FAQs

1. **What is beer?**

   Ans: Beer is an alcoholic beverage produced by the saccharification of starch and fermentation of the resulting sugar. The starch and saccharification enzymes are often derived from malted cereal grains, most commonly malted barley. Most beer is also flavoured with hops, which add bitterness and act as a natural preservative, though other flavourings such as herbs or fruit may occasionally be included. The brewing process causes a natural carbonation effect, although forced carbonation is also used

2. **Write an account on alcohol content in beer?**

   Ans: The strength of beer may be measured by the percentage by volume of ethyl alcohol. Strong beers are in excess of 4 percent, the so-called barley wines 8 to 10 percent. Diet beers or light beers are fully fermented, low-carbohydrate beers in which enzymes are used to convert normally unfermentable (and high-calorie) carbohydrates to fermentable form. In low-alcohol beers (0.5 to 2.0 percent alcohol) and “alcohol-free” beers (less than 0.1 percent alcohol), alcohol is removed after fermentation by low-temperature vacuum evaporation or by membrane filtration. Other low-alcohol products may be produced from worts of low fermentability, using yeasts that cannot ferment maltose, or by mixing yeast separated from a normal fermentation with weak wort at a low temperature for a short time.

3. **Briefly explain the historical development of brewing process of beer.**

   Ans: Before 6000 BC, beer was made from barley in Sumer and Babylonia. Reliefs on Egyptian tombs dating from 2400 BC show that barley or partly germinated barley was crushed, mixed with water, and dried into cakes. When broken up and mixed with water, the cakes gave an extract that was fermented by microorganisms accumulated on the surfaces of fermenting vessels. The basic techniques of brewing came to Europe from the Middle East. In 1420 beer was made in Germany by a bottom-fermentation process, so called because the yeast tend to sink to the bottom of the brewing vessel; before that, the type of yeast used tend to rise to the top of the fermenting product and was allowed to overflow or was manually skimmed.

   The Industrial Revolution brought the mechanization of brewing. Better control over the process, with the use of the thermometer and saccharometer, was developed in Britain and transferred to the Continent, where the development of ice-making and refrigeration equipment in the late 19th century enabled lager beers to be brewed in summer. In the 1860s the French chemist Louis Pasteur, through his investigations of fermentation, established many of the microbiological practices still used in brewing. The Danish botanist Emile Hansen devised methods for growing yeasts in

cultures free of other yeasts and bacteria. This pure-culture technology was taken up quickly by Continental lager brewers but not until the 20th century by the ale brewers of Britain. Meanwhile, German-style lagers bottom-fermented by pure yeast cultures became dominant in the Americas. Brewing in the 21st century is a large-scale industry. Modern breweries use stainless-steel equipment and computer-controlled automated operations, and they package beer in metal casks, glass bottles, aluminum cans, and plastic containers. Beers are now exported worldwide and are produced under license in foreign countries.

4. What are bottom-fermented beers?

Ans: Bottom-fermented beers are also known as lager beers because they were stored or 'lagered' in cold cellars after fermentation for clarification and maturation. Yeasts used in bottom-fermented beers are strains of *Saccharomyces uvarum*.

5. Discuss the different types of bottom-fermented beers.

Ans: The different bottom-fermented beers are as follows

i. *Pilsener beer*: This is a pale beer with a medium hop taste. Its alcohol content is 3.0- 3.8% by weight. Classically it is lagered for two to three months, but modern breweries have substantially reduced the lagering time, which has been cut down to about two weeks in many breweries around the world. The water for Pilsener brew is soft, containing comparatively little calcium and magnesium ions.

ii. *Dortmund beer*: This is a pale beer, but it contains less hops (and therefore is less bitter) than Pilsener. However it has more body (i.e., it is thicker) and aroma. The alcohol content is also 3.0-3.8%, and is classically lagered for slightly longer: 3-4 months. The brewing water is hard, containing large amounts of carbonates, sulphates and chlorides.

iii. *Munich:* This is a dark, aromatic and full-bodied beer with a slightly sweet taste, because it is only slightly hopped. The alcohol content could be quite high, varying from 2 to 5% alcohol. The brewing water is high in carbonates but low in other ions.

iv. *Weiss:* Weiss beer of Germany made from wheat and *steam* beer of California, USA are both bottom fermented beers which are characterized by being highly effervescent.

6. What is an ale beer?

Ans: Ale beer (Pale ale) is England's own beer. English ale is a pale, highly hopped beer with an alcohol content of 4.0 to 5.0% (w/v) and sometimes as high as 8.0%. Hops are added during and sometimes after fermentation. It is therefore very bitter

and has a sharp acid taste and an aroma of wine because of its high ester content. *Mild ale* is sweeter because it is less strongly hopped than the standard Pale ale. When ale is produced in places with less suitable water, such water may be 'burtonized' ie., by the addition of calcium sulfate.

7. What is a stout beer?

Ans: Stout is a very dark heavily bodied and highly hopped beer with a strong malt aroma. It is produced from dark or caramelized malt; sometimes caramel may be added. It has a comparatively high alcohol content, 5.0-6.5% (w/v) and is classically stored for up to six months, fermentation sometimes proceeding in the bottle. Some stouts are sweet, being less hopped than usual.

8. What are the raw materials used for Beer production?

Ans: The raw materials used in brewing are: barley malt, adjuncts, yeasts, hops, and water.

- **Barley malt:** As a brewing cereal, barley has the following advantages. Its husks are thick, difficult to crush and adhere to the kernel. This makes malting as well as filtration after mashing, much easier than with other cereals, such as wheat. The second advantage is that the thick husk is a protection against fungal attack during storage. Thirdly, the gelatinization temperature (i.e., the temperature at which the starch is converted into a water soluble gel) is 52-59°C much lower than the optimum temperature of alpha-amylase (70°C) as well as of beta-amylase (65°C) of barley malt.

- **Adjuncts:** Adjuncts are starchy materials which were originally introduced. Starchy adjuncts, which usually contain little protein contribute, after their hydrolysis, to fermentable sugars which in turn increase the alcoholic content of the beverage. Adjuncts thus help bring down the cost of brewing because they are much cheaper than malt. They do not play much part in imparting aroma, color, or taste.

- **Hops:** Hops are the dried cone-shaped female flower of hop-plant *Humulus lupulus* (synomyn: *H. americanus, H. heomexicams, H. cordifolius*).

- **Water:** The mineral and ionic content and the pH of the water have profound effects on the type of beer produced. Some ions are undesirable in brewing water: nitrates slow down fermentation, while iron destroys the colloidal stability of the beer. In general calcium ions lead to a better flavor than magnesium and sodium ions. Calcium and bicarbonate ions are most important because of their effect on pH. Water is so important that the natural

water available in great brewing centers of the world lent special character to beers peculiar to these centers.

- **Brewer's yeasts:** Yeasts in general will produce alcohol from sugars under anaerobic conditions, but not all yeasts are necessarily suitable for brewing. Brewing yeasts are able, besides producing alcohol, to produce from wort sugars and proteins a balanced proportion of esters, acids, higher alcohols, and ketones which contribute to the peculiar flavor of beer.

9. Write an account on importance and effects of hops used in beer production?

Ans: The importance of hops in brewing lies in its resins which provide the precursors of the bitter principles in beer and the essential (volatile) oils which provide the hop aroma. In the original Pilsener beer the amount of hops added is about 4 g/liter, but smaller amounts varying 0.4-4.0 g/liter are used elsewhere. The addition of hops has several following effects:

- Originally it was to replace the flat taste of unhopped beer with the characteristic bitterness and pleasant aroma of hops.
- Hops have some anti-microbial effects especially against beer sarcina (*Pediococus damnosus*) and other beer spoiling bacteria.
- Due to the colloidal nature of the bitter substances they contribute to the body, colloidal stability and foam head retention of beer.
- The tannins in the hops help precipitate proteins during the boiling of the wort; these proteins if not removed cause a haze (chill haze) in the beer at low temperature.

10. Which are the two types of brewers' yeasts used commonly in brewing process**?**

Ans: The two types of brewers' yeasts used commonly in brewing process are *Saccharomyces cerevisiae* and *Saccharomyces uvarum* (i.e. the top and the bottom-fermenting yeasts). Yeasts are reused after fermentation for a number of times which depend on the practice of the particular brewery. Mutation and contamination are two hazards in this practice, but they are inherent in all inocula.

11. What are the sources of adjuncts used for the beer production?

Ans: Adjuncts are starchy materials which were originally introduced. Starch sources such as sorghum, maize, rice, unmalted barley, cassava, potatoes can or have been used, depending on the price. Corn grits (defatted and ground), corn syrup, and rice are most widely used in the United States. Since adjuncts contain little nitrogen, all the needs for the growth of the yeast must come from the malt. The malt/adjunct ratio hardly exceeds 60/40.

12. List out the important steps carried out for the beer production?

Ans: The important brewing processing steps for beer production involves malting, milling, mashing, extract separation, hop addition and boiling, removal of hops and precipitates, cooling and aeration, fermentation, separation of yeast from young beer, aging, maturing, and packaging. The object of the entire process is to convert grain starches to sugar, extract the sugar with water, and then ferment it with yeast to produce the alcoholic, lightly carbonated beverage.

13. Write a brief account of beer production?

Ans: Malting: Malting modifies barley to green malt, which can then be preserved by drying. The process involves steeping and aerating the barley, allowing it to germinate, and drying and curing the malt. In order to be fermented by yeast, the food reserve of barley ie., starch must be converted into simple sugars by enzymes such as α- and β-amylases which carry out the conversion. Malting begins by immersing barley, harvested at less than 12 percent moisture, in water at 12 to 15°C for 40 to 50 hours. During this steeping period, the barley may be drained and given air rests, or the steep may be forcibly aerated.

- **Germination**
  In traditional malting, the steeped barley was placed in heaps called couches and, after 24 hours, spread on a floor to permit germination.
- **Kilning**
  In the first stage of kilning, a high flow of dry air at 50°C for lager malt and 65°C for ale malt is maintained through a bed of green malt. This lowers the moisture content from 45 to 25 percent. A second stage of drying removes more firmly bound water, the temperature rising to 70–75°C and the moisture content falling to 12 percent. In the final curing stage, the temperature is raised to 75–90°C for lager and 90–105°C for ale. The finished malt is then cooled and screened to remove rootlets.

- **Mashing**
  After kilning, the malt is mixed with water at 62 to 72°C, and the enzymatic conversion of starch into fermentable sugar is completed. The aqueous extract (wort) is then separated from the residual “spent” grain.

- **Milling**
  For efficient extraction with water, malt must be milled. The object is to retain the husk relatively intact while breaking up the brittle, modified starch into particles.

- **Mixing the Mashing**
  Traditionally, mashing may be one of two distinct types. The simplest process, infusion mashing, uses a well-modified malt, two to three volumes of water per volume of malt, a single vessel, and a single temperature in the range of 62 to 67°C. With well-modified malt, breakdown of proteins and glucans has already

occurred at the malting stage, and at 65°C the starch readily gelatinizes and the amylases become very active. Less-well-modified malt, however, benefits from a period of mashing at lower temperatures to permit the breakdown of proteins and glucans. This requires some form of temperature programming, which is achieved by decoction mashing. After grist is mashed in at 35 to 40 °C, a proportion is removed, boiled, and added back. Mashing with two or three of these decoctions raises the temperature in stages to 65 °C .

- **Boiling and fermenting**

  Boiling

  After separation, the wort is transferred to a vessel called the kettle or copper for boiling, which is necessary to arrest enzyme activity and to obtain the bitterness value of added hops.

- **Hops**

  Several varieties of the hop are selected and bred for the bitter and aromatic qualities that they lend to brewing. The female flowers, or cones, produce tiny glands that contain the chemicals of value in brewing. Humulones are the chemical constituents extracted during wort boiling. Traditionally, the dried hop cones are added whole to the boiling wort, but powdered compressed hops are often used because they are more efficiently extracted. In addition, the hop components may be extracted by solvents such as liquid carbon dioxide and added in this form to the wort or, after isomerization, to the finished beer.

- **Heating and Cooling**

  The kettle boil lasts 60 to 90 minutes, sterilizing the wort, evaporating undesirable aromas, and precipitating insoluble proteins (known as hot break, or trub). Trub and spent hops are then removed in a separator where the hop cones form the filter bed. Clarified wort is cooled, formerly in shallow troughs or by trickling down an inclined cooled plate but now in a plate heat exchanger. Oxygen is added at this stage, and the cooled wort passes to fermentation vessels.

- **Fermentation**

  In this most important stage of the brewing process, the simple sugars in wort are converted to alcohol and carbon dioxide, and green (young) beer is produced. Fermentation is carried out by yeast, which is added, or pitched, to the wort at 0.3 kilogram per hectolitre (about 0.4 ounce per gallon), yielding approximately 1 crore (10,000,000) cells per millilitre of wort. In brewing it is traditional to refer to ale yeasts used predominantly in top fermentation as top strains of *S. cerevisiae* and to lager yeasts as bottom strains of *S. carlsbergensis*.

- **Maturation and packaging**

  A slow secondary fermentation of residual or added sugar (called primings) or, in lager brewing, the addition of actively fermenting wort generates carbon dioxide, which is vented and purges the green beer of undesirable volatile compounds. Continued yeast activity also removes strong flavouring compounds such as

diacetyl. Allowing pressure to build up in the sealed vessel then increases the level of carbonation, giving the beer its "condition." In traditional brewing, large volumes of ale were conditioned in tanks for seven days at 15 °C, whereas lagers were matured at 0 °C for up to three months. Beer produced on a large scale in modern breweries is kept free of oxygen (which ultimately spoils beer), filtered through cellulose or diatomaceous earth to remove all yeast, and packaged at 0 °C under pressure of carbon dioxide. Beer produced by high-gravity brewing is diluted to the desired alcohol concentration immediately prior to packaging with oxygen-free, carbonated water. Most beers packaged in bottles or metal cans are pasteurized in pack by heating to 60°C for 5 to 20 minutes. Beer is also packaged into metal kegs of 50-litre capacity after pasteurization at 70 °C for 5 to 20 seconds.

14. What is the purpose of following a step called germination during brewing process?

Ans: Because respiration of the grain causes oxygen to be taken up and carbon dioxide and heat to be produced, control of aeration, ventilation, and temperature was achieved by manually turning the grain. Large-scale floor maltings with mechanical turners were introduced, later replaced by pneumatic maltings, in which germination occurred in boxes with the bed automatically turned, aerated, and ventilated with forced air. In some malting operations, gibberellic acid is sprayed onto the barley to speed germination, and bromates are used to suppress rootlet growth and malting loss.

15. Briefly write an account on a sorghum beer?

Ans: Barley is a temperate crop. In many parts of tropical Africa beer has been brewed for generations with locally available cereals. The commonest cereal used is *Sorghum bicolour* (= *Sorghum vulgare*) known in the United States as milo, in South Africa as kaffir corn and in some parts of West Africa as Guinea corn. The cereal which is indigenous to Africa is highly resistant to drought. Sorghum is often mixed with maize (*Zea mays*) or millets, (*Pennisetum* spp). In some cases such as in Central Africa e.g. Zimbabwe, maize may form the major cereal. Outside Africa sorghum is not used normally for brewing except in the United States where it is occasionally used as an adjunct. The method for producing these sorghum beers of the African continent as well as their nature is remarkably similar.

- They are all pinkish in color; sour in taste; and of fairly heavy consistency imposed partly by starch particles
- They are consumed without removal of the organisms;
- They are not aged, or clarified, and
  They include a lactic fermentation..