**Short Answer questions**

1. What is batch fermentation?
   Batch fermentation is a closed system where nutrients are added at the start and the process runs until completion.
2. What is continuous fermentation?
   Continuous fermentation is a process where fresh medium is continuously added and used medium is removed simultaneously.
3. What is fed-batch fermentation?
   Fed-batch fermentation is a modified batch process where nutrients are added periodically during fermentation.
4. What is anaerobic fermentation?
   Anaerobic fermentation is carried out in the absence of oxygen.
5. What is aerobic fermentation?
   Aerobic fermentation is carried out in the presence of oxygen.
6. What is submerged fermentation?
   It is a fermentation process where microorganisms grow in liquid medium.
7. What is surface fermentation?
   It is a process where microorganisms grow on the surface of the substrate.
8. What is solid-state fermentation (SSF)?
   SSF is the growth of microorganisms on solid materials with little or no free water.
9. What is a chemostat?
   A chemostat is a continuous culture system where growth is controlled by a limiting nutrient.
10. What is a turbidostat?
    A turbidostat maintains constant cell density by controlling turbidity.

**Short Notes**

**1. Describe continuous fermentation and its types**

Continuous fermentation is an open, steady-state bioreactor process where sterile nutrients are continuously added while an equivalent volume of fermented broth (cells and products) is removed, maintaining constant volume and environmental conditions. This keeps microorganisms in a prolonged logarithmic (exponential) growth phase, maximizing productivity and consistency compared to batch methods.

Types of Continuous Fermentation

The two main types differ in how microbial growth is controlled:

1.Chemostat: A specific growth rate is maintained by controlling the feed rate of a limiting nutrient. The concentration of the limiting nutrient determines the microbial density.

2.Turbidostat: Maintains a constant cell density (turbidity) by adjusting the feed rate based on light scattering (turbidity) in the bioreactor.

3.Semi-Continuous Systems: A hybrid method involving periodic rather than constant nutrient addition and product removal

**2. Write note on Solid State Fermentation (SSF) and its types**

Solid State Fermentation (SSF) is a fermentation method used by several industries like the pharmaceuticals, food, textile etc., to produce metabolites of microorganisms using solid support in place of the liquid medium

Initially, mostly fungi were used in such fermentation (as these microorganisms were considered to be very optimally active in very low water activity). Later, many bacterial species and yeasts were used to carry out such fermentation also.The microbiological process of SSF has generated great interest in recent years because it can be used for a variety of purposes, supported by some authors who have even indicated numerous advantages over their liquid counterparts (submerged fermentation).

Advantages of Solid-State Fermentation (SSF)

The main advantage of such methods is that it produces a minimum amount of waste and liquid effluent thus not very damaging to the environment.

Solid substrate fermentation employs simple natural solids as the media.

1. Low technology, low energy expenditure and requires less capital investment.
2. No need for sterilization, less microbial contamination, and easy downstream processing.
3. Utilization of agro-industrial residues as substrates in SSF processes provides an alternative avenue and value-addition to these otherwise under- or non-utilized residues.
4. The yield of the products is reasonably high.
5. Bioreactor design, aeration process, and effluent treatment are quite simple.
6. Many domestic, industrial and agricultural wastes can be fruitfully used in SSF