Qualifications

The General Certificate in Brewing (GCB)

Examination Syllabus 2019

Unit 1: Overview and Glossary

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
1.1	Definition of beer and types of beer	1. A generic, non-legalistic definition of beer in terms of its typical ingredients and methods of production. Characteristics which differentiate lagers, ales and stouts. 2.
1.2	Brewing process overview	1. The sequence of events from raw material intake to the preparation of beer for packaging and the typical points of use for raw materials and process aids. A representation of the brewing process as a flow diagram. 2.

Unit 2: Raw Materials

Lesson: Water

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
2.1	Water sources and treatments	1. Characteristics and quality of an ideal brewery water supply. 2. Sources of water for a brewery. 3. The basic principles and diagrammatic representation treatment plants for: - water filtration - water sterilization - water softening / deionization - water de-aeration

Lesson: Malt

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
2.2	Barley and malt	1. The role of barley as a principal source of starch. 2. The special attributes of barley for malting. 3. The significant changes that occur when the barley grain is malted. 4. The principal constituents of malt. 5. The key malt parameters of degree of modification, extract content, moisture content, extract, and colour. 6. The selection of malt for beer type and mash conversion method. 7. Pre-acceptance checks at malt intake.

Lesson: Hops

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
2.3	The nature of hop bitterness	1. The nature and origins of hops and hop products. 2. Isomerization and how hops or hop products yield bitterness during wort boiling. 3. How alternative or supplementary additions of hop bitterness are made at later stages in brewing.

Lesson: Yeast

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
2.4	Brewing yeast	1. Basic understanding of the relationship of brewing yeast to other living organisms. 2. The differences between the bottom-fermenting/cropping (lager) and top- fermenting/cropping (ale) yeasts in terms of their practical brewing applications. 3. The microscopic appearance of a yeast cell. 4. The nutritional requirements of yeast derived from wort including trace elements.

Lesson: Adjuncts

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:

2.5	Adjuncts and coloured malts	1. Reasons for the use of adjuncts. 2. Types of adjunct and their method of use. 3. Typical usage rate as proportion of the grist. 4. Types of coloured malt and their characteristics. 5. Typical uses of coloured malts.

Unit 3: Wort Production

Lesson: Milling

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
3.1	Brewhouse plant operation – grain handling and milling	1. The purposes of milling with respect to the type of mashing / mash separation systems available. 2. The significance of grist fraction analysis (expressed in quantitative terms) and its assessment. 3. The operating principles and diagrammatic representation of malt mills and their associated malt preparation equipment. [i] 4. Grain handling and safety.

Lesson: Mashing

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:

3.2	Mash conversion	1. The respective roles of the amylases and protease, the effect of temperature, pH and time on their activity. 2. Temperature and wort viscosity. 3. The influence of the ionic composition (hardness salts) of mashing water in the mash and on beer flavour. 4. The starch test. 5. Key sweet wort parameters of fermentability.
3.3	Grist composition and extract performance	1. The extract yield of raw materials. 2. Malt and adjunct quantities required for a grist from theoretical material extract values. 3. Calculation of brewhouse extract performance.
3.4	Brewhouse plant operation – mashing and conversion	1. The operating principles and diagrammatic representation of mashing/mash conversion systems, including the cereal-cooking vessel, if appropriate. [ii] 2. An awareness of the operational differences between isothermal (mashtun) conversion and temperature programmed conversion vessels. 3. A quantitative knowledge of typical times, temperatures and grist ratios used in the conversion vessel. 4. The qualitative assessment of starch conversion.

Lesson: Mash Separation

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
3.5	Brewhouse plant operation – wort separation	1. The operating principles and diagrammatic representation of wort separation devices. 2. The significance of cycle times for brewhouse capacity. 3. Methods for the assessment of wort clarity / solids content. 4. Use of spent grains as a co-product.

Lesson: Wort Boiling

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
3.6	Wort boiling	1. The purposes of boiling: sterilization, stabilization of enzyme action, evaporation, coagulation and precipitation of protein (trub formation) and beer haze precursors, flavour development other than hop bitterness, and colour formation. 2. Factors affecting the effectiveness of wort boiling. 3. The purposes of liquid adjunct additions to the wort kettle.
3.7	Wort boiling systems	1. The operating principles and diagrammatic representation of wort boiling systems.[iii] 2. Typical boiling times and hop addition practices.
3.8	Hop calculations	1. How bitterness value of beer is expressed and typical values. 2. The bitterness potential of hops. 3. Calculation of required hop addition rates to achieve a given beer bitterness. 4. Calculation of hop utilization.

Lesson: Wort Clarification, Cooling & Oxygenation

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:

3.9	Wort clarification	1. The potential of trub constituents, spent hops, etc in boiled wort to detract from beer quality. 2. Methods available for kettle fining. 3. Methods available for the removal of trub and / or spent hops. 4. The basic operating principles and diagrammatic representation of wort clarification devices. [iv]
3.10	Wort cooling	1. The purposes of wort cooling. 2. The effect of cooling on wort constituents. 3. Methods available for cooling wort. 4. The basic operating principles and diagrammatic representation of a type of wort cooler.
3.11	Wort oxygenation / aeration	1. The purpose of wort oxygenation. 2. Methods of wort oxygenation / aeration and values achievable. 3. The basic operating principles and diagrammatic representation of wort oxygenation systems, including the air or oxygen sterilization equipment.

Unit 4: Fermentation

Lesson: Fermentation Theory

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
4.1	Yeast selection, treatment and pitching	1. The selection of yeast for pitching. 2. Characteristics of healthy pitching yeast and the assessment of yeast condition and purity. 3. Acid washing procedures including a quantitative knowledge of time, temperature and pH ranges. 4. Yeast pitching methods. The calculation of yeast pitching rate for a fermentation.

		5.
4.2	Fermentation theory	1. The production of alcohol and carbon dioxide from wort sugars by yeast.[v] 2. Key flavour compounds produced by yeast. 3. The main phases and events of brewery fermentations. 4. The significance of the presence and absence of dissolved oxygen. 5. Other factors affecting the phases of fermentations. 6. Other factors affecting the speed of fermentations.

Lesson: Fermentation Practice

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
4.3	Fermentation vessels and their control	**1.** General knowledge of the basic requirements of brewery fermentation vessels**.** **2.** The operating principles and diagrammatic representation of fermentation vessels, the reasons for their choice, their advantages and disadvantages.[vi] **3.** Reasons for temperature control. **4.** Procedures for the temperature control of fermentations**.**

4.4	Health and Safety	1. The evolution of carbon dioxide from fermentations. 2. The hazards associated with carbon dioxide. 3. The monitoring / checking of atmospheres for safe working including a quantitative knowledge of exposure limits. 4. Safe working practices for fermenting room operations.

Lesson: Yeast Propagation

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
4.5	Yeast propagation, storage and cropping	1. The reasons for yeast propagation. 2. Basic procedures for producing a pure culture yeast. 3. The operating principles and diagrammatic representation of a yeast culture plant. 4. The purposes and timing of yeast cropping. 5. The operating principles and diagrammatic representation of systems for the removal of yeast from a completed fermentation. [vii] 6. The monitoring of yeast growth. 7. The conditions necessary for the storage of either pressed or liquid yeast.

Unit 5: Maturation

Lesson: Maturation

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:

5.1	Warm maturation	1. The purposes of warm maturation. 2. Typical times and temperatures appropriate to different beer types. 3. Typical changes affecting beer flavour.
5.2	Cold storage and stabilization	1. The purposes of cold storage. 2. Typical times and temperatures appropriate to different beer types. 3. The general principles of stabilization. 4. Haze precursors and their removal. 5. The nature and action of the principal types of stabilizing agents.

Lesson: Carbonation

Bright beer preparation (for Mainstream Brewery option A).

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
5.3a	Chilling and carbonation	1. The operating principles and diagrammatic representation of a beer chiller (plate or shell and tube). 2. The purposes of carbonation. 3. Typical dissolved CO_2 levels for different beer types. 4. Location in process of carbonation points. 5. The operating principles and diagrammatic representation of a carbonator.

Lesson: Filtration and Clarification

Bright beer preparation (for Mainstream Brewery option A).

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
5.4a	Filtration	1. The purposes of filtration. 2. The principles of filtration – sieving, depth and absorption. 3. The origin, nature and preparation of filter aid – diatomaceous earth (kieselguhr) and perlite.
		4. The operating principles of a rough beer filter. 5. The types of beer sterilizing (polishing) filters available. 6. Representation of the sequence of events in a typical filtration system as a flow diagram. 7. Awareness of alternative rough beer filter types – cross flow filtration. 8. The health and safety hazards associated with filter aids. Personal protection equipment (PPE) and the plant safety features necessary.

Lesson: High Gravity Dilution

Bright beer preparation (for Mainstream Brewery option A).

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
5.5a	High gravity dilution	1. Reasons for brewing at high gravity. 2. Typical quality specifications for water to be used for dilution (quantitative data required). 3. Deaerated water production. 4. The calculation of blending quantities.
5.6a	Considerations for other package types	1. Cask conditioned beer.

Lesson: Cask and Bottle Conditioned Beer

Cask and craft beer preparation and packaging (for Craft option B)

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
5.3b	Cask beer preparation for racking	1. The purposes of cask conditioning. 2. The importance of controlling yeast concentration / count, and typical values. 3. Conditioning and the necessity for residual fermentable sugars, with typical values.
5.4b	Clarification of cask beer	1. Clarification of cask conditioned beer. 2. The origin, nature and action of auxiliary and isinglass finings. 3. Storage of prepared finings prior to use. 4. Typical addition rates and procedures for finings. 5. The operating principles and diagrammatic representation of finings addition equipment.
		6. Reasons for the addition of priming sugar. 7. Types of hops and hop products used for cask beer. 8. Reasons for addition of hops or hop products.
5.5b	Cask washing and racking	1. Preparation and inspection of casks for racking. 2. Cask filling practice, typical temperature specifications, filling volume control. 3. Conditioning in cask including storage temperature, the use of soft/hard pegs and shelf life.

5.6b	Craft beer preparation for packaging	1. The operating principles and diagrammatic representation of a beer chiller (plate or shell and tube). 2. The purposes of filtration. 3. The principles of filtration – sieving, depth and absorption. 4. The operating principles of a small scale rough beer filter. 5. The types of small scale beer sterilizing (polishing) filters available. 6. The health and safety hazards associated with filter aids. Personal protection equipment (PPE) and the plant safety features necessary.
5.7b	Considerations for other package types	1. Bottled conditioned beer.

Unit 6: Quality

Lesson: Process Control

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
		Key parameters examined in this section are: *Original gravity (OG), present gravity (PG), alcohol content (ABV %), pH, colour, haze, bitterness, head retention or foam stability, dissolved oxygen, dissolved carbon dioxide.*
6.1	Process specifications	1. The variable nature of the natural ingredients of beer. 2. The purpose of process specifications. 3. Effects of the brewing process on the final product value of these key parameters.

6.2	Process control	1. The principles of monitoring and adjustment to achieve product consistency. 2. Simple statistical quality control procedures. 3. The concepts of tolerance and range for specification parameter values. 4. Typical specifications which differentiate beer types. 5. Typical process specification ranges, especially those requiring periodic adjustment to achieve product consistency. Typical applications for in-line and on-line instruments for process control. 6.

Lesson: Sensory Assessment

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
6.3	Terminology, evaluation and tasting during brewing operations	1. The reasons for adopting industry standard descriptors for flavour. 2. The flavour wheel. 3. The more commonly used components. 4. Taste training procedures. 5. The three-glass test – statistical significance rating. 6. Flavour profiling. 7. Trueness to type panel tasting. 8. Common faults / contamination by contact materials that may be detected by tasting during brewing operations.

Lesson: Dissolved Oxygen

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:

6.4	The spoilage of beer by oxygen	1. Sensitivity of beer to small amounts of oxygen – typical levels causing spoilage. 2. Basic mechanism for haze formation. 3. Oxidation reactions to form flavour compounds. 4. Typical flavour descriptors for oxidation effects. 5. Oxygen as a constituent of air. 6. Typical points of exposure of beer to air.
6.5	Monitoring and control of dissolved oxygen levels	1. Key control points. 2. The significance of sampling time. 3. Operating a dissolved oxygen meter. 4. Typical specified maximum levels. 5. Good practices to avoid oxygen pick-up. 6. The use of sulphur dioxide, ascorbic acid and potassium meta-bisulphite (KMS).

Lesson: Microbiological Contamination

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
6.6	Beer spoilage	1. Anaerobic growth. 2. Typical spoilage products formed. 3. Effects on beer quality of microbiological spoilage, appropriate use of flavour descriptors to describe spoilage. [See also section 12.1]
6.7	Spoilage organisms	1. The principal categories of spoilage organisms: *Pediococcus, Lactobacillus, Acetobacter, Obesumbacterium*, *Megasphaera,* wild yeasts and their common points of contamination in the brewery.
6.8	Detection and monitoring	1. Methods of sampling for microbiological testing. 2. Sampling points.

6.9	Control	1. Practices to protect against infection. 2. Measures to combat known sources of contamination.

Lesson: Quality Management

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
6.10	Features of a quality system	1. The key features of a quality system: - written specifications - written procedures - monitoring of performance - corrective actions - auditing - regular reviews for improvement
6.11	Roles responsibilities and benefits	1. The impact of individual actions on product and service quality. 2. The control of documentation. 3. The maintenance of conformity. 4. The business benefits of an effective quality management system.
6.12	Product safety	1. The control of product safety. Hazard Analysis Critical Control Point (HCCP). 2. The importance of traceability for product recall.

Unit 7: Hygiene

Lesson: Detergents and Sterilizing Agents

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
7.1	Detergents	1. Types of detergent (alkali, acid and neutral). 2. The constituents of detergents. 3. The individual functions of the constituents. 4. Criteria for choice of detergent for an application. 5. Considerations for the use of hot detergent cleaning.
7.2	Sterilants	1. Types of sterilant as defined by the active agent. 2. Criteria for choice of sterilant for an application. 3. The effect of sterilant residues on beer quality.
7.3	Heat sterilization	1. Uses of steam and hot water as a sterilant. 2. Time and temperature.
7.4	Safety	1. The hazards associated with chemical cleaning and sterilizing agents. 2. Good practices for the storage of chemicals. 3. Use of personal protective equipment (PPE). 4. Procedures in case of accidental spillage or discharge of chemicals.

Lesson: CIP

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:

7.5	Types of CIP systems	1. The general differences between single use and recovery systems – advantages and disadvantages. 2. The types of cleaning head used and reasons for their choice. 3. The operating principles and diagrammatic representation of CIP systems.
7.6	CIP cleaning cycles	1. Typical cleaning programs and cycle times. 2. The function of each of the cleaning cycle stages. 3. Quality assurance of cleaning operations.
7.7	CIP plant design hygiene considerations	1. Design features that minimize soil accumulation in brewery vessels and pipelines. 2. Design features that facilitate vessel and pipeline cleaning using a CIP system. 3. Design features which promote a hygienic working environment.
7.8	General plant cleaning	1. Cleaning plant surfaces, walls and floors. 2. The constituents of foam cleaning agents. 3. The use of foaming systems.

Unit 8: Engineering / Utilities / Environment

Lesson: Engineering

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
8.1	Engineering basics	This subsection is not examined.

8.2	Brewing Plan – Maintenance Approaches and Tasks	1. The key business reasons for an effective maintenance system. 2. The features, advantages, disadvantages and applications of: - no maintenance - breakdown maintenance - preventive maintenance - predictive maintenance 3. The contribution of maintenance tasks to plant safety, reliability, quality, economics and environmental impact. 4. Familiarity with key maintenance tasks: - mechanical - electrical - calibration - inspection - condition monitoring - cleaning of plant - health and safety 5. Maintenance planning and record keeping. 6. Autonomous maintenance.
8.3	Performance improvements	1. The key features of the following performance improvement systems: - Reliability Centred Maintenance (RCM) - Total Productive Maintenance (TPM) - Workplace Organisation (5S)

Lesson: Utilities

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
8.4	Water types and uses	1. Differentiation and typical uses of: - de-aerated water - process water - service water 2. *Legionella* in cooling water and service water and the health risks associated with the micro-organism. 3. Points at which water is introduced into the process and the special water quality needed at these points.

8.5	Sources of effluent and its measurement	1. The nature and characteristics of effluent from principal brewery operations. 2. The components of effluent quality: - volume - suspended solids (SS) - chemical oxygen demand (COD) - biological oxygen demand (BOD) - pH - temperature
8.6	Properties, applications and safety	1. The essential properties and quality of compressed air and oxygen for use as process gases. 2. The essential properties of carbon dioxide and nitrogen for use as process gases. 3. The practice and benefits of carbon dioxide collection. [viii] 4. The significance of inertness. 5. Typical uses for process gases. 6. The economic importance of leak prevention. 7. Safe handling and storage of compressed gas cylinders. 8. Safety hazards associated with storage of liquid gases and their distribution in high-pressure mains.

Lesson: Environment

Ref.	Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
8.7	Sustainability and climate change	1. The concept of a sustainable industry. 2. The role of carbon dioxide – the carbon cycle. 3. Sources of carbon dioxide emissions.

8.8	Conservation	1. Principal energy consuming activities in a brewery. 2. Typical energy reduction strategies. 3. Principal water consuming activities. 4. Typical water conservation strategies.
8.9	Waste	1. Principal waste generating activities in a brewery. 2. Issues for waste disposal. 3. Strategies to minimize waste and encourage recycling.

Notes for examiners and tutors.

[i] Options include 4, 5, and 6 –roll dry mills, wet mill, and hammer mill. The malt preparation equipment, appropriate to the type of mill, includes screens, destoners, weighers and malt conditioning devices. Candidates should be aware of the different operating principles of a dry roll mill, a wet mill and a hammer mill, and their association with the type of mash separation device used. [ii]

For decoction systems incorporating a cereal cooker, familiarity with the plant configuration is expected but the quantitative data required is restricted to the temperatures achieved in the main conversion vessel. Details of volumes and cereal temperatures are not required. [iii]

Candidates may be aware of other systems, but questions will only be asked on 'traditional' wort boiling systems. [iv]

Wort filtration systems using filter aids are not required. [v]

Knowledge of metabolic pathways and yeast enzymes is not required. [vi]

No knowledge of continuous fermentation systems is required. [vii]

Includes green beer centrifuging, though questions will not be asked about the centrifuges themselves. [viii]

No knowledge of the collection and compression plant is required. Candidates should be aware of the economic and environmental arguments for collection and the operational procedures for the timing of collect.