Maharashtra Agricultural Universities Examination Board, Pune.

Semester End Examination

B.Sc. (Hons) Agriculture

Semester: Ist New
Course No: Agro-112
Credit :2 (1+1)
Time : 2 hrs

Academic year : 2017-18
Title :Introductory Agro-meteorology and Climate change
Date:
Total marks :40

Note: 1. Solve any **Eight** Questions from **Section 'A'**
2. All Questions from **Section 'B'** are compulsory.
3. All Questions carry equal marks.
4. Draw neat diagrams wherever necessary.

Agro-112 model que. paper

Answer Sheet

Section "A"

1-1 Q.1. **Define weather forecasting. Give the classification of weather forecasting and purpose of short range forecast**

Means any advance information about the probable weather in future, which is obtained by evaluating th present and past meteorological conditions of the atmosphere is called weather forecast.

Classification weather forecasting:

Weather forecasting on the basis of their validity periods or time scale is classified as follows :

1. Now casting:

It is based on synoptic situation prevailing at the time of forecasting and is valid up to 3 days on 72 hrs and is issued twice a day.

2. Short range forecast (SRF):

It is based on synoptic situation prevailing at the time of forecasting and is valid up to 3 days or 72 h and are issued twice a day.

3. Medium range forecast (MRF):

Forecasting of meteorological elements over different agro climatic zones for periods ranging from3-10 days is known as medium range forecast.

4. Long range forecast (LRF):

The forecast valid for more than 10 days (i.e. a month or a season is knows as long range forecast.

Use of short range forecast

Short range Upto 72 hours
a Now casting 0-2 hours
b Very short range0-12 hours
Useful for Farmers, marine agencies, General public etc.
Rainfall distribution, heavy rainfall, heat and cold wave conditions, thunder storms etc.

2 Q.2. **Dew point:** It is defined as the temperature to which a given parcel of air must be coole constant pressure and constant water vapour content in order to become saturation

Conditions for condensation: The following three conditions must be fulfilled for the condensation occurrence of in the atmosphere.

a) Presence of sufficient water vapour

- An adequate amount of water vapour is necessary to bring about saturation of air.
- Dew point shall be reached through this water vapour to begin condensation.

b) Presence of condensation nuclei

- Sodium chloride injected into the atmosphere by sea-spray; Sulphur dioxide, nitrous oxide etc., released from industries as combustion products; dust present in the atmosphere act as nuclei of condensation.
- Water vapour can only deposit and condense on them as these are hygroscopic in nature (affinity to water).
- As these particles are microscopic or sub-microscopic in size (0.1 to 1 micron) these are called either hygroscopic nuclei or condensation nuclei.
- In the absence of hygroscopic nuclei condensation can not trigger even if air is supersaturated and its temperature being below freezing level.

c) Cooling of air : Cooling of air upto and below dew point is necessary for saturation of atmospheric air with water vapour.

Q.3. **Types of wind :**

1 Geostrophic wind :

2 Gradient wind :

3 Thermal wind

Differences between cyclones and anticyclones

S. No.	Cyciones	Anticyciones
1	Lowest pressure at the centre and it increases towards the outer rim gradually	Highest pressure at the centre and it decreases towards the outer rim gradually
2	Relative humidity increases towards centre and bring cloudy weather.	Relative humidity decreases and clouds are dissipated giving fair weather.
3	Variety of clouds lies at different heights	Little clouds with cool dry air are usually associated.
4	Highest rainfall occurs at the front side	Rainfall is almost negligible
5	Wind velocity increases from outer rim to the centre.	Wind velocities ask much lesser than cyclones (Wind spirally rushes outward from the centre to periphere).
6	Move in anticlock wise in northern hemisphere and clock wise in southern hemisphere	Move in clock wise in northern hemisphere and anti clock wise in southern hemisphere.

Q4. **Define lapse rate and diurnal temperature variation or daily temperature cycle**

The rate of decrease of atmospheric temperature with increase in altitude.

The Diurnal Temperature Variation give rise to daily maximum and Minimum temperatures.

From the sun-rise, sun energy continuously supplied and the Temperature continuously rises, recording maximum at about 2.00 to 4.00.P. m. though the maximum amount of solar radiation is received at the solar None (i.e. 12.00 hrs). This delay in occurrence of maximum temperature is Caused by gradual heating of the air by convective heat transfer from the Ground which is known as thermal lag or thermal

inertia.
Similarly minimum air temperature occurs shortly after sunrise due to lag in transfer of heat form the surface to the air / space.

Q.5. **Describe in short about radiation budget of the earth atmospheric system .**

Radiation Balance Or Net Radiation

The net radiation is the difference between the total downward and upward radiation fluxes and is a measure of the energy available at the ground surface. The balance of energy after gain and loss of both short wave and long wave radiation fluxes is known as net radiation.

Net radiation represents the amount of energy, which is used for various kinds of activities. It is dispensed as sensible heat, latent heat and also in physiological processes such as photosynthesis and respiration.

The importance of this parameter is that it is the fundamental quantity of energy available at the earth's surface to drive he processes of evaporation, air and soil heat fluxes as well as other smaller energy consuming processes like photosynthesis etc.

If we consider the extra terrestrial radiation reaching annually (338wm-2) as 100%; Then out of this-

The net radiation reaching (SW) =100-28-25)-47% the earth surface. =114%

Long wave radiation reaching at earth surface =+96%

Therefore, Net long wave radiation =-114+96 = -18%

Net all wave radiation at earth surface =+47-18 = 29%

This surplus energy is used at the earth surface for

a) Sensible heat (QH) =4%

b) Latent heat (Eva)(QE)=25%

29%

Q.6. **Write in brief about physical structure of atmosphere with height**

Physical Structure Of Atmosphere

(Stratification of atmosphere or layering of atmosphere)

On the basis of the vertical temperature difference, the atmosphere can be divided into four horizontal layers or shells, namely.

A) Lower Atmosphere: 1. Troposphere and 2. Stratosphere

B) Upper Atmosphere: 1. Mesosphere and 2. Thermosphere.

A) Lower Atmosphere:

1.Troposphere:

The altitude of the troposphere changes according to latitude. It has an elevation of about 16 km at the equator and only 8 km at the poles. Its average altitude is about 11 km. It contains near about 75% of the gaseous mass of the total atmosphere, water vapour and aerosols. It is the realm of clouds, storm and convective motion, The outstanding characteristic of the troposphere is the filmy uniform degree in temperature with increase in altitude until minimum temperature of -50% 0C-------600C is reached. The isothermal layer marking the end of temperature decrease is called tropopause and it separates troposphere and stratosphere. Through out the troposphere there is a general decrease of temperature with increase in height at a minimum rate of about 6.50C/km or 3.60F/1000 ft.0C

2.Stratosphere:

This is the second atmospheric layer above trop pause which extends upwards about 50 km. The stratosphere contains much of the total atmospheric ozone. The density of ozone is maximum at 22 to 24\5 km height approximately. The ozone at the upper layer of this sphere absorbs the ultraviolet rays from the Sun and temperature may exceed 00C. In stratosphere the temperature increases with increase in height.

B) Upper Atmosphere:

1.Mesosphere:

This is the third layer of atmosphere. A thin isothermal layer called a stratopause is the boundary layer which separates stratosphere and mesosphere. Above the warm stratopause, temperature decreases with increase in height to a minimum of about-900C at about 80 km height Pressure in this layer is very low and decreases from 1 Mb at about 50 km to about 0.01 mb at 80 km nearly. The thin isothermal layer, which separates mesosphere from thermosphere, is called mesopause.

2.Thermosphere:

Outermost shell is known as thermosphere. It lies above 80 km height. In this sphere the atmospheric densities are extremely low. In this sphere temperature increases with increase in height due to absorption of ultraviolet radiation from the Sun. probably it reaches to 9500C at 350 km to 17000 C at an underfined upper limit but these temperatures are essentially theoretical. Such temperatures are not felt by the hands exposed by astronaut or the artificial satellite because of rarefied air.

Q.7. Causes of climate change:

Humans are increasingly influencing the climate and the earth's temperature by burning fossil fuels, cutting down rainforests and farming livestock.

This adds enormous amounts of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warming.

Greenhouse gases

Some gases in the Earth's atmosphere act a bit like the glass in a greenhouse, trapping the sun's heat and stopping it from leaking back into space.

Many of these gases occur naturally, but human activity is increasing the concentrations of some of them in the atmosphere, in particular:

- carbon dioxide (CO_2)
- methane
- nitrous oxide
- fluorinated gases

CO_2 is the greenhouse gas most commonly produced by human activities and is responsible for 64% of man-made global warming. Its concentration in the atmosphere is currently 40% higher than it was when industrialisation began.

Other greenhouse gases are emitted in smaller quantities, but they trap heat far more effectively than CO_2, and in some cases are thousands of times stronger. Methane is responsible for 17% of man-made global warming, nitrous oxide for 6%.

Causes for rising emissions

- Burning coal, oil and gas produces carbon dioxide and nitrous oxide.
- Cutting down forests (deforestation). Trees help to regulate the climate by

absorbing CO2 from the atmosphere. So when they are cut down, that beneficial effect is lost and the carbon stored in the trees is released into the atmosphere,adding to the greenhouse effect.

- Increasing livestock farming. Cows and sheep produce large amounts of methane when they digest their food.
- Fertilizers containing nitrogen produce nitrous oxide emissions.
- Fluorinated gases produce a very strong warming effect, up to 23 000 times greater than CO2. Thankfully these are released in smaller quantities and are being phased down by EU regulation.

Q.8. Described in brief agriculture and weather relationship.

What is the relation between agriculture and weather?

For any ecosystem , the interrelation between Biotic factors (living things like plants, micro organisms, animals,etc.,) and Abiotic factors (Temperature, sunlight, rainfall, wind) is necessary Similar is the case for Agriculture. The interrelationship between Agriculture and abiotic factors are unavoidable. It may lead to both positive and negative impact in crop production.

Weather means the state of the atmosphere at a particular place and time as regards heat, cloudiness, dryness, sunshine, wind, rain, etc.

The cropping pattern, selection of crops, cultural operations, application of farm inputs, harvesting and even storage / transport is decided by the prevailing weather conditions.

- Farmers will start plough their fields only after soil has enough moisture.
- Operations like application of pesticides, herbicides are withheld if it seems raining. Because it will be washed away or diluted.
- You can see farmers harvesting at early morning. To avoid moisture loss in produce due to bright sunshine.

These are some of basic examples that establishes relationship between weather and Agriculture.

If we go in depth,

- Sunshine, wind movement, temperature has direct relation with photosynthesis , transpiration and respiration activity.
- Even Flowering is influenced by duration of sunlight and darkness. This is called as photoperiodism.
- Some plants needs precipitation for fruit set and for Flowering. In South India, pre monsoon showers aid early ripening of mangoes. And its even called as Mango showers.

There are many more relations like these. Weather is an important factor that influences crop production.

Agriculture and Irrigation is very important. The relationship is need of water and how we preserve it for a year for agriculture and drinking through monsoon rains every year. Of course Climate/Weather plays important role. But India is a Temperate nation (Zone) where crops can be grown even in summer with water we preserve underground. So Ponds, Lakes, Dams, Tanks, Canals, Rivers play important role for agriculture, irrigation, drinking water in Tamil Nadu and rest of the States in India during drought too. And the very important thing we should care about is to stop polluting these water bodies especially pollution through industrial waste and plastic dump.

Agrometeorology or Agricultural meteorology studies meteorological and hydrological factors in relation to agriculture. Agrometeorology studies the behaviour of the weather elements that have direct relevance to agriculture and their effect on crop production.

Q.9. **Classify the cloud. Write in brief about the nimbus cloud**

Types of clouds: There are four basic types of clouds:

1. Cirrus (CI):

Meaning "cur" and is recognized by its veil, like fibrous or featery form. It is the highest type of cloud, ranging from approximately 7-12 km in altitude. (20,000 to 35,000 feet).

2. Cumulus (Cu):

Meaning "heap", is the wooly, bundly cloud with rounded top and flat base. It is the most common in the summer season and in latitudes where high temperature prevail and it always results from convection Its height is variable and depends on relative humidity of the air.

3. Stratus (St):

It is a sheet type cloud without any form to distinguish it. It is usually lower than cumulus.

4. Nimbus (Nb):

It is any dark and ragged cloud and from which precipitation occurs.

Composition: Ice in upper level and water in lower level

Possible weather change: Violet winds rain, all possible thunderstorm hail lighting possible.

Description and appearance: Thunder head, towering anvil top, violet up and down drafts, aviators avoid them, develop from cumulus chief precipitation makers.

Q.10. **Short note (Any two)**

1 Orographic rains

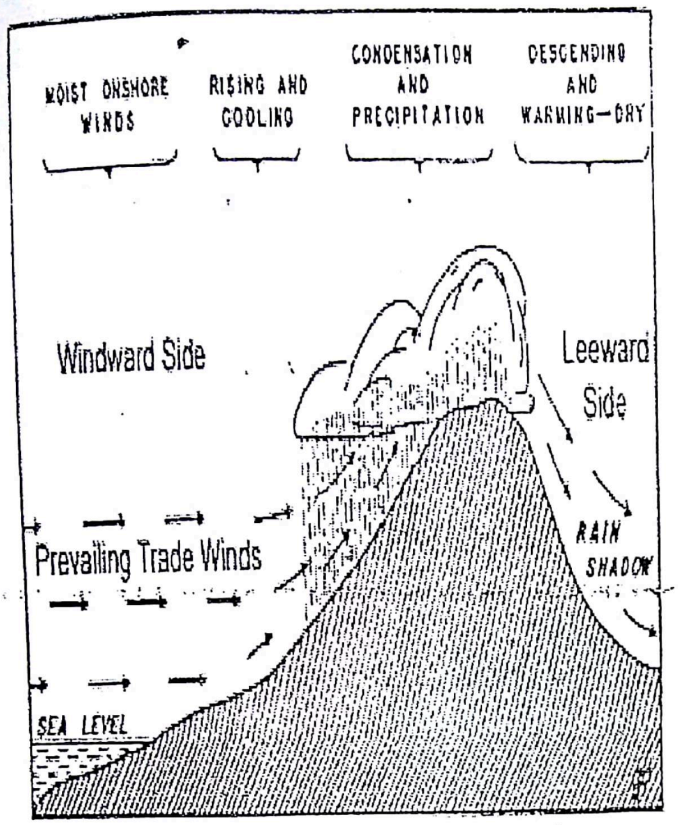
1 When moist air coming from the sea or ocean strikes mountain it can not move horizontaliy. It has to over come the mountations.

2 When this air rises upward, cools down, cloud is formed and condensation starts giving precipitation.

3 These rains are known as orographic rains.

4 These are also known as "relief rains" as the rains also occurs when the air from sea or ocean strike or pass over relief barriers.

5 Due to these processes rains with high intensity are possible on the windward side of the mountain.



2 **Drought is explained by the following ways.**

a. The condition under which crops fail to mature because of insufficient supply of water through rains.

b. The situation in which the amount of water required for transpiration and evaporation by crop plants in a defined area exceeds the amount of available moisture in the soil.

c. A situation of no precipitation in a rainy season for more than 15 days continuously

Drought

Frequent crop failure in dry lands.

Prolonged dry spell during crop growth.

Management practices

Application of organic manures.

Soil and moisture conservation practices.

Collection of runoff water and its utilisation.

Minimising evaporation and transpiration losses.

Introduction of drought resistant and drought escaping crops and cultivars.

Intercropping

Farm forestry

Identification of remunerative cropping system

Untimely rains

Late onset – delays sowing of crops – poor yield.

Early withdrawal – soil moisture stress – poor yield.

Continuous rains from August – problem in harvesting.

Management strategy

Early land preparation.

Abnormal delay – Growing of short duration pulses.

Implementation of intercropping with long and short duration crops.

3 **Global warming**

Due to increase in maximum temperature.
Change in temp. – 1 to 3.5 0C.
Lengthening of growing season.
Change in CO2. 1950 – 280 ppm
2000 - 370 ppm
Increase by 1.5 to 1.8 ppm/year.
Increase in conc. of methane and nitrous oxide.

Increased global temp. by 0.6 0C.
Increase in sea level – 2.5 mm/year.

Ozone depletion

Thickness of ozone – 300 Dibson units (3 mm)
Now it is 100 Dibson units.
Due to chlorine and bromine compounds released by chlorofluorocarbons and halons.

UV B-solar radiation

Plants use sunlight for photosynthesis – exposed to UV radiation.
Due to ozone depletion – UV B radiation (280-320 nm) reaches the ground
- Detrimental to crops.
- Delay in flowering.

4 **Scope of Agricultural meteorology:**

Almost all social, industrial, agricultural, commercial, transports etc. Activities directly or indirectly are affected by weather and climate. The atmosphere affects and sustains human life, animal, micro-organisms, insects, pests, plants, tree's forests and marine culture at all times during every stage of growth and development Meteorology has therefore, greatest scope on every human enterprise in the modern Life.

The fields of applications are given below to illustrate the scope of meteorology.

1. Safe Navigation:

For safe navigation on sea the knowledge of adverse weather i.e. large tidal waves, ocean waves, high speed wind, cyclonic storms etc is needed which is supplied in weather forecast from meteorology.

2. Safe aviation:

For transport through air, the pilots need the information about atmospheric conditions such as the electric lightening, high speed winds and their directions, thunder storms, foggy atmosphere etc. So pilots can go safely. For this purpose accurate forecasts are needed and are only possible from meteorology.

3. Industry:

Many industries for their raw material depend on agricultural produce and accordingly location of industry is decided, so it is necessary to consider the weather and climate e.g. sugar mill, distillery, jute mill etc.

4. Animal Production:

Beef, poultry and milk production also depend on weather and meteorology provides the information for successful animal production and animal husbandry.

5. Fisheries:

Fishermen need information of atmospheric and oceanic changes before they proceed on sea for fishing and this is possible from meteorological knowledge.

6. Irrigation and water resources:

Meteorological and hydrological information assists in planning the location size and storage capacities of dams to ensure water supply for irrigation and domestic needs. When and how much to irrigate is also decided from the meteorological information.

7. Land use planning:
The meteorological data supplemented with soil and topographic information help to plan the sites for the specific land use for drop production, forests, urban residence, industry etc.
8. Human Life:
Human being tries to acclimatize himself with the prevailing weather conditions, for this they manage for type of clothing, housing food habit etc.
8.1 Clothing:
Warm cloths during winter and,thin cloth during summer are used.
8.2 Housing:
Direction of windows, doors for proper ventilation, roofing-plain in low rainfall region whereas. Slanting roof in the areas where rainfall is more and frequent in occurrence.
8.3 Food habits:
Heavy diet during winter season is recommended whereas during summer season more quantum of water consumption is needed.
9. Human health:
If any sudden change in the climatic conditions is experienced it results into equdemics of material fever. Asthma patent suffers more during cloudy conditions.
10. Commerce:
Trading of any item is made according to need of the people in relation to weather prevailing e.g. Gum shoes, umbrella and raincoats are generally traded in rainy season only, woolen cloths in winter season and white cotton cloths. Cold drinks etc. are in more demand in summer season.

Section "B"

Define the following

1. Fog : "Low cloud" near the ground surface. Extremely small water droplets suspended in the atmosphere reducing the horizontal visibility is known as 'Fog'.

2 Heat wave: Heat Wave is a period of abnormally high temperatures, more than the normal maximum temperature that occurs during the summer season in the North-Western parts of India

3. Microclimate: microclimate is a local atmospheric zone where the climate differs from the surrounding area. The term may refer to areas as small as a few square feet (for example a garden bed) or as large as many square miles (for example a valley).

4. Albedo: The ratio of reflected radiation to the total incident radiation is called as albedo.

Fill in the blanks

1. **(J.W.Smith)** scientist (1916) has defined Agricultural Meteorology as "Meteorology in its relation to agriculture
2. Medium range forecast is valid for a period more than (**3 to 10 days**) period
3. Stratosphere consists rich layer of **(ozone)**
4. Rainfall associated with the hailstones is called as **(hailstorm)**