Very Short Answer Questions (PYQ)

[1 Mark]

Q.1. Which one of the following is the baker's yeast used in fermentation?

Saccharum barberi, Saccharomyces cerevisiae, Sonalika

Ans. *Saccharomyces cerevisiae.*

Q.2. Write the scientific name of the microbe used for fermenting malted cereals and fruit juices.

Ans. *Saccharomyces cerevisiae.*

Q.3. Milk starts to coagulate when Lactic Acid Bacteria (LAB) is added to warm milk as a starter. Mention any other two benefits that LAB provides.

Ans.

i. It increases nutritional quality of curd by increasing vitamin B_{12} content.
ii. It checks the growth of disease-causing organisms in the gut.

Q.4. Give the scientific name of the source organism from which the first antibiotic was produced.

Ans. *Penicillium notatum*

Q.5. Mention the information that the health workers derive by measuring BOD of a water body.

Ans. By measuring BOD of a water body, health workers find the amount of dissolved oxygen in water. The lesser the amount of dissolved oxygen, the more polluted the water body will be.

Q.6. Name the group of organisms and the substrate they act on to produce biogas.

Ans. Group of organisms—Methanogens.
Substrate—Cellulosic material/cow dung/agriculture waste.

Q.7. Which of the following is a free-living bacterium that can fix nitrogen in the soil?

Spirulina, Azospirillum, Sonalika

Ans. *Azospirillum*

Q.8. Which of the following is a cyanobacterium that can fix atmospheric nitrogen?

Azospirillum, Oscillatoria, Spirulina.

Ans. *Oscillatoria*

Q.9. How is the presence of cyanobacteria in the paddy fields beneficial to rice crop?

Ans. Cyanobacteria can fix atmospheric nitrogen. In paddy fields, the cyanobacteria act as an important biofertiliser. They also add organic matter to soil and increase its fertility

Q.10. Mention the role of cyanobacteria as a biofertiliser.

Ans. It is a biological organism that fixes atmospheric nitrogen.

Very Short Answer Questions (OIQ)

[1 Mark]

Q.1. Give an example of a rod-shaped virus.

Ans. Tobacco mosaic virus.

Q.2. Which one of these is a proteinaceous infecting agent?

a. Viroids,
b. prions,
c. protern,
d. wat.

Ans. Prions

Q.2. Consuming curd keeps the gastrointestinal tract intact. Give reason.

Ans. Curd contains lactic acid bacteria which checks the growth of disease-causing microbes and protects the gastrointestinal tract.

Q.3. Expand the terms

i. LAB
ii. BOD.

Ans.

i. LAB—Lactic Acid Bacteria.

ii. BOD—Biochemical Oxygen Demand.

Q.5. Discuss the role of LAB in producing curd.

Ans. *Lactobacillus lactis* and *Streptococcus lactis* bacterias produce acids which cause coagulation of milk protein called casein and changes milk into curd.

Q.6. Name the kind of cheese which possesses characteristic holes.

Ans. Swiss cheese.

Q.7. What causes doughing of wheat flour?

Ans. Production of CO_2 gas during yeast fermentation of bacteria.

Q.8. Why is distillation required for producing certain alcoholic drinks?

Ans. Distillation increases the alcohol content in alcoholic drinks.

Q.9. Why are drinks like Whisky and Rum are more intoxicating than wine?

Ans. This is because wine is produced without distillation whereas whisky and rum are produced by distillation of the fermented broth.

Q.10. How is 'toddy' prepared?

Ans. Toddy is a traditional drink of southern India which is prepared by the yeast fermentation of coconut water.

Q.11. Mention the three enzymes of industrial importance.

Ans. Three enzymes of industrial importance are proteases, pectinases and lipases.

Q.12. Who discovered the first antibiotic? Name the antibiotic.

Ans. Alexander Fleming discovered the first antibiotic named penicillin.

Q.13. Who gave the term antibiotic?

Ans. Selman Waksman.

Q.14. What would have happened if antibiotics were not discovered?

Ans. If antibiotics were not discovered, bacterial and fungal diseases would not have been controllable.

Q.15. Why are antibiotics always sold in combination with *Lactobacillus*?

Ans. Antibiotics may kill even the useful bacteria present in the digestive tract. LAB is given, which will protect some microbes in the digestive tract and enhance the production of vitamin B_{12}.

Q.16. Name two liquid household products obtained by microbial activity.

Ans. The products are vinegar and toddy.

Q.17. Name the first organic acid produced by microbial fermentation.

Ans. Lactic acid.

Q.18. Name the two vitamins produced by microbial fermentation.

Ans. Vitamin B_{12} (Cobalamine) and Vitamin B_2 (Riboflavin).

Q.19. What is the medical use of cyclosporin A?

Ans. Cyclosporin A is used as an immunosuppressive agent in organ transplant patient.

Q.20. Mention one commercial use of lipase.

Ans. Lipases are used in detergents to remove oily stains from the clothes.

Q.21. Who won the Nobel Prize for the discovery of penicillin?

Ans. Chain, Florey and Fleming won the Nobel Prize for the discovery of penicillin in 1945.

Q.22. The excreta of cattle do not contain any cellulose but human excreta may contain cellulose. Why?

Ans. The rumen of cattle contains methanogens which help in the digestion of cellulose but these bacteria are not present in human stomach so cellulose is not digested.

Q.23. What function do methanogens perform in the rumen of cattle?

Ans. Methanogens help in the digestion of cellulose in the rumen of cattle.

Q.24. Expand the term STP.

Ans. Sewage Treatment Plant.

Q.25. When was Ganga Action Plan started?

Ans. In 1985.

Q.26. What are flocs?

Ans. Flocs are masses of bacteria, associated with fungal hyphae, which form mesh-like structures, during secondary treatment of sewage.

Q.27. Write the constituents of biogas.

Ans. Biogas comprises a mixture of methane, carbon dioxide, hydrogen sulphide and ammonia.

Q.28. Name the bacterium that was used as biopesticide for the first time.

Ans. *Bacillus thuringiensis.*

Q.29. What are baculoviruses?

Ans. Viruses used in biological control of insects, pests and other arthropods.

Q.30. Name the pests that Ladybird, beetle and Dragonflies help to get rid of.

Ans. Ladybird, beetle and Dragonflies control mosquitoes and aphids.

Q.31. What are biofertilisers?

Ans. Biofertilisers are organisms that enrich the nutrients in the soil.

Q.32. Name two free-living nitrogen fixing microbes.

Ans. *Azotobacter* and *Clostridium*.

Q.33. Give the significance of biofertilisers.

Ans. Biofertilisers increase the soil fertility and reduce the use of chemical fertilisers and in turn, reduce the chances of environmental pollution.

Q.34. What are *Nucleopolyhedroviruses* being used for nowadays?

Ans. *Nucleopolyhedroviruses* are used for the biological control of insect pests.

Short Answer Questions-I (PYQ)

[2 Marks]

Q.1. Mention the importance of Lactic acid bacteria to humans other than setting milk into curd.

Ans. Lactic acid bacteria increase vitamin B_{12} absorption and also checks disease-causing microbes.

Q.2. How does addition of a small amount of curd to fresh milk help in the formation of curd? Mention a nutritional quality that gets added to the curd.

OR

How does 'starter' added to milk help it to set into curd?

Ans. When a small amount of curd as starter is added to fresh milk, millions of lactic acid bacteria(LAB) present in the starter grow in milk and convert it to curd. During this process, acids are produced by LAB that coagulate and partially digest the milk proteins.

LAB increases vitamin B_{12} content along with other vitamins in the curd.

Q.3. Mention a product of human welfare obtained with the help of each one of the following microbes:

Q. LAB

Ans. Convert milk to curd

Q. *Saccharomyces cerevisiae*

Ans. Bread/alcoholic drinks

Q. *Propionibacterium sharmanii*

Ans. Swiss cheese

Q. *Aspergillus niger*

Ans. Citric acid

Q.4. Name the bacterium responsible for the large holes seen in "Swiss Cheese". What are these holes due to?

Ans. *Propionibacterium sharmanii.*
The holes are because of production of large amount of CO_2.

Q.5. Name the microbes that help production of the following products commercially:

Q. Statin

Ans. *Monascus purpureus*

Q. Citric acid

Ans. *Aspergillus niger*

Q. Penicillin

Ans. *Penicillium notatum*

Q. Butyric acid

Ans. *Clostridium butylicum*

Q.6. Write the binomials of two fungi and mention the products/bioactive molecules they help to produce.

Ans.

Fungi	Products/Bioactive molecules produced
Trichoderma polysporum	Cyclosporin A
Aspergillus niger	Citric Acid
Monascus purpureus	Statin
Saccharomyces cerevisiae	Ethanol/alcohol
Penicillium notatum	Penicillin

Q.7. Name the blank spaces a, b, c and d given in the following table:

Type of microbe	Name	Commercial product
Bacterium	*a*	Lactic acid
Fungus	*b*	Cyclosporin A
c	*Monascus purpureus*	Statins
Fungus	*Penicillium notatum*	*d*

Ans.

a. *Lactobacillus*
b. *Trichoderma polysporum*
c. Fungus
d. Penicillin

Q.8. Name the blank spaces *a*, *b*, *c* and *d* from the table given below:

Type of microbe	Scientific name	Product	Medical application
(*i*) Fungus	*a*	Cyclosporin	*b*
(*ii*) *c*	*Monascus purpureus*	Statin	*d*

Ans.

a. Trichoderma polysporum
b. Immuno-suppressive agent
c. Fungus
d. Blood cholesterol lowering agent.

Q.9. Give the binomials of two types of yeast and the commercial bioactive products they help to produce.

Ans.

Yeast	Their bioactive products
Saccharomyces cerevisiae	Ethanol/alcohol
Monascus purpureus	Statin

Q.10. Name the source of statin and state its action on the human body.

OR

Name a microbe used for statin production. How do statin lower blood cholesterol level?

Ans. Statin is produced by the yeast *Monascus purpureus*. It acts as a blood-cholesterol lowering agent, by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

Q.11. Name a bioactive molecule, its source organism and the purpose for which it is given to organ transplant patients.

Ans. Cyclosporin A is a bioactive molecule given to organ transplant patients. It is obtained from a fungus *Trichoderma polysporum*. It is used as an immunosuppressive agent.

Q.12. Name the source of streptokinase. How does this bioactive molecule function in our body?

Ans. Source: *Streptococcus*.

Streptokinase is a clot buster, *i.e.*, it removes clot from the blood vessels of patients who had a heart attack.

Q.13. Give the scientific name of the microbes from which cyclosporin A and statin are obtained. Write one medical use of each one of these drugs.

Ans. Cyclosporin A that is used as an immuno-suppressive agent during organ transplantation in patients is produced by the fungus *Trichoderma polysporum*. Statins produced by yeast Monascus *pupureus* have been commercialised as blood cholesterol lowering agents.

Q.14. Name the source of cyclosporin-A. How does this bioactive molecule function in our body?

Ans. *Trichoderma polysporum*.

It acts as an immuno-suppresant and is used in organ transplant patient.

Q.15. Name the enzyme produced by *Streptococcus* bacterium. Explain its importance in medical sciences.

Ans. *Streptococcus* bacterium produces streptokinase.

It is used for removing clots from the blood vessels in a patient suffering from myocardial infarction/or in a heart patient.

Q.16. During the secondary treatment of the primary effluent how does the significant decrease in BOD occur?

OR

During the secondary treatment of the primary effluent how does the significant decrease in BOD occur?

Ans. During secondary treatment of primary effluents, vigorous growth of useful aerobic microbes into flocs occur when it is agitated mechanically and air is pumped into it in a large aeration tank. These microbes while growing consume major part of the organic matter in the effluent. This significantly reduces BOD.

- Useful aerobic microbes grow rapidly and form flocs.
- Flocs are masses of bacteria associated with fungal filaments to form mesh-like structures.
- The growing microbes consume organic matter and thus reduce the biochemical oxygen demand (BOD).

Q.17. Name the two different categories of microbes naturally occurring in sewage water. Explain their role in cleaning sewage water into usable water.

Ans. Aerobic and anaerobic bacteria or fungi exist in sewage water.

After the primary treatment of water, aerobic bacteria are added in aeration tanks. Growth of these bacteria reduces BOD as they consume organic matter. Anaerobic

bacteria are added in anaerobic sludge digesters, where these digest the sludge and form biogas, etc.

Q.18. List the events that lead to biogas production from waste water whose BOD has been reduced significantly.

Ans. The effluent is passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This is called activated sludge. The sludge is pumped into anaerobic sludge digesters where they are anaerobically digested. During this digestion, bacteria produce biogas.

Q.19. Describe how biogas is generated from activated sludge. List the components of biogas.

Ans. The activated sludge is pumped into large tanks called anaerobic sludge digesters. Here, bacteria which grow anaerobically digest the bacteria and the fungi in the sludge. During this digestion, bacteria produce a mixture of gases which form biogas. Biogas is made up of methane, hydrogen sulphide and carbon dioxide.

Q.20. What are methanogens? Name the animals they are present in and the role they play there.

Ans. Methanogens are bacteria which grow anaerobically on cellulosic material.
They are present in the rumen of cattles.
These bacteria are responsible for the breakdown of cellulose help in nutrition of animal.

Q.21. What are methanogens? How do they generate biogas?

Ans. Anaerobic methane producing bacteria are called methanogens. Methanogens generate biogas when they act by anaerobic decomposition on cellulose rich biowaste (anaerobically).

Q.22. Name a free-living and a symbiotic bacterium that serve as bio-fertiliser. Why are they so called?

Ans. *Azospirillium/Azotobacter* and *Rhizohium* act as biofertilisers.
They are so called because they enrich soil nutrient by nitrogen fixation.

Q.23. List the events that reduce the Biological Oxygen Demand (BOD) of a primary effluent during sewage treatment.

Ans.

- Useful aerobic microbes grow rapidly and form flocs.
- Flocs are masses of bacteria associated with fungal filaments to form mesh-like structures.
- The growing microbes consume organic matter and thus reduce the biochemical oxygen demand (BOD).

Q.24. Distinguish between the roles of flocs and anaerobic sludge digesters in sewage treatments.

Ans. Flocs are masses of bacteria associated with fungal filaments to form mesh-like structures. These consume the major part of the organic matter in the effluent, significantly reducing the BOD. The effluent is then passed into a settling tank where the flocs sediment. A part of this sediment (activated sludge) is pumped into anaerobic sludge digestors where anaerobic digestion of sludge takes place, producing biogas in the process.

Q.25. Why is *Rhizobium* categorised as a 'symbiotic bacterium'? How does it act as a biofertiliser?

Ans. *Rhizobium* is present in the root nodules of leguminous plants. Theirs is a symbiotic relationship in which the bacterium obtains food and shelter from the plant and the plant gets fixed nitrogen in return. These bacteria fix atmospheric nitrogen into organic forms, which is used by the plant as nutrient.

Q.26. How do mycorrhizae act as biofertilisers? Explain. Name a genus of fungi that forms a mycorrhizal association with plants.

Ans. Mycorrhizae is a symbiotic association of a fungus with roots of higher plants. The fungus absorbs phosphate from soil and passes it to the plant. It also provides resistance to root-borne pathogen and increase the tolerance of plant to salinity and drought. This way they act as biofertilisers.

Genus of fungi — *Glomus*.

Q.27. Explain the process of secondary treatment given to the primary effluent up to the point it shows significant change in the level of biological oxygen demand (BOD) in it.

Ans. The primary effluent is passed into large aeration tanks where it is constantly agitated. Air is pumped into it mechanically. This allows vigorous growth of useful aerobic microbes into flocs. These microbes consumes the major part of organic matter in the effluent (this significantly reduces the BOD of the effluent).

Q.28. Why are some molecules called bioactive molecules? Give two examples of such molecules.

Ans. Some molecules are called bioactive molecules, because microbes like bacteria or fungi are used in their production.

e.g., Citric acid — Acetic acid
Butyric acid — Lactic acid
Ethanol — Lipase
Streptokinase — Cyclosporin A (*Any two*)

Q.29. How does the application of the fungal genus, Glomus, to the agricultural farm increase the farm output?

Ans. *Glomus* is a fungus which is found in symbiotic relationship with roots of seed plants. It absorbs phosphorus from the soil and passes it on to the plant, and in turn gets sugars from the plant. Due to increased availability of phosphorus there is an increase in farm output.

Q.30. How does the application of cyanobacteria help to improve agriculture output?

Ans. Cyanobacteria are autotrophic, free-living or symbiotic microbes. They can fix atmospheric nitrogen. Blue-green algae also add organic matter to the soil and increases its fertility. They replenish soil nutrients and reduce dependence on chemical fertilisers.

Q.31. How do mycorrhizae help the plants to grow better?

Ans. Mycorrhizae absorb phosphorus, provide resistance to root-borne pathogens and enhance the tolerance of the plants towards salinity and drought.

Short Answer Questions-I (OIQ)

[2 Mark]

Q.1. What is the role of baker's yeast in the production of bread?

Ans. *Saccharomyces cerevisiae* (Baker's yeast) causes the alcoholic fermentation of sugars in wheat flour and produce ethanol and CO_2. CO_2 raises the bread when baked and makes it soft.

Q.2. How is cheese prepared?

Ans. Cheese is partially degraded flavoured milk curd formed by the activity of micro-organisms. Processed cheese is formed by blending and emulsifying different types of cheese with or without cream.

Q.3. What is puffed up appearance of *IdliDosa* due to which metabolic pathway is involved in it?

Ans. Puffed up appearance of dough is due to production of CO_2 as a result of fermentation.

Q.4. Name any two varieties of cheese and mention the names of microbes used?

Ans.

Swiss cheese—*Propionibacterium*
Roquefort cheese—*Penicillium roqueforti*

Q.5. Name the blank spaces *a*, *b*, *c* and *d* given in the following table:

Ans.

Type of microbe	Name	Commercial product
Bacterium	*a*	Clot buster enzyme
b	*Aspergillus niger*	Citric acid
Fungus	*Trichoderma polysporum*	*c*
Bacterium	*d*	Butyric acid

Ans.

a. *Streptococcus*
b. Fungus
c. Cyclosporin A
d. *Clostridium butylicum*

Q.6. What is a broad spectrum antibiotic? Name a broad spectrum antibiotic and source organism.

Ans. A broad spectrum antibiotic is one which can inhibit the growth of both gram positive and gram negative bacteria. For example, tetracycline, which is obtained from *Streptomyces aureofaciens*.

Q.7. How was penicillin discovered?

Ans. Penicillin was an accidental discovery. Sir Alexander Fleming observed that in unwanted culture plates of *Staphylococcus* a mould of *Penicillium* was growing This mould inhibited the growth of *Staphylococcus*around it. Later the antibiotic penicillin was isolated from this fungus.

Q.8. What is the chemical nature of biogas? Name an organism which is known to be employed in biogas.

Ans. The biogas contains methane, CO_2 and H_2. *Methanobacterium*, a type of methanogen is employed for biogas production.

Q.9. What is BOD? What does it mean if a water sample has more BOD?

Ans. BOD stands for biochemical oxygen demand which represents the amount of dissolved oxygen that would be consumed if all the organic matter in one litre of water were oxidised by microorganisms. More BOD value means the water sample is polluted by organic matter.

Q.10. What are biopesticides? Give the scientific name and use of first commercially used biopesticide in the world.

Ans. Biopesticides are living organisms which are able to kill or repel specific pests. Nowadays biopesticides are used in place of chemical fertilisers. *Bacillus thuringiensis* (Bt) is the first bacterial biopesticide to be used on commercial scale.

Q.11. What is biogas? Why is it preferred to other conventional energy fuels?

Ans. The gas produced by the anaerobic action of bacteria on biomass is known as biogas. It is preferred over other conventional energy fuels because it is a cleaner fuel, has no foul smell and can be used as a source of energy as it is inflammable.

Q.12. Legumes fertilise the soil but cereals do not. Discuss.

Ans. Leguminous plants possess root nodules where nitrogen is fixed by symbiotic nitrogen fixing bacteria *Rhizobium* whereas cereals do not possess nitrogen fixing bacteria in their root nodules, so, they cannot fertilise the soil.

Q.13. How do cyanobacteria act as biofertiliser?

Ans. **Cyanobacteria as biofertilisers**

- They fix atmospheric nitrogen and increase the organic matter of the soil through their photosynthetic activity, e.g., Nostoc, Anabaena, Oscillatoria, etc.
- Blue-green algae increase the soil fertility by adding organic matter to the soil.

Q.14. Describe critically the main ideas behind the biological control of pests and diseases.

Ans. Biological control means life against life. It's a natural and ecofriendly concept. It employs the natural organisms to control the population of pathogens and pests in an ecosystem. Classical examples are *Trichoderma* which is antagonist against many soil-borne plant pathogens. Similarly, *Penicillium* inhibits the growth of *Staphylococcus* and therefore has been successfully used in the production of penicillin antibiotic to control many human bacterial pathogens.

Q.15. What is *Chakravarthy* bug? Give its scientific name and its application?

Ans. *Chakravarthy* bug is a super bug of *Pseudomonas* with multiple plasmids. They are helpful in removing oil spills.

Q.16. What does the Ganga Action Plan tend to achieve?

Ans. Ganga Action Plan tends to save the major rivers from pollution. Under these plans, a large number of sewage treatment plants were built so that only treated sewage is discharged in the rivers.

Q.17. How do mycorrhizal fungi help the plants harbouring them?

Ans. The mycorrhizal fungi absorb phosphorus from the soil and transfer them to the host cells. They also impart resistance to host plants against root pathogens. They also help plants to tolerate salinity and draught.

Q.18. Answer the following questions:

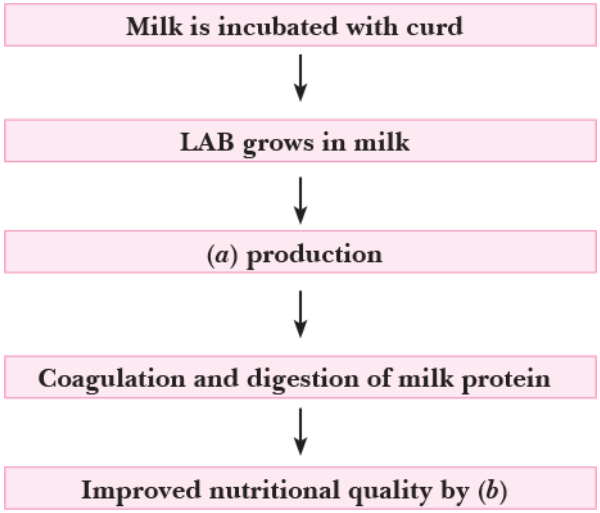
Q. Patients who have undergone myocardial infarction are given clot buster. Mention the clot buster administered and its microbial source.

Ans. *Streptokinase* is the clot buster and its microbial source is *Streptococcus*.

Q. A person recuperating from illness is advised to have curd regularly. Why?

Ans. Curd contains Lactic Acid Bacteria, which play beneficial role in checking disease-causing microbes. It is also a source of vitamin B_{12}.

Q.19. Following is the process of curd formation from milk.



i. What does (*a*) and (*b*) signifies in the flow chart.
ii. Expand the word LAB.

Ans.

i.
   a. Lactic acid;
   b. increased vitamin B_{12}
ii. Lactic Acid Bacteria

Q.20. Name two alcoholic drink produced in each of the following ways:

i. with distillation
ii. without distillation

Ans.

i. with distillation — Brandy, Whisky, Rum
ii. without distillation — Wine and Beer.

Short Answer Questions-II (PYQ)

[3 Marks]

Q.1. Identify *a*, *b*, *c*, *d*, *e* and *f* in the table given below:

S. No.	Organism	Bioactive molecule	Use
(*i*)	*Monascus purpureus (yeast)*	*a*	*b*
(*ii*)	*c*	*d*	Antibiotic
(*iii*)	*e*	Cyclosporin A	*f*

Ans.

a. Statins
b. Blood cholesterol lowering agent
c. *Penicillium notatum*
d. Penicillin
e. *Trichoderma polysporum*
f. Immunosuppressant

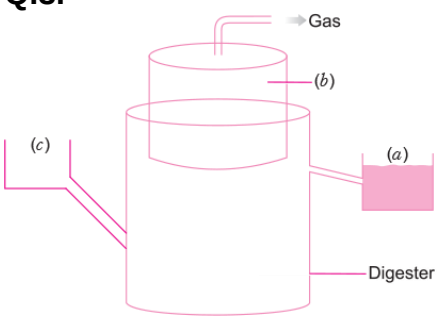
Q.2. State the medicinal value and the bioactive molecules produced by

Streptococcus, *Monascus* and *Trichoderma*.

Ans.

		Bioactive Molecule Produced	Medicinal Value
(*i*)	*Streptococcus*	Streptokinase	Removes clot from the blood vessels
(*ii*)	*Monascus*	Statin	Inhibits enzymes responsible for synthesis of cholesterol.
(*iii*)	*Trichoderma*	Cyclosporin A	Immunosuppressive agents used in organ transplantation.

Q.3.



The diagram above is that of a typical biogas plant. Explain the sequence of events occurring in a biogas plant. Identify *a*, *b* and *c*.

Ans. The biogas plant tank is fed with slurry of dung. A floating cover is placed over the slurry which keeps on rising as the gas is produced in the tank due to the microbial activity of methanogens like *Methanobacterium*. Methanogens grow anaerobically on cellulosic material in cow dung to produce large amount of methane, CO_2 and H_2. The biogas plant has an outlet, which is connected to a pipe to supply biogas. The spent slurry is removed through another outlet and is used as fertiliser.

a—Sludge tank; *b*—Gas holder; *c*—Charge pit (Gobar + H_2O) inlet

Q.4. Explain the function of "anaerobic sludge digester" in a sewage treatment plant.

Ans. Anaerobic sludge digester has anaerobic bacteria that digests the aerobic bacteria and fungi present in the sludge. During the digestion these bacteria produce mixture of gases such as methane, H_2S and CO_2(biogas).

Q.5. Explain the different steps involved during primary treatment phase of sewage.

Ans. Primary treatment or physical treatment

- It is the physical removal of large and small particles from sewage.
- First, the floating debris is removed by sequential filtration by passing through wire mesh screens.
- Then, the grit (soil and small pebbles) are removed by sedimentation in settling tanks. The sediment is called primary sludge and the supernatant is the effluent.
- The effluent is taken for secondary treatment.

Q.6. Describe how do 'flocs' and 'activated sludge' help in sewage treatment.

Ans. Flocs are masses of aerobic bacteria associated with fungal filaments to form mesh like structures. These aerobic microbes consume the major part of the organic matter in the effluent. This significantly reduces Biological oxygen demand (BOD) of the effluent.

A small part of the activated sludge is used as inoculum and pumped back to aeration tank. The remaining major part of the sludge is pumped into anaerobic sludge digesters where microbes or bacteria grow anaerobically to produce CH_4 or H_2S or CO_2 or biogas.

Q.7.

i. **List the components of biogas.**
ii. **What makes methanogens suitable for biogas production?**

Ans.

i. Biogas is a mixture of inflammable gases like methane, carbon dioxide and hydrogen.
ii. Methanogens grow anaerobically and help in breakdown of cellulosic material to produce large amount of methane, carbon dioxide and hydrogen and so it is suitable for biogas production.

Q.8. How can sewage be used to generate biogas? Explain.

Ans. When biochemical oxygen demand (BOD) of sewage is reduced, effluent is passed into a settling tank for bacterial flocs to settle down. The sediment is called activated sludge. Activated sludge is pumped into anaerobic sludge digesters. In the digesters, heterotrophic microbes anaerobically digest bacteria and fungi in the sludge producing a mixture of gases which form the biogas.

Q.9. Secondary treatment of the sewage is also called Biological treatment. Justify this statement and explain the process.

Ans. Secondary treatment of sewage involves biological organism such as aerobic and anaerobic microbes or bacteria and fungi to digest or consume organic waste. Therefore, it is also called biological treatment.

Q.10.

a. How is activated sludge produced during sewage treatment?
b. Explain how this sludge is used in biogas production.

Ans.

a. Once the BOD of sewage or waste water is reduced significantly, the effluent is passed into a settling tank where the bacterial flocs undergo sedimentation and the sediment is thus called activated sludge.
b. A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the activated sludge is pumped into large tanks called anaerobic sludge digesters. The anaerobic bacteria digest the bacteria and fungi in the sludge and produce mixture of gases like methane, hydrogen sulphide and CO_2 which constitute biogas.

Q.11. Cow dung and water is mixed and this slurry is fed into the biogas plant for digestion by microbes. The person performing the process shares that there is no need to provide inoculum for it, why? What is the role of microbes at the source? Under which condition will they be most active and effective?

Ans. There is no need to provide inoculum for it because the bacteria, methanogens are present in cow dung. The role of these microbes is breakdown of cellulose. These are most active in an anaerobic condition.

Q.12. Name the genus to which baculoviruses belong. Describe their role in the integrated pest management programmes.

Ans. Baculovirus belongs to the genus *Nucleopolyhedrovirus*. Baculoviruses are pathogens that attack insects and other arthopods. These viruses are very useful for species-specific, narrow spectrum insecticidal applications. Also, as they show no negative impacts on plants, mammals, birds, fish or even on non-target insects, they are beneficial in integrated pest management (IPM) programme in which beneficial insects are conserved.

Q.13. Given below is a list of six microorganisms. State their usefulness to humans.

Q. *Nucleopolyhedrovirus*

Ans. *Nucleopolyhedrovirus:* Used as bio-control agents.

Q. *Saccharomyces cerevisiae*

Ans. *Saccharomyces cerevisiae*: Used in bread making and in brewing industry.

Q. *Monascus purpureus*

Ans. *Monascus purpureus*: Cholesterol lowering agent

Q. *Trichoderma polysporum*

Ans. *Trichoderma polysporum*: Produces Cyclosporin-A

Q. *Penicillium notatum*

Ans. *Penicillium notatum*: Produces antibiotic penicillin

Q. *Propionibacterium sharmanii*

Ans. *Propionibacterium sharmanii*: Produces large amount of CO_2 in Swiss cheese.

Q.14. Explain the role of the following in increasing the soil fertility and crop yield:

Q. Leguminous plants

Ans. Leguminous plants possess root nodules where nitrogen is fixed by symbiotic nitrogen fixing bacteria *Rhizobium* and fertilise the soil.

Q. Cyanobacteria

Ans. Cyanobacteria as biofertilisers

- They fix atmospheric nitrogen and increase the organic matter of the soil through their photosynthetic activity, e.g., Nostoc, Anabaena, Oscillatoria, etc.
- Blue-green algae increase the soil fertility by adding organic matter to the soil.

Q. Mycorrhizae

Ans. Mycorrhiza shows the following benefits:

a. resistance to root-borne pathogens.
b. tolerance to salinity and drought.
c. overall increase in plant growth and development.

Q.15. Choose any three microbes, from the following which are suited for organic farming, which is in great demand these days for various reasons. Mention one application of each one chosen.

Mycorrhiza; Monascus; Anabaena; Rhizobium; Methanobacterium; Trichoderma.

Ans. *Mycorrhiza*: (Fungal symbiont of the association) Absorbs phosphorus from soil.
***Anabaena*:** Fix atmospheric nitrogen and adds organic matter to the soil.
***Rhizobium*:** Fix atmospheric nitrogen (in leguminous plants).
***Methanobacterium*:** They digest cellulosic material and their product/spent slurry can be used as a fertiliser.
***Trichoderma*:** Biocontrol agent for several plant pathogens.

Q.16. Answer the following questions:

Q. Why are the fruit juices bought from market clearer as compared to those made at home?

Ans. The fruit juices bought from market are clearer because they have been clarified by pectinases and proteases.

Q. Name the bioactive molecules produced by Trichoderma polysporum and Monascus purpureus.

Ans. *Trichoderma polysporum*: Cyclosporin A

Monascus purpureus: Statins

Short Answer Questions-II (OIQ)

[3 Marks]

Q.1. Mention the functions of LAB that are useful to man.

Ans.

i. LAB convert milk into curd and are employed in dairy industries.

ii. LAB in human intestine synthesize vitamin B_{12}.
iii. LAB in human stomach, checks the growth of harmful disease causing microbes.

Q.2. What are the properties of an antibiotic?

Ans. The properties of an antibiotic are as follows:

i. It should not kill useful microorganisms found in alimentary canal of man.
ii. It should not cause side-effects in the host.
iii. It should have quick action and should be broad spectrum, *i.e.*, must have the ability to act on various pathogenic microorganisms which differ from each other.
iv. The action of antibiotics must be specific on the pathogens only.

Q.3. Name any three enzymes used in industry and explain their importance.

Ans.

S. No.	Enzyme	Uses
(i)	Lipase	(a) Used in detergent formulations.(b) Helps in removing oily stains from laundry.
(ii)	Pectinase and protease	Used for clarifying bottled juices.
(iii)	Streptokinase (produced by Streptococcus and modified by genetic engineering)	Used as ‘clot-buster’ for removing clots from blood vessels of patients who have undergone myocardial infarction.

Q.4. What are antibiotics? Name the classes of organisms that produce antibiotics.

Ans. Antibiotics are chemical substances primarily produced by some microorganisms which in low concentration can kill or retard the growth of other disease causing micro-organisms. Antibiotics are mainly produced from three groups of microorganisms:

i. Eubacteria (true bacteria)
ii. Actinomycetes (ramified bacteria)
iii. Fungi.

Q.5. Suggest three features of plants that will prevent insect and pest infestation.

Ans.

i. Increasing hair growth on aerial parts of plants.
ii. Rendering the flowers nectar less.
iii. Enabling plants to secrete insect killing chemicals (toxins).

Q.6. What are the harmful effects of chemical pesticides?

Ans. The harmful effects of chemical pesticides are:

i. They pollute the soil and water.
ii. They kill many useful organisms in the soil.
iii. They enter the food chain and cause disease at various trophic levels.
iv. They affect the salinity of the soil.

Q.7. What are the advantages of using biofertilisers in agriculture?

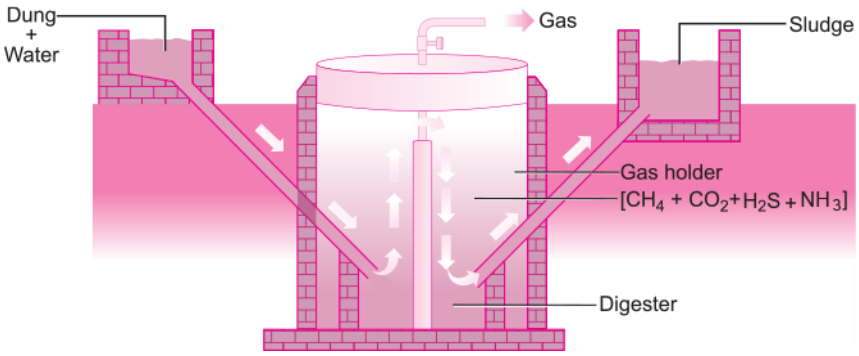
Ans. Following are the advantages of using biofertilisers in agriculture:

i. Biofertilisers do not cause any pollution.
ii. These are cheap and economical.
iii. Some of them act as biopesticides also.
iv. In ill-irrigated conditions few biofertilisers can enhance the crop yield.
v. They improve soil structure and function.
vi. They make available vitamins and other growth promoting biochemicals.

Q.8. Describe a biogas plant

Ans. Mechanism of Biogas or Gobar Gas Production

- The raw material for biogas production is excreta (dung) of cattle.
- The biogas plant has a concrete tank (10–15 feet deep) in which bio-wastes and slurry of dung is collected.
- The tank has a floating cover which rises on production of gas in the tank.
- Methanobacterium in the dung act on the bio-wastes to produce biogas.
- The gas produced is supplied to nearby houses by an outlet.
- Through another outlet, the spent slurry is removed to be used as fertiliser.
- Biogas is used as fuel for cooking and lighting.



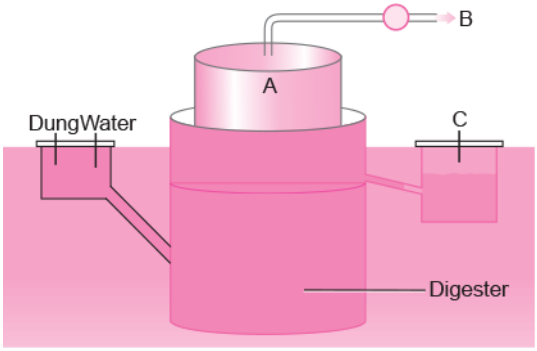
A typical biogas plant

Q.9. Why are biogas plants more suitable and advantageous in rural area?

Ans. Biogas plants are most suitable and advantageous in rural areas because of the following reasons:

i. Raw material for biogas plant is mainly cow dung which is available in plenty in rural areas where cattle are used.
ii. The biogas is used for lighting and cooking in these areas as distribution is only in short distances.
iii. The spent slurry from the biogas plant is used as a fertiliser for agriculture hence are more suitable in rural areas.

Q.10. Given below is a figure of a biogas plant.



Q. Identify A and justify its floating nature.

Ans. A is the floating cover which is placed over the slurry, which keeps on rising as the gas is produced in the tank due to the microbial activity.

Q. Identify the products B and C and discuss their significance.

Ans. B is the biogas which is a mixture of gases consisting of methane, hydrogen sulphide and carbon dioxide. It can be used as a source of energy to nearby houses as it is inflammable. C is the spent slurry or sludge which is removed through another outlet and may be used as fertiliser.

Long Answer Questions (PYQ)

[5 Marks]

Q.1. Explain the different steps involved in sewage treatment before it can be released into natural water bodies.

OR

Describe the process of waste-water treatment under the following heads:

a. **Primary treatment**
b. **Secondary treatment**

OR

Explain the process of sewage water treatment before it can be discharged into natural water bodies. Why is this treatment essential?

Ans.

(i) Primary treatment or physical treatment

- It is the physical removal of large and small particles from sewage.
- First, the floating debris is removed by sequential filtration by passing through wire mesh screens.
- Then, the grit (soil and small pebbles) are removed by sedimentation in settling tanks. The sediment is called primary sludge and the supernatant is the effluent.
- The effluent is taken for secondary treatment.

(ii) Secondary treatment or biological treatment

- Primary effluent is passed into large aeration tanks with constant mechanical agitation and air supply.
- Useful aerobic microbes grow rapidly and form flocs.
- Flocs are masses of bacteria associated with fungal filaments to form mesh-like structures.
- The growing microbes consume organic matter and thus reduce the biochemical oxygen demand (BOD).
- When BOD of sewage has reduced, the effluent is passed into settling tank.
- Here, the bacterial flocs settle and the sediment is called activated sludge.
- A small part of the sludge is used as an inoculum in the aeration tank and the remaining part is passed into large tanks called anaerobic sludge digesters.
- In the digesters, heterotrophic microbes anaerobically digest bacteria and fungi in sludge producing mixture of gases such as methane, hydrogen sulphide and CO_2 which form the biogas.

The sewage treatment is essential before being released into water bodies so as to check water borne diseases or pathogenic organisms due to water pollution.

Q.2.

a. **Name the category of microbes occurring naturally in sewage and making it less polluted during the treatment.**
b. **Explain the different steps involved in the secondary treatment of sewage.**

Ans.

(a) Aerobic microbes

(b) Secondary treatment or biological treatment

- Primary effluent is passed into large aeration tanks with constant mechanical agitation and air supply.
- Useful aerobic microbes grow rapidly and form flocs.
- Flocs are masses of bacteria associated with fungal filaments to form mesh-like structures.
- The growing microbes consume organic matter and thus reduce the biochemical oxygen demand (BOD).
- When BOD of sewage has reduced, the effluent is passed into settling tank.
- Here, the bacterial flocs settle and the sediment is called activated sludge.
- A small part of the sludge is used as an inoculum in the aeration tank and the remaining part is passed into large tanks called anaerobic sludge digesters.
- In the digesters, heterotrophic microbes anaerobically digest bacteria and fungi in sludge producing mixture of gases such as methane, hydrogen sulphide and CO_2 which form the biogas.

Q.3. Identify '*a*', '*b*', '*c*', '*d*', '*e*' and '*f*' in the table given below:

Scientific name of the organism	Product produced	Use in human welfare
Streptococcus	Streptokinase that was later modified	*a*
b	Cyclosporin A	*c*
Monascus purpureus	*d*	*e*
Lactobacillus	*f*	Sets milk into curd

Ans.

a. Bioactive molecule used to remove blood clot
b. *Trichoderma polysporum*
c. Immunosuppressant
d. Statin

e. Blood cholesterol lowering agent
f. Lactic acid

Q.4. What are biofertilisers? Describe their role in agriculture. Why are they preferred to chemical fertilisers?

Ans. Microbes as Biofertilisers

- Biofertilisers are the microorganisms which enrich the nutrient (nitrogen, phosphorus, etc.) quality of the soil.
- Bacteria, fungi and cyanobacteria are the three main sources of biofertilisers.
- **Rhizobium** is a symbiotic bacterium that lives in the root nodules of legumes and fixes atmospheric nitrogen into organic compounds.
- Fungi form symbiotic association with the roots of higher plants called mycorrhiza, e.g., *Glomus*.
- They fix atmospheric nitrogen and increase the organic matter of the soil through their photosynthetic activity, e.g., *Nostoc, Anabaena, Oscillatoria*, etc.

These are preferred to chemical fertilisers because:

i. They do not pollute soil, air and water.
ii. They do not spoil the soil texture or pH of the soil.

Q.5. Explain the role of baculoviruses as biological control agents. Mention their importance in organic farming.

OR

Explain the significant role of the genus *Nucleopolyhedrovirus* in an ecological sensitive area.

Ans. Baculoviruses are pathogens that attack insects and other arthropods. Baculoviruses of genus *Nucleopolyhedrovirus* are used as biological control agents. They are excellent candidates for species-specific, narrow spectrum insecticidal applications. They do not show negative impact on plants, birds, non-target insects. Therefore, they are used as biological control agents.

Importance in organic farming: It is desirable when beneficial insects are being conserved to aid in an overall integrated pest management (IPM) programme. In organic farming, it is used to conserve beneficial insects and kills harmful ones.

Long Answer Questions (OIQ)

[5 Marks]

Q.1. Enumerate the role of microbes in producing some household products.

Ans. Microbes in Household Products

i. **Curd**

- Curd is formed by adding a small amount of curd to milk, which acts as a starter.
- *Lactobacillus* and lactic acid bacteria (LAB) present in starter, multiply at suitable temperature and convert milk into curd.
- Acids released by LAB during the growth coagulates and partially digest milk protein, casein.
- **Benefits of LAB**:
  a. Increases vitamin B_{12} amount thus increasing nutrient quality of milk.
  b. Checks disease-causing microbes in stomach.

ii. **Dough**

- Dough is formed by fermentation by bacteria.
- Bread is made by fermentation by *Saccharomyces cerevisiae* or commonly called baker's yeast.
- CO_2 released during the process of fermentation gives the puffy appearance to dough.
- It is used to make foods like *idli, dosa*, bread, etc.

iii. **Toddy**

- It is a traditional drink of Southern India.
- It is made by fermentation of sap from palm trees by bacteria.

iv. **Cheese**

- Cheese is formed by partial degradation of milk by different microorganisms.
- Swiss cheese is formed by the bacterium *Propionibacterium sharmanii*. Its characteristic feature is formation of large holes due to production of large amount of CO_2.
- Roquefort cheese is formed by ripening with the fungi *Penicillium roqueforti* for a particular flavour.

Q.2. Write short notes on:

Q. Yamuna Action Plan

Ans. Yamuna Action Plan: In order to protect the major rivers of India from sewage pollution, the Ministry of Environment and Forests has initiated development of sewage treatment plants under the National River Conservation Authority, *e.g.*, Ganga Action Plan and Yamuna Action Plan. Industries contribute chemical effluents to the river's pollution load and the toxicity kills aquatic animals in large sections of the river. Under these plans, a large number of sewage treatment plants were built so that only treated sewage is discharged into the rivers.

Q.3. Complete the given table.

Name of the organism	Product/Enzyme/Bioactive male cule
Aspergillus niger	(*i*)

(*ii*)	Ethanol
(*iii*)	Cyclosporin-A
(*iv*)	Acetic acid
Monascus purpureus	(*v*)
Streptococcus	(*vi*)

Ans.

i. Citric acid
ii. *Saccharomyces cerevisiae*
iii. *Trichoderma polysporum*
iv. *Acetobacter aceti*
v. Statin
vi. Streptokinase

Q.4. How are microbes employed in different steps of sewage treatment?

Ans. Refer to Basic Concepts Point 4.

Q.5. Why should biological control of pests and pathogens be preferred to the conventional use of chemical pesticides? Explain how the following microbes act as biocontrol agents:

a. *Bacillus thuringiensis*
b. *Nucleopolyhedrovirus*

Ans. Biological control of pests and pathogens is preferred because:

i. The chemicals cause pollution of water bodies as well as ground water, besides getting stored in the plants.
ii. The chemicals are toxic thus extremely harmful to human beings and other animals.
    a. ***Bacillus thuringiensis***: B. thuringiensis toxin genes when introduced into plant, become resistant to attack by insect pests. They are available in sachets as dried spores, which are mixed with water and sprayed onto vulnerable plants. When they are eaten by the insect larvae, the toxin is released in the gut where it becomes active and kills the larvae. Specific Bt toxin genes obtained from B. thuringiensis are used in several crop plants which make them resistant to insect pest.
    b. ***Nucleopolyhedrovirus*:** These viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications. This is especially desirable when beneficial insects are being conserved to aid in an overall integrated pest management (IPM) programme.

Q.6. "Microbes play a dual role when used for sewage treatment as they not only help to retrieve usable water but also generate fuel". Explain.

Ans.

- Microbes naturally present in the sewage are employed in the secondary treatment of the sewage.
- The effluent from the primary treatment is passed into large aeration tanks.
- This allows the rapid growth of aerobic microbes into flocs which consume the organic matter of the sewage and reduces the BOD.
- Then the effluent is passed into a settling tank, where the flocs are allowed to sediment forming the activated sludge.
- Major parts of this activated sludge is pumped into anaerobic sludge digesters, where the anaerobic bacteria digest microbes in the activated sludge.
- During this digestion bacteria produce a mixture of gases like methane, hydrogen sulphide and carbon dioxide, which form the biogas and can be used as a source of energy. The effluent is generally released into rivers and streams.

Q.7. Answer the following questions:

Q. What are biopesticides? Give any two examples of their application.

Ans. Biopesticides are biological agents and their products are used to control pests like weeds, insects and pathogens. Bioherbicides like cochineal insects *Lactoblastic cactorum* controlled the spread of *Opuntia*, and Baculoviruses are viral pathogens that kill insects and other arthropods.

Q. What are mycorrhiza? How does it act as a biofertiliser?

Ans. The symbiotic association of fungi and roots of higher plants is called mycorrhiza. The fungal hyphae absorbs phosphorus from soil and passes it to the soil and thus enriches the soil. It also protects plants by providing resistance from root-borne pathogens, tolerance to salinity and drought.