



## **Qualifications**

# **General Certificate in Packaging (Beer)**

## **Examination Syllabus**

## Unit 1: An Overview – Beer Types and their Packaging

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Definition of beer and types of beer	<ul style="list-style-type: none"> <li>• A generic, non-legalistic definition of distilled beer in terms of its typical ingredients and methods of production</li> <li>• Characteristics which differentiate lagers, ales and stouts</li> </ul>
Definition of packaging and package types	<ul style="list-style-type: none"> <li>• The definition of packaging in terms of its aims to meet the needs of the packager, customers, consumers, and typical regulatory requirements</li> <li>• The concept of due diligence to ensure consumer safety</li> <li>• A general knowledge of different types of packaging containers and their suitability to meet differing market conditions</li> </ul>

## Unit 2: Bright Beer Production, Storage and Handling

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Bright beer filtration	<ul style="list-style-type: none"> <li>• The purposes of beer filtration</li> <li>• The basic principles of beer filtration</li> </ul>
Transfer of filtered beer and bright beer handling	<ul style="list-style-type: none"> <li>• A working knowledge of the key operational procedures</li> <li>• Basic design features of plant and pipe work (not cleaning)</li> <li>• Significance of atmospheric oxygen and the use of inert gases.</li> <li>• The essential plant items from the outlet of a filter to a bright beer tank and from the bright beer tank to a filling machine</li> </ul>
Storage	<ul style="list-style-type: none"> <li>• The purposes of storage (holding)</li> <li>• Equilibration and sampling</li> <li>• Minimum and maximum residence times</li> <li>• Beer blending procedures</li> <li>• Calculations using beer blend parameters</li> </ul>

## Unit 3: Beer Pasteurisation, Sterile Filtration and Filling

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Pasteurisation	<ul style="list-style-type: none"> <li>• The purposes of pasteurisation</li> <li>• A description of pasteurisation and the concept of pasteurisation units (PU)</li> <li>• The significance of the presence of dissolved oxygen before pasteurisation</li> </ul>
Types of pasteurisers and their principal features	<ul style="list-style-type: none"> <li>• The principal features of plate (flash) and tunnel pasteurisers</li> <li>• The differences between tunnel and flash pasteurisers in the achievement of typical values</li> <li>• The diagrammatic representation of the beer/container flows through the sections/zones of plate and tunnel pasteurisers, and their typical operating parameters</li> </ul>
Sterile filtration	<ul style="list-style-type: none"> <li>• An awareness of different types of sterile filters and their operation</li> <li>• The basic principles of sterile filtration</li> </ul>

## Unit 4 (CAN): Specialist Section - Cans and Associated Packaging Materials

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Can design	<ul style="list-style-type: none"> <li>• A detailed description of the principal characteristics of a can – shape, dimensions, suitability for beer, special features, and wear and tear</li> <li>• A simple labelled diagram of a can including the seamed end</li> </ul>
Cans and associated packaging materials	<ul style="list-style-type: none"> <li>• Materials of construction for cans and ends.</li> <li>• Typical sizes and the importance of dimensions.</li> <li>• Can decoration.</li> <li>• Types of associated packaging materials and their application</li> </ul>

## Unit 4 (KEG): Specialist Section - Cans and Associated Packaging Materials

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Keg design	<ul style="list-style-type: none"> <li>• A description of the principal characteristics of a keg and extractor (spear) – shape, dimensions, suitability for beer, special features, and wear and tear</li> <li>• A simple labelled diagram of a sealed keg including details of the extractor (spear) and closure</li> </ul>
Keg materials of construction and associated packaging materials	<ul style="list-style-type: none"> <li>• Materials of construction for kegs, extractor (spear) and their main characteristics</li> <li>• The principal features of caps, labels, pallets, spacer boards/unitizers/locator boards</li> </ul>

## Unit 4 (NRB): Specialist Section - Non-Returnable Glass Bottles (NRB) and Associated Packaging Materials

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
NRB design	<ul style="list-style-type: none"> <li>• A detailed description of the principal characteristics of a non-returnable bottle and its crown/closure - shape, dimensions, suitability for beer, special features, and wear and tear</li> <li>• A simple labelled diagram of an NRB including the sealed crown/closure</li> </ul>
NRB and associated packaging materials	<ul style="list-style-type: none"> <li>• Characteristics of bottles including colours</li> <li>• Materials of construction for crowns/closures</li> <li>• The importance of dimensions</li> <li>• NRB permanent decoration</li> <li>• Types of associated packaging materials and their application</li> </ul>

## Unit 4 (RB): Specialist Section - Returnable Glass Bottles (RB) and Associated Packaging Materials

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
RB design	<ul style="list-style-type: none"> <li>• A detailed description of the principal characteristics of a returnable bottle and its crown/closure - shape, dimensions, suitability for beer, special features, and wear and tear</li> <li>• A simple labelled diagram of a RB including the sealed crown/closure</li> </ul>
NRB and associated packaging materials	<ul style="list-style-type: none"> <li>• Characteristics of bottles including colours</li> <li>• Materials of construction for crowns/closures</li> <li>• The importance of dimensions</li> <li>• RB permanent decoration</li> <li>• Types of associated packaging materials and their application</li> </ul>

## Unit 5 (CAN): Specialist Section - Canning Line

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Principal plant items	<ul style="list-style-type: none"> <li>• The function of each plant items</li> <li>• The key operational features of each plant item</li> <li>• The sequence of events for a canning line from empties handling to finished products being discharged from the line [A representation of a total can line operation as a labelled flow diagram]</li> <li>• Plant arrangement and compliance with health and safety</li> </ul>
Can filling systems	<ul style="list-style-type: none"> <li>• The principal operating features of can filling systems</li> <li>• A simple diagram of a filler</li> <li>• Sequence of events and processes during filling</li> <li>• Can transfer and systems to prevent oxygen pick-up</li> </ul>
Control of filling levels	<ul style="list-style-type: none"> <li>• The control of filling levels and the causes of over / under filling</li> <li>• The use of a filling control chart system</li> <li>• The reason for other filling faults and their causes</li> </ul>
Can seaming	<ul style="list-style-type: none"> <li>• The principal operating features of a seamer</li> <li>• A simple labelled diagram of a seamed can</li> <li>• Methods to avoid oxygen pick-up during seaming</li> </ul>

## Unit 5 (KEG): Specialist Section - Kegging Line

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Principal plant items	<ul style="list-style-type: none"> <li>• The purposes of each plant item</li> <li>• The key operational features of each plant item</li> <li>• The sequence of events for a kegging line from empties handling to finished products being discharged from the line [A representation of a total keg line operation as a labelled flow diagram]</li> <li>• The main stages of keg cleaning and sterilisation</li> <li>• Plant arrangement and compliance with health and safety</li> </ul>
Internal Keg cleaning/sterilising	<ul style="list-style-type: none"> <li>• The purposes of internal cleaning and sterilising</li> <li>• The principal operating features of internal keg cleaning/sterilising systems</li> <li>• A description of the normal sequence of events</li> <li>• Times, temperatures, detergent strengths</li> <li>• A diagrammatic representation of a keg being cleaned and sterilised</li> <li>• Rejection of kegs and the reasons</li> </ul>
Keg filling systems	<ul style="list-style-type: none"> <li>• The principal operating features of keg filling systems and how filling levels in the keg are controlled</li> <li>• Cause of over and or under filling</li> <li>• The use of a filling control chart system</li> <li>• A diagram of a keg being filled</li> </ul>
Heat sterilisation	<ul style="list-style-type: none"> <li>• Use of steam and hot water as a sterilising agent</li> </ul>

## Unit 5 (NRB): Specialist Section - The Non-Returnable Glass Bottling Line

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Principal plant items	<ul style="list-style-type: none"> <li>• The purposes of each plant item</li> <li>• The key operational features of each plant item</li> <li>• The sequence of events for a bottling line from empties handling to finished products being discharged from the line. [A labelled flow diagram of a complete NRB line operation]</li> <li>• Plant arrangement and compliance with health and safety requirements</li> </ul>
Bottle filling systems	<ul style="list-style-type: none"> <li>• The principal operating features of filling systems.</li> <li>• A simple diagram of filler</li> <li>• Sequence of events and processes during filling.</li> <li>• The control of filling levels and the causes of over / under filling</li> <li>• The use of a filling control chart system</li> <li>• Full bottle transfer and systems to prevent oxygen pick-up</li> <li>• The reasons for other filling faults and their causes</li> </ul>
Bottle crowner and other closure methods	<ul style="list-style-type: none"> <li>• The principal operating features of a crowner and crimping tolerances</li> <li>• A simple labelled diagram of a crown closure</li> <li>• Other methods of closing a bottle</li> <li>• Methods to avoid oxygen pick-up</li> </ul>
Sterile filling	<ul style="list-style-type: none"> <li>• The special arrangements at the filler for sterile filling</li> </ul>

## Unit 5 (RB): Specialist Section - The Returnable Glass Bottling Line

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Principal plant items	<ul style="list-style-type: none"> <li>• The purposes of each plant item</li> <li>• The key operational features of each plant item</li> <li>• The sequence of events for a bottling line from empties handling to finished products being discharged from the line. [A labelled flow diagram of a complete RB line operation]</li> <li>• Plant arrangement and compliance with health and safety requirements</li> </ul>
Bottle filling systems	<ul style="list-style-type: none"> <li>• The principal operating features of a bottle washer with a quantitative knowledge of solution strengths and temperatures</li> <li>• The principal operating features of filling systems</li> <li>• A simple diagram of filler</li> <li>• Sequence of events and processes during filling</li> <li>• The control of filling levels, the causes of over / under filling</li> <li>• The use of a filling control chart system</li> <li>• Full bottle transfer, systems to prevent oxygen pick up</li> <li>• The reasons for other filling faults and their causes</li> </ul>
Bottle crowner	<ul style="list-style-type: none"> <li>• The purpose of crowning a bottle</li> <li>• The principal operating features of a crowner</li> <li>• Crimping</li> <li>• Methods to avoid oxygen pick-up</li> <li>• A simple labelled diagram of a crown closure</li> </ul>
Sterile filling	<ul style="list-style-type: none"> <li>• The special arrangements at the filler for sterile filling</li> </ul>



## Unit 6 (CAN): Specialist Section - Can Inspection, Plant and Packaging Materials Preparation, and On-line Checks

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Preparation of plant and packaging materials	<ul style="list-style-type: none"> <li>• The concept of supplier quality assurance</li> <li>• The procedures and checks carried out on a canning line before production (including utilities)</li> <li>• Incoming quality control, on-line checks and processes carried out on a can prior to filling</li> <li>• Incoming quality control, on-line checks and processes carried out on associated packaging materials</li> <li>• The procedures for size, beer type and package changes.</li> </ul>
Empty can inspection and rinsing	<ul style="list-style-type: none"> <li>• Empty can inspection</li> <li>• The purposes and effectiveness of can rinsing</li> </ul>
On-line checks and record keeping	<ul style="list-style-type: none"> <li>• The purpose of full can checks</li> <li>• Finished pack inspection and common faults</li> <li>• The purposes and importance of on-line checks during filling, sampling and record keeping</li> <li>• Dealing with complaints</li> </ul>

## Unit 6 (KEG): Specialist Section - Keg Inspection, Plant and Packaging Materials Preparation, and On-line Checks

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Preparation of plant and packaging materials	<ul style="list-style-type: none"> <li>• The concept of supplier quality assurance</li> <li>• The procedures and checks carried out on a keg line before production (including utilities)</li> <li>• Incoming quality control, on-line checks and processes carried out on a keg prior to filling</li> <li>• Incoming quality control, on-line checks and processes carried out on associated packaging materials</li> <li>• The procedures for size and beer type changes</li> </ul>
Empty keg inspection and rinsing	<ul style="list-style-type: none"> <li>• Empty keg inspection</li> <li>• The purposes and effectiveness of keg cleaning and sterilising</li> </ul>
On-line checks and record keeping	<ul style="list-style-type: none"> <li>• The purpose of full keg checks</li> <li>• Finished keg inspection and common faults</li> <li>• The purposes and importance of on-line checks during filling, sampling and record keeping</li> <li>• Dealing with complaints</li> </ul>

## Unit 6 (NRB): Specialist Section - Bottle Inspection, Plant and Packaging Materials Preparation, and On-line Checks

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Preparation of plant and packaging materials	<ul style="list-style-type: none"> <li>• The concept of supplier quality assurance</li> <li>• The procedures and checks carried out on a non-returnable bottle line before production (including utilities)</li> <li>• Incoming quality control, on-line checks and processes carried out on a bottle prior to filling</li> <li>• Incoming quality control, on-line checks and processes carried out on associated packaging materials</li> <li>• The procedures for size, beer type and package changes</li> </ul>
Empty bottle inspection and rinsing	<ul style="list-style-type: none"> <li>• Empty bottle inspection</li> <li>• The purposes and effectiveness of bottle rinsing</li> </ul>
Quality checks and record keeping	<ul style="list-style-type: none"> <li>• The purpose of full bottle checks</li> <li>• Finished pack inspection and common faults</li> <li>• The purposes and importance of on-line checks during filling, sampling and record keeping</li> <li>• Dealing with complaints</li> </ul>

## Unit 6 (RB): Specialist Section – Bottle Washing and Inspection, Plant and Packaging Materials Preparation, and On-line Checks

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Preparation of plant and packaging materials	<ul style="list-style-type: none"> <li>• The concept of supplier quality assurance</li> <li>• The procedures and checks carried out on a returnable bottle line before production (including utilities)</li> <li>• Incoming quality control, on-line checks and processes carried out on a bottle prior to filling</li> <li>• Incoming quality control, on-line checks and processes carried out on associated packaging materials</li> <li>• The procedures for size, beer type and package changes</li> </ul>
Empty bottle inspection and rinsing	<ul style="list-style-type: none"> <li>• Empty bottle inspection</li> <li>• The purposes and effectiveness of bottle washing</li> </ul>
Quality checks and record keeping	<ul style="list-style-type: none"> <li>• The purpose of full bottle checks</li> <li>• Finished keg inspection and common faults</li> <li>• The purposes and importance of on-line checks during filling, sampling and record keeping</li> <li>• Dealing with complaints</li> </ul>

## Unit 7: Labelling and Coding

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Labelling and coding	<ul style="list-style-type: none"> <li>• The purposes of labelling and coding</li> <li>• The reasons for bar coding</li> <li>• Locations on containers and final packages for coding information</li> <li>• The importance of record keeping</li> </ul>

## Unit 8: Measurement and Reporting of Line Capacity and Packaging Performance

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Efficiency reporting	<ul style="list-style-type: none"> <li>• The purposes of efficiency reporting</li> <li>• Typical efficiency calculations and the analysis of data [Candidates will be presented with data to carry out typical calculations of performance indicators]</li> <li>• A description of a typical efficiency reporting system and its use for performance improvement</li> <li>• Visual performance measurement (VPM)</li> </ul>
The “V-curve”	<ul style="list-style-type: none"> <li>• Line capacity rating conventions</li> <li>• The basic principles of a “V-curve” applied to typical packaging lines</li> <li>• Rate limiting factors and critical processes</li> <li>• Machine cycle times and the reasons for maintaining a packaging line in balance</li> </ul>
Beer and packaging material losses	<ul style="list-style-type: none"> <li>• The analysis of data and basic loss calculations [Candidates will be presented with data to carry out typical loss calculations]</li> <li>• The causes and control of beer and material losses</li> </ul>

## Unit 9: Warehousing

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Warehouse operations and best practices	<ul style="list-style-type: none"> <li>• The purposes of a warehouse operation</li> <li>• The handling of empty and full packages with forklift trucks or mechanical systems</li> <li>• Reception and storage of packaging materials and pallets</li> <li>• The reasons for stock rotation</li> <li>• Working knowledge of a stock control system</li> <li>• A quantitative knowledge of the environmental storage conditions for packaged beer and materials</li> </ul>
Health and safety	<ul style="list-style-type: none"> <li>• The hazards associated with warehousing and typical safety procedures to help avoid them</li> <li>• Typical housekeeping tasks</li> <li>• The importance of pest control</li> <li>• The importance of regular inspection checks for full and empty stock, pallets and packaging materials</li> <li>• Operator duties for fork lift truck operation: <ul style="list-style-type: none"> <li>○ inspections at the beginning of a shift</li> <li>○ basic FLT maintenance requirements</li> </ul> </li> </ul>

## Unit 10: Beer Quality and Process Control for Packaging

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
	<ul style="list-style-type: none"> <li>• Key parameters examined in this section are:               <ul style="list-style-type: none"> <li>○ original gravity (OG)</li> <li>○ present gravity (PG)</li> <li>○ alcohol content (ABV %)</li> <li>○ pH</li> <li>○ colour</li> <li>○ haze</li> <li>○ head retention or foam stability</li> <li>○ dissolved gases (oxygen, carbon dioxide, nitrogen)</li> </ul> </li> </ul>
Key packaged beer parameters	<ul style="list-style-type: none"> <li>• The significance of key parameters (including their units of measure) for monitoring beer quality</li> <li>• Factors which can affect the values of these parameters during packaging</li> </ul>
Process specifications	<ul style="list-style-type: none"> <li>• The purpose of process specifications</li> <li>• The influence of packaging processes on final package parameters</li> </ul>
Process control	<ul style="list-style-type: none"> <li>• The principles of monitoring and adjustment to achieve product consistency and in-package specification</li> <li>• Pre-package nosing</li> <li>• Statistical quality control charts</li> <li>• Typical applications for in-line and on-line instruments for process control</li> </ul>

## Unit 11: Beer Quality – Flavour

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Terminology	<ul style="list-style-type: none"> <li>• The reasons for adopting industry standard descriptors for flavour</li> <li>• The flavour wheel</li> <li>• The more commonly used components</li> <li>• Taste training procedures</li> </ul>
Evaluation and tasting during processing	<ul style="list-style-type: none"> <li>• The three-glass test – statistical significance rating</li> <li>• Flavour profiling</li> <li>• Trueness to type panel tasting</li> <li>• Common faults / contamination by contact materials that may be detected by tasting during packaging operations</li> </ul>

## Unit 12: Beer Quality – Dissolved Oxygen

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Flavour deterioration by oxygen	<ul style="list-style-type: none"> <li>• Sensitivity of beer to small amounts of oxygen</li> <li>• Flavour stability and beer freshness</li> </ul>
Sources of oxygen	<ul style="list-style-type: none"> <li>• Oxygen as a constituent of air</li> <li>• Potential points of exposure of beer to air</li> </ul>
Monitoring of oxygen levels	<ul style="list-style-type: none"> <li>• Key control points, significance of sampling time</li> <li>• Total in-package oxygen (TIPO) measurement</li> </ul>
Control of dissolved oxygen levels	<ul style="list-style-type: none"> <li>• Best practice maximum levels</li> <li>• Techniques to avoid oxygen pick-up</li> </ul>

## Unit 13: Beer Quality – Contamination and Microbiological Infection

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Non-microbiological contamination	<ul style="list-style-type: none"> <li>• Sources of contamination from:               <ul style="list-style-type: none"> <li>○ empty containers and closures</li> <li>○ conveying systems for small packages</li> <li>○ plant cleaning</li> <li>○ oil and grease</li> <li>○ water and the atmosphere</li> </ul> </li> </ul>
Microbiological contamination and spoilage organisms	<ul style="list-style-type: none"> <li>• The principal categories of spoilage organisms:               <ul style="list-style-type: none"> <li>○ <i>Pediococcus</i></li> <li>○ <i>Lactobacillus</i></li> <li>○ <i>Megasphaera</i></li> <li>○ wild yeasts                   <ul style="list-style-type: none"> <li>▪ potential points of contamination in bright beer or container</li> <li>▪ their respective characteristic effects on beer in-package</li> </ul> </li> </ul> </li> </ul>
Other organisms indicative of contamination	<ul style="list-style-type: none"> <li>• Water-borne coliform (<i>Escherichia</i>, <i>Enterobacter</i>);               <ul style="list-style-type: none"> <li>○ the implications of their presence</li> </ul> </li> </ul>
Detection and monitoring and control	<ul style="list-style-type: none"> <li>• Methods of sampling for microbiological examination</li> <li>• Key sampling points</li> <li>• Laboratory detection methods</li> <li>• Routine practices to protect against infection</li> <li>• Special measures to eliminate on-going sources of infection</li> </ul>



## Unit 14: Quality Management

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Features of a quality system	<ul style="list-style-type: none"><li>• The key features of a quality system:<ul style="list-style-type: none"><li>○ written specifications</li><li>○ written procedures</li><li>○ monitoring of performance</li><li>○ corrective actions</li><li>○ auditing</li><li>○ regular reviews for improvement</li></ul></li></ul>
Roles responsibilities and benefits	<ul style="list-style-type: none"><li>• The impact of individual actions on product and service quality</li><li>• The control of documentation</li><li>• The maintenance of conformity</li><li>• The business benefits of an effective quality management system</li></ul>
Product safety	<ul style="list-style-type: none"><li>• The control of product safety<ul style="list-style-type: none"><li>○ Hazard analysis and critical control points (HACCP)</li></ul></li><li>• The importance of traceability for product recall</li></ul>

## Unit 15: Plant Cleaning – Detergents and Sterilising Agents

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Detergents	<ul style="list-style-type: none"><li>• Types of detergent (alkali, acid and neutral)</li><li>• The constituents of detergents</li><li>• The individual functions of the constituents</li><li>• Criteria for choice of detergent for an application</li><li>• Considerations for the use of hot detergent cleaning</li></ul>
Sterilants	<ul style="list-style-type: none"><li>• Types of sterilant as defined by the active agent</li><li>• Criteria for choice of sterilant for an application</li><li>• The effect of sterilant residues on beer quality</li></ul>
Heat sterilisation	<ul style="list-style-type: none"><li>• Uses of steam and hot water as a sterilant</li><li>• Time and temperature</li></ul>
Safety	<ul style="list-style-type: none"><li>• The hazards associated with chemical cleaning and sterilising agents</li><li>• Good practices for the storage of chemicals</li><li>• Use of personal protective clothing</li><li>• Procedures in case of accidental spillage or discharge of chemicals</li></ul>

## Unit 16: Plant Cleaning – Cleaning-in-Place (CIP) and General Plant Cleaning

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Types of CIP systems	<ul style="list-style-type: none"> <li>• The general differences between single use and recovery systems – advantages and disadvantages</li> <li>• The types of cleaning head used and reasons for their choice</li> <li>• The operating principles and diagrammatic representation of CIP systems</li> </ul>
CIP cleaning cycles	<ul style="list-style-type: none"> <li>• Typical cleaning programmes and cycle times</li> <li>• The function of each of the cleaning cycle stages</li> <li>• Quality assurance of cleaning operations</li> </ul>
CIP plant design hygiene considerations	<ul style="list-style-type: none"> <li>• Design features that minimise soil accumulation in brewery vessels and pipelines</li> <li>• Design features that facilitate vessel and pipeline cleaning using a CIP system</li> <li>• Design features which promote a hygienic working environment</li> </ul>
General plant cleaning	<ul style="list-style-type: none"> <li>• Cleaning plant surfaces, walls and floors</li> <li>• The constituents of foam cleaning agents</li> <li>• The use of foaming systems</li> </ul>

## Unit 17: Engineering Maintenance

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Objectives and approaches	<ul style="list-style-type: none"> <li>• The key business reasons for an effective maintenance system</li> <li>• The features, advantages, disadvantages and applications of:               <ul style="list-style-type: none"> <li>○ no maintenance</li> <li>○ breakdown maintenance</li> <li>○ preventive maintenance</li> <li>○ predictive maintenance</li> </ul> </li> <li>• The contribution of maintenance tasks to plant safety, reliability, quality, economics and environmental impact</li> </ul>
Maintenance tasks	<ul style="list-style-type: none"> <li>• A detailed description of key maintenance tasks:               <ul style="list-style-type: none"> <li>○ mechanical</li> <li>○ electrical</li> <li>○ calibration</li> <li>○ inspection</li> <li>○ condition monitoring</li> <li>○ cleaning of plant</li> <li>○ health and safety</li> </ul> </li> <li>• Maintenance planning and record keeping</li> <li>• Autonomous maintenance</li> </ul>
Systems for continuous improvement	<ul style="list-style-type: none"> <li>• The key features of the following performance improvement systems:               <ul style="list-style-type: none"> <li>○ Reliability Centered Maintenance (RCM)</li> <li>○ Total Productive Maintenance (TPM)</li> <li>○ Workplace Organisation (5S)</li> </ul> </li> </ul>

## Unit 18: Utilities – Water and Effluent in Packaging

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Water treatments	<ul style="list-style-type: none"> <li>• The basic principles and diagrammatic representation treatment plants for:               <ul style="list-style-type: none"> <li>○ water filtration</li> <li>○ water sterilisation</li> <li>○ water softening / deionisation</li> <li>○ water de-aeration</li> </ul> </li> </ul>
Water types and uses	<ul style="list-style-type: none"> <li>• Differentiation and typical uses of:               <ul style="list-style-type: none"> <li>○ de-aerated water</li> <li>○ process water</li> <li>○ service water</li> </ul> </li> <li>• <i>Legionella</i> in cooling water and service water and the health risks associated with the organism</li> <li>• Points at which water is introduced into the process and the special water quality needed at these points</li> </ul>
Sources of effluent and its measurement	<ul style="list-style-type: none"> <li>• The nature and characteristics of effluent from principal packaging and bright beer room sources</li> <li>• The components of effluent quality:               <ul style="list-style-type: none"> <li>○ volume</li> <li>○ suspended solids (SS)</li> <li>○ chemical oxygen demand (COD)</li> <li>○ biological oxygen demand (BOD)</li> <li>○ pH</li> <li>○ temperature</li> </ul> </li> </ul>

## Unit 19: Utilities – Process Gases

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Properties and applications	<ul style="list-style-type: none"> <li>• The essential properties and quality of compressed air for use as a process gas</li> <li>• The essential properties of carbon dioxide and nitrogen for use as process gases</li> <li>• The significance of inertness</li> <li>• Typical uses for process gases</li> <li>• The economic importance of leak prevention</li> </ul>
Health and safety issues	<ul style="list-style-type: none"> <li>• Safe entry into tanks, cold rooms and other confined spaces</li> <li>• Safe handling and storage of compressed gas cylinders</li> <li>• Safety hazards associated with storage of liquid gases and their distribution in high-pressure mains</li> </ul>

## Unit 20: Packaging and the Environment

Topics	Candidates should understand and be able to explain and describe in simple terms, or demonstrate familiarity with:
Sustainability and climate change	<ul style="list-style-type: none"> <li>• The concept of a sustainable industry</li> <li>• The role of carbon dioxide – the carbon cycle</li> <li>• Sources of carbon dioxide emissions</li> </ul>
Conservation	<ul style="list-style-type: none"> <li>• The principal energy consuming activities on a packaging line</li> <li>• Typical energy reduction strategies</li> <li>• Principal water consuming activities</li> <li>• Typical water conservation strategies</li> </ul>
Packaging waste	<ul style="list-style-type: none"> <li>• Waste generating activities and issues for disposal</li> <li>• Strategies to minimise packaging material and encourage recycling</li> <li>• The impact of packaging waste on household (consumer) recycling</li> </ul>