Snow melt' based on 'Energy Balance Approach'.
49. For calculation of average rainfall for a state which method is more appropriate:
    a) Arithmetic Mean of all station rainfall data available in the state.
    b) District Area weighted average rainfall.
    c) Both the above method will lead to same results.

65. Write down the equation for estimation of 'Snow melt' based on 'Linear Degree-Day' Approach.
66. Write the equation of Hydrologic Budget and describe each of its term.
67. What is Permanent snow cover?
68. State any two reasons for the formation of various shape of the ice crystals.
69. State whether the Albedo of snow is highly variable or constant.
70. Hydrological cycle
71. Quantitative Precipitation forecast (QPF)
72. Classification of snow cover with the properties of hardness.
73. Estimate the snowmelt volume at a base station A shown in the following diagram by linear Degree-Day method from a glacier of 3500 sq km, assuming that: The mean density of glacier snow is 0.5 gm/cm3 Degree-Day factor is 1.1 Mean Temp. at base station is 16^0C and Average lapse rate is 8^0C per km.



Elevation (m)	Area Sq. (km)	Mean Temp. (0^0C)	Snow Melt (cm)	Snow Melt Volume
1000-1500	500			
1500-2000	1000			
2000-2500	1200			
2500-3000	800			
			Total Flow Volume	

INDIA METEOROLOGICAL DEPARTMENT

FORECASTER TRAINING COURSE (FTC)

FINAL EXAMINATION

PAPER –IV : CLIMATE SCIENCE, HYDROMETEOROLOGY AND ADVANCED STATISTICS

PART C : ADVANCED STATISTICS

Q1 Fill the blanks

1. In a multiple regression model predictors must be _____.
2. For a perfect forecast POD should be _____ , FAR should be _____ and MR should be _____.
3. PCA is used for _____.
4. Variance explained by a principal component is given by_____.
5. Variance explained by a principal component is given by_____.
6. If population is normally distributed then sample mean also _____.
7. In linear trend analysis, r2 represents _____.
8. To find out periodicity in a time series _____ is applied.
9. Significance of correlation coefficient is tested using _____.
10. Value of correlation co-efficient lies between _____
11. Regression Coefficient = _____.
12. In statistics a large sample means greater than --------- (30, 50, 100)
13. Regression coefficient indicates the degree of change in the ---------- (dependent/independent) variable with regards to a change in the ---------- (dependent/independent) variable)
14. The correlation coefficient between two variables is 0.9, hence the variation explained is -------- (10%, 81%, 90%)
15. To test the significance difference between two sample means of small sizes we use the --------- test (t-test, Z-test, chi-square test, F-test)
16. Verification of forecasts under the categories of below-normal / normal / above normal could be best done by ---------- test (t-test, Z-test, chi-square test, F-test)
17. In statistics a large sample means greater than _____.
18. To compare 3 or more means _____ technique is used.

19. To test significance of correlation coefficient _____ is used.
20. Variance of sample Mean_____.
21. Harmonic analysis is used to identify _____ in a time series
22. When an increase in one variable leads to decrease in the other the correlation is called as_____.
23. In multivariate regression analysis predictors should be _____.
24. 1st principle component explains _____.
25. If S.D. = 2.0, A. M. =5.0, then its Coefficient of variability is _____.
26. The normal distribution is based on two parameters viz. _ _____& _____.
27. Goodness of fit of a regression equation is measured by_____.
28. Any amount of departure from the normal can be termed abnormal ____(T/F)
29. Correlation coefficient is measure of linear association ship _____ (T/F)
30. For a regression equation y = a+bx; "a" denotes the intercept on --------- (X-axis,
31. For comparison of means of 3 or more normal population _____ is used.
32. In statistics a large sample means, 'N' more than or equal to (≥) _____ .
33. If sample size is sufficient, inference drawn from the sample could be applied to the population _____(T/F)
34. The correlation coefficient between two variables is 0.9, hence the variation explained is _____
35. Normal distribution is a--- distribution
36. The correlation coefficient between two variables is 0.9, hence the variation explained is ---
37. ii) In the regression equation Y= a + bX, b is called as _____ (X axis, Y-axis, Z-axis), and "b" determines the ---------- (slope, intercept, magnification).
38. 5% level of significance means _____
39. 95% level of confidence means _____ % level of significance.
40. 95% level of confidence means _____ % level of significance.
41. In _____ sampling each individual of the population has the same chance of being included in the sample.
42. In a multiple regression model predictors must be _____.
43. In statistics a large sample means greater than --------- (30, 50, 100)
44. In statistics a large sample means, 'N' more than or equal to (≥) _____ .
45. In statistics a small sample means, 'N' less than _____
46. Value of correlation coefficient is lies between --- & ---

47. Negative Correlation is also called as _____
48. When an increase in one variable leads to decrease in the other the correlation is
49. The Coefficient of Correlation is the _____ of two regression coefficient.
50. Normal distribution is based on two parameters viz. -----& ----.
51. Regression coefficient indicates the degree of change in the ----variable with regards to a change in the ---- variable.
52. Regression coefficient indicates the degree of change in the ---------- (dependent/independent) variable with regards to a change in the ---------- (dependent/independent) variable)
53. Sometimes numerical value of correlation coefficient is more than 1 _____(T/F)
54. Standard deviation gives natural variability of the data set____(T/F)
55. The correlation coefficient between two variables is - 0.7, hence the variation explained is -------- (70%, 49%, - 30%, -49%).
56. The correlation coefficient between two variables is 0.9, hence the variation explained is -------- (10%, 81%, 90%)
57. The plot of auto correlation coefficient against lag is called ---.
58. To test the significance difference between two sample means of small sizes we use the --------- test (t-test, Z-test, chi-square test, F-test)
59. To test the significant difference between two sample mean of small sizes we use the ----- test.
60. Auto correlation coefficient of lag 0 is ---
61. Mean ± 3 S.D. covers _____ % of the items
62. Verification of forecasts under the categories of below-normal / normal / above normal could be best done by ---------- test (t-test, Z-test, chi-square test, F-test)
63. If S.D. = 2.0, A. M. =5.0, then its Coefficient of variability is _____.
64. If S.D. = 2.0, A. M. =5.0, then its Coefficient of variability is _____.
65. Positive correlation is also called as _____
66. Dew point temperature and Minimum temperature of a station is an example of
67. The regression line is also called as _____
68. The coefficient of correlation will have the same sign as that of _____
69. viii) The normal distribution is based on two parameters viz. _____ & _____

Q2. State true or false

1. It is possible that one of the regression coefficients is negative and another positive.

2. Height and temperature in the troposphere is an example of positive correlation. .
3. In the regression equation Y= a + bX, parameter ‘b’ denotes the intercept on Y axis.
4. The value of the coefficient of correlation (r) cannot greater than one.
5. Acceptance of null hypothesis, when it is false, leads to committing type II error.
6. Level of significance represents the power of a test.

Q2. Answer in brief

1. What is the difference between Empirical Orthogonal Functions and Principal Components?
2. What is the difference between Power Spectrum Analysis and Harmonic Analysis?
3. What is the difference between a low-pass filter and a band-pass filter?
4. What is the difference between Correlation and Regression Analysis?
5. What do you understand by ANOVA?
6. What is the main purpose of sampling?
7. What is the difference between “Parameter” and “Statistic” ?
8. What is the difference between correlation and regression?
9. How do you define a large sample in Statistics?
10. In a cloud seeding experiment under Plan A the mean rainfall was 12 mm based on 10 observations. Under Plan B the mean rainfall was 15 mm based on 12 observations. The standard error for these experiments was found to be approximately 2.0. Estimate the number of degrees of freedom for these two sets of experiments. Check whether the mean rainfall under the two Plans are significantly different (t=2.09 at 5% significance level).
11. Define a time series. Mention some of the important components of a time series. Discuss how periodicities in a time series is found.
12. Discuss the importance of Principal Component Analysis (PCA) in meteorology. Discuss the different steps, followed while performing PCA.
13. What is the main purpose of sampling?
14. What is the difference between Parameter and Statistic?
15. What is the difference between simple correlation analysis and multiple correlation analysis?
16. What is the difference between Null Hypothesis and Alternate Hypothesis?
17. In statistics what is considered as a large sample?

18. Compute chi-square for the following table:

	Condition of Home		
Condition of Child	Clean	Dirty	Total
Clean	5	15	20
Fairly Clean	20	20	40
Dirty	15	25	40
Total	40	60	100

From the computed chi-square value can we infer that Clean Home means a Clean Child? (Significant chi-square value is approximately 6.0 at 5% significance level for 2 degrees of freedom).

19. Assume that for a station the probability of rainy and non-rainy day is equal. State the Null Hypothesis. From records it is found that 5195 days were rainy days out of a total of 10000 days data for this station. Will you accept or reject the Null Hypothesis. (Critical Z-value at 99% confidence level is 2.58)
20. The following data gives the number of aircraft accidents that occurred during the various days of the week.

Day	Sun	Mon	Tue	Wed	Thu	Fri	Sat
No. of accidents	14	16	08	12	11	09	14

Using chi-square test find whether the accidents are uniformly distributed over the week. (Significant chi-square value=12.59 for 6 degrees of freedom)

21. What is ANOVA?
22. What is the relation between the two regression coefficients b_{YX} and b_{XY}?
23. What do we understand by Empirical Orthogonal Functions and Principal Components in Meteorology?
24. What is the difference between Spectrum Analysis and Wavelet Analysis?

25. For the following data (1x5= 5 marks)

X	14	19	24	21	26	22	15	20	19
Y	31	36	48	37	50	45	33	41	39

Compute the two regression coefficients, Compute the correlation coefficient using result from (i) For a value of Y to be 30, what should be the value of X? (Use of Calculator allowed)

26. Explain student't' test for correlation coefficient. A random sample of 27 pairs of observations have a correlation coefficient, r = 0.6. Is it significant at 5% level? (Given: for 25 degrees of freedom t value of 5 % level = 2.06)
27. What is the difference between correlation and regression analysis. Write down the relation between regression coefficient and correlation coefficient and give its proof.
28. Discuss in brief about simple multiple regression analysis.
29. (a)What is mean by ANOVA (b) write down the difference between PCA & EOF
30. Discuss in brief about simple linear regression analysis.
31. Define a null hypothesis. Discuss in brief how a null hypothesis is tested against an alternative hypothesis.
32. If sample values lie in the critical region then the null hypothesis should be accepted.
33. For a simple linear regression equation y=a+bx, what do a and b represent?
34. For a multiple linear regression equation, the predictors should be dependent or independent of each other?
35. If two variables have a correlation coefficient of -0.7, what is the variance explained?
36. What is the relation between total variance and standard deviation?
37. For a simple linear regression equation how to estimate the correlation coefficient from the two regression coefficients bxy and byx?
38. What do you understand by Variation explained?
39. . What are the measures of goodness of fit for a regression equation?
40. What is the difference between Correlation Analysis and Regression Analysis?
41. Regression Analysis
42. Sampling, Random sampling and sampling distribution.
43. What is the relation between total variance and standard deviation?
44. What do you understand by Variation explained?
45. What are the measures of goodness of fit for a regression equation?
46. What is the difference between Correlation Analysis and Regression Analysis?
47. Significance of trend is tested using Chi-square test.

Q3 Write short notes

1. Trend analysis.
2. ANOVA.
3. What is the difference between t-test and chi-square test?
4. What is the difference Spectrum Analysis and Harmonic Analysis?
5. Explain in brief Cluster Analysis.
6. Explain simple steps for Harmonic analysis.
7. Explain in brief Factor Analysis.
8. Empirical Orthogonal Function
   Normal distribution
9. Low pass filter
10. Periodicity analysis
11. Auto correlation function
12. Periodicity analysis
13. Principal component analysis
14. Harmonic Analysis
15. ANOVA & MANOVA or FACTOR analysis & procedure to construct FACTOR analysis
16. Karl Pearson's Coefficient of Correlation.
17. Regression Lines.
18. Tests of significance (Student 't' test) for correlation coefficient.
19. Regression Analysis
20. Sampling, Random sampling and sampling distribution.
21. Explain Null and Alternate Hypothesis.
22. The correlation coefficient between two times series is -0.7 . What is the variation explained (VE)? If the correlation is +0.7 what is the VE?
23. In the simple linear regression equation y=a+bx, explain the terms "a" and "b"
