



**Foundation in Distilling**

**Examination Syllabus**

## Introduction

In advance of their examination, candidates will be expected to have full knowledge of the syllabus as examination questions can be asked from any of the topics as detailed below and in the learning materials. The examination may also include some calculation questions.

## Unit 1: An Overview of Distilled Products

Topics	Candidates should understand and be able to demonstrate familiarity with:
General knowledge of types of potable distilled spirits and their characteristics	<ul style="list-style-type: none"><li>• The generic, often legalistic, definitions and outline specifications of potable distilled spirits worldwide</li><li>• The range of spirits and their respective styles and characters</li><li>• Outline knowledge of their typical compositions and methods of production</li></ul>
General knowledge of the processes used in the production of distilled spirits	<ul style="list-style-type: none"><li>• The sequence of events from raw material processing to the finished product</li><li>• A visualisation of raw materials handling, fermentation, distillation, maturation and packaging processes as a flow diagram</li></ul>
Technical terms	<ul style="list-style-type: none"><li>• A basic understanding of the technical terms used in distilling</li></ul>

## Unit 2: Raw Materials of the Principal Potable Spirits

Topics	Candidates should understand and be able to demonstrate familiarity with:
General knowledge of the principal raw materials	<ul style="list-style-type: none"><li>• The characteristics and differentiation of the primary ingredients, basic raw materials and their processing, prior to fermentation for the principal different types of spirits</li></ul>
The major cereals and the sources of enzymes for production of whisky (whiskey) and for grain neutral spirit	<ul style="list-style-type: none"><li>• The basic cereals and their processing to produce 'wort' for fermentation</li><li>• Outline of the production of malted barley</li><li>• Different component cereals producing different products</li><li>• Conversion of cereal starch to fermentable sugars</li></ul>

Grapes and wine for brandy and neutral spirit production	<ul style="list-style-type: none"> <li>• Cultivation of grape vines and the varieties used</li> <li>• Harvesting and pressing of grapes</li> <li>• The production and treatment of 'must' (grape juice)</li> </ul>
Sugar cane and molasses for rum and neutral spirit production	<ul style="list-style-type: none"> <li>• Refining of sugar cane</li> <li>• Production of molasses</li> <li>• Treatment and composition of molasses</li> </ul>

## Unit 3: Fermentation Theory

Topics	Candidates should understand and be able to demonstrate familiarity with:
Principles of alcoholic fermentations	<ul style="list-style-type: none"> <li>• The principal fermentable sugars</li> <li>• Conversion of sugars into ethyl alcohol (ethanol) and carbon dioxide (CO<sub>2</sub>)</li> <li>• Relationship between initial sugar concentration and final yield of ethanol</li> <li>• Production of small amounts of by-products of fermentation which contribute to the flavour and aroma of the fermented wash</li> <li>• Nutritional requirements of distilling yeast: sugars, amino acids, mineral salts, vitamins</li> <li>• Changes in concentration of yeast, sugar and alcohol over the course of fermentation</li> <li>• Production of flavour congeners, acids and heat</li> </ul>
Yeasts and pitching yeast quality	<ul style="list-style-type: none"> <li>• Significance of the name <i>Saccharomyces cerevisiae</i></li> <li>• Structure and appearance of yeast cells</li> <li>• Function of the principle structures of the yeast cell</li> <li>• Mechanism of yeast growth by budding</li> <li>• The requirement for yeast of good viability and vitality and with a low level of infection</li> <li>• The effect of poor yeast quality on the fermentation and subsequent spirit yield</li> </ul>
Pure culture yeast and 'natural' fermentations	<ul style="list-style-type: none"> <li>• Propagation of a pure yeast culture</li> <li>• Different types of yeast: cake, cream and dried: use of dried yeast and re-hydration methods</li> <li>• Procedures for pitching (inoculating) of wort with these types of yeast</li> <li>• Advantages and disadvantages of spontaneous ('natural') fermentation</li> </ul>
Role of other micro-organisms	<ul style="list-style-type: none"> <li>• Influence on pH and positive and negative influences on flavour</li> <li>• The role of <i>Lactobacillus</i> in spirit fermentations and its effect on flavour</li> </ul>

## Unit 4: Fermentation Technology

Topics	Candidates should understand and be able to demonstrate familiarity with:
Design, construction and operation of fermentation vessels	<ul style="list-style-type: none"> <li>• Structure of fermentation vessels constructed of wood, steel or stainless steel</li> <li>• Operating principles</li> <li>• Importance of sterilisation of fermenters, yeast mixing vessel and associated pipe work</li> </ul>
Fermentation control: influence of temperature	<ul style="list-style-type: none"> <li>• Significance of temperature at pitching with yeast</li> <li>• Practical aspects of the phases of typical temperature profiles</li> <li>• Importance of 'setting temperature' to control maximum temperature during fermentation</li> </ul>
Typical fermentation conditions and progress of fermentation	<ul style="list-style-type: none"> <li>• Procedures to control and monitor fermentation</li> <li>• Significance of specific gravity and pH measurements during fermentation</li> </ul>

## Unit 5: Fundamentals of Distillation

Topics	Candidates should understand and be able to demonstrate familiarity with:
Theory of distillation	<ul style="list-style-type: none"> <li>• Liquid/vapour equilibrium – understanding of the graphic model</li> <li>• Volatility of components</li> <li>• The reason distillation alone cannot achieve 100% pure ethanol (alcohol)</li> </ul>
Basic concepts of batch and continuous distillation	<ul style="list-style-type: none"> <li>• Meaning of the terms 'batch' and 'continuous' distillation</li> <li>• Outline descriptions of both processes</li> </ul>
The role of copper	<ul style="list-style-type: none"> <li>• Use in stills and condensers to remove sulphur compounds</li> </ul>

	<ul style="list-style-type: none"> <li>• Other reasons to use copper: malleability, heat conductivity, corrosion resistance, soldering</li> </ul>
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## Unit 6: Distillation Technology – Batch and Continuous

Topics	Candidates should understand and be able to demonstrate familiarity with:
Basic operation of batch (pot) stills	<ul style="list-style-type: none"> <li>• The basic double distillation process: outline comparison with triple distillation systems</li> <li>• Basic construction and design of stills and their operation</li> <li>• Effect of speed of distillation, reflux and still design on alcohol concentration and congeners</li> <li>• Cut points to control flavour</li> <li>• Reflux and the distillation of flavour congeners</li> <li>• The design and operation of condensers – worm tub (serpentines) and shell and tube</li> <li>• The design of the spirit safe and procedures for the collection of low wines, spirit and heads and tails</li> </ul>
Continuous (column) distillation: basic operation of a single column still and the two column distillation process	<ul style="list-style-type: none"> <li>• Design and operation of a two still system (e.g. Coffey still)</li> <li>• Composition and preheating of the feed</li> <li>• Condensing and cooling systems</li> <li>• Steam quality requirements</li> <li>• Control of product rectification for flavour and removal of fusel oils</li> <li>• The distribution of flavour congeners in the rectifier</li> <li>• Re-rectification to reduce/remove impurities</li> <li>• Recovery and recycling of hot and cold feints</li> <li>• Reasons and methods for removal of fusel oils from the still system</li> </ul>
Basics of design and operation of continuous stills for neutral spirit (NS) production	<ul style="list-style-type: none"> <li>• Extractive (hydro-selective) distillation and re-rectification to reduce congeners</li> <li>• Methods for removal of fusel oils, volatiles and methanol</li> <li>• Recovery and recycling of hot and cold feints</li> </ul>

## Unit 7: Specific Production Details for Different Distilled Spirits

Topics	Candidates should understand and be able to demonstrate familiarity with:
Malt whisky	<ul style="list-style-type: none"> <li>• The principles of mashing: the origin of the fermentable sugars of wort, and their significance</li> <li>• The purpose and practice of separating malt distillery wort from the (spent) grains</li> <li>• The importance of preservation of enzymes for activity in the washback</li> <li>• Batch (pot) distillation for malt whisky:               <ul style="list-style-type: none"> <li>○ Operation of pot stills for malt whisky and similar whiskies</li> </ul> </li> </ul>
Grain whisky/GNS	<ul style="list-style-type: none"> <li>• The options and purpose of cereal processing</li> <li>• Gelatinisation of the starch of maize (and possibly wheat) prior to mashing</li> <li>• Batch or continuous processing</li> <li>• The options for mashing and mash separation ('grains in' or 'grains out')</li> <li>• The origin of the fermentable sugars of wort, and their significance</li> <li>• The reasons why exogenous enzymes are permitted to prepare wort for neutral spirit/gin/vodka production but not for Scotch whisky wort</li> <li>• Continuous (column) distillation for grain whisky</li> <li>• Design and operation of a two still system – Coffey still or Beer Stripper/Rectifier set-up</li> <li>• Composition and preheating of the feed</li> </ul>
Brandy	<ul style="list-style-type: none"> <li>• Details of wine fermentation and use of purchased wines as feedstock</li> <li>• Operation of batch (pot) stills for cognac and similar brandies, both single and double distillation process</li> <li>• Design of the simple alembic still</li> <li>• Time constraints on distillation for Cognac production</li> <li>• Operation of the column distillation process</li> <li>• The design and operation of:</li> </ul>

	<ul style="list-style-type: none"> <li>○ Armagnac still and Two column still (e.g. Barbet still)</li> </ul>
Rum	<ul style="list-style-type: none"> <li>● Operation of batch stills (pot) for heavy rum production</li> <li>● Design of the stills, including batch pot and column arrangement for heavy type rum production</li> <li>● Sequential batch – beer, low wine, high wine – stills for rum</li> <li>● Operation of the two column distillation process</li> <li>● The design and operation of column still set-ups: <ul style="list-style-type: none"> <li>○ Two columns (Coffey type) still</li> <li>○ Barbet still and concentrator</li> </ul> </li> </ul>
Gin and Vodka production from NS and methods of use for gin production	<ul style="list-style-type: none"> <li>● Quality standards of neutral spirit feedstock for gin and vodka production</li> <li>● The principal botanicals (plant materials) used for the flavouring of gin: how essential oils are preserved, and how and why botanicals are used in gin distillation</li> <li>● Production of flavouring extracts by solvent extraction or distillation for compounded gin</li> <li>● Production of vodka from neutral spirit</li> <li>● Requirement for removal of flavour congeners by re-distillation or charcoal (carbon) filtration</li> </ul>

## Unit 8: Maturation and Blending

Topics	Candidates should understand and be able to demonstrate familiarity with:
Role of wood and wood treatment: finishes	<ul style="list-style-type: none"> <li>● Main types of cask wood: American and European oak</li> <li>● Reasons for use of these woods: no leakage, contribution to flavour</li> <li>● Surface/volume ratio of different types of cask</li> <li>● Storage conditions, especially temperature and humidity</li> <li>● For whisky: use of treated cask, or casks used previously to hold another beverage (e.g. port, sherry, wine etc.) to produce whisky 'finishes'</li> </ul>
Changes occurring in the spirit over the process of maturation	<ul style="list-style-type: none"> <li>● Characteristics of new and mature spirit</li> <li>● Immature characters to be removed</li> <li>● Desirable mature characteristics</li> <li>● Evaporation (loss of high-volatile congeners)</li> <li>● Absorption into char layer of wood surface</li> <li>● Extraction of colour and flavour compounds from wood (e.g. vanillin)</li> </ul>

	<ul style="list-style-type: none"> <li>• Reactions within the maturing spirit, e.g. oxidation, formation of esters</li> </ul>
Blending and flavourings	<ul style="list-style-type: none"> <li>• Reasons for blending: improving the drinkability of the spirit: targeting a particular market, balancing light and heavy flavours, ensuring consistency of taste and appearance and quality in the final product</li> <li>• Organisation of stock</li> <li>• Choice of spirits, emptying casks, filtration, mixing, the importance of tasting and/or chemical analysis at critical points in the process</li> <li>• For rum: Use of caramel in rum production: use of flavours and essences to produce rum based products</li> </ul>

## Unit 9: Packaging

Topics	Candidates should understand and be able to demonstrate familiarity with:
Spirit preparation for packaging	<ul style="list-style-type: none"> <li>• The process and equipment used to: <ul style="list-style-type: none"> <li>○ Reduce the spirit to bottling strength – reduction water quality</li> <li>○ Adjust the colour to specification</li> <li>○ Chill filtration to remove haze and floc</li> <li>○ Attemperation to filling temperature</li> </ul> </li> </ul>
Unit processes of packaging	<ul style="list-style-type: none"> <li>• Control of in-coming raw materials</li> <li>• Processes of bottle rinsing, filling, capping/sealing, labelling, inspection, packing, case sealing and palletisation</li> </ul>
Identification and protection of packages and the detection and prevention of fraud	<ul style="list-style-type: none"> <li>• Lot marking, bar coding and date stamping</li> <li>• Use of secondary and tertiary packaging for product protection</li> <li>• Use of tamper evident seals, non-refillable fitments and tax strips and labels</li> <li>• Analysis of components specific to a brand</li> </ul>



## Unit 10: Distillery Co-products

Topics	Candidates should understand and be able to demonstrate familiarity with:
Range of distillery co-products	<ul style="list-style-type: none"> <li>• Spent grains (draff) from malt distillery mashing</li> <li>• Carbon dioxide from grain distillery fermentation</li> <li>• Pot ale from malt whisky wash distillation</li> <li>• 'Marc'/'Pomace' from grape pressing and fermentation lees</li> <li>• Spent wash/stillage from continuous distillation</li> <li>• 'Fusel oil' from continuous distillation</li> <li>• Recovery of copper from spent lees</li> <li>• Awareness of other waste streams of no commercial value: CO<sub>2</sub>, spent lees</li> </ul>
Use and disposal of still residues	<ul style="list-style-type: none"> <li>• Specific products – Preparation of animal feed</li> <li>• Concentration of pot ale to syrup</li> <li>• Dark grains preparation and drying</li> <li>• Energy-saving implications of multiple-effect evaporation</li> </ul>

## Unit 11: Quality Management Systems

Topics	Candidates should understand and be able to demonstrate familiarity with:
Description of basic quality systems:	<ul style="list-style-type: none"> <li>• The key features of a quality system viz : <ul style="list-style-type: none"> <li>○ written specifications</li> <li>○ written procedures</li> <li>○ document control</li> </ul> </li> </ul>

benefits, roles and responsibilities	<ul style="list-style-type: none"> <li>○ monitoring of performance</li> <li>○ corrective actions</li> <li>○ auditing</li> <li>○ regular reviews for improvement</li> <li>● The business benefits of an effective quality management system</li> <li>● The impact of individual actions on product and service quality</li> <li>● The control of documentation</li> <li>● The maintenance of conformity</li> </ul>
Product safety: HACCP (Hazard Analysis and Critical Control Points)	<ul style="list-style-type: none"> <li>● Product and process control procedures to ensure product safety</li> </ul>

## Unit 12: Quality – Process Control

Topics	Candidates should understand and be able to demonstrate familiarity with:
Product consistency	<ul style="list-style-type: none"> <li>● The variable nature of natural ingredients</li> <li>● The influence of process parameters on final product</li> <li>● The principles of monitoring and adjustment to achieve product consistency</li> <li>● The concept of ‘trueness to type’</li> <li>● Simple statistical quality control procedures</li> </ul>
Quality parameters: process and end product	<ul style="list-style-type: none"> <li>● The key parameters to be measured, their units of measure and their influence on quality, such as sensory, spirit alcohol, colour, chill haze analysis</li> <li>● Factors affecting these parameters during production</li> <li>● The purpose of a specification</li> <li>● The concepts of tolerance and range for specification parameter values</li> </ul>

## Unit 13: Quality – Sensory Evaluation

Topics	Candidates should understand and be able to demonstrate familiarity with:
Sensory evaluation	<ul style="list-style-type: none"> <li>● The reasons for adopting industry standard descriptors for aroma and taste</li> <li>● The more commonly used descriptors of the flavour wheel</li> <li>● Common faults / contamination that may be detected by tasting during production</li> </ul>

	operations
Evaluation procedures	<ul style="list-style-type: none"> <li>• Difference testing procedures (e.g. the three-glass test)</li> <li>• Flavour profiling and descriptive testing (e.g. trueness to type panel testing)</li> </ul>

## Unit 14: Quality – Plant Hygiene and Cleaning Systems

Topics	Candidates should understand and be able to demonstrate familiarity with:
Microbiological control	<ul style="list-style-type: none"> <li>• Health risks and control of Legionella pneumophila in cooling water towers and other warm service waters</li> <li>• Water-borne bacteria (e.g. Escherichia coli) and the implications of their presence</li> <li>• Microbiological control of yeast handling systems</li> <li>• Microbiological control of reduction and process waters</li> <li>• Positive and negative aspects of lactic acid bacteria in a distillery</li> </ul>
Detergents, sterilants and cleaning systems (including cleaning-in-place (CIP) systems)	<ul style="list-style-type: none"> <li>• The chemical nature of typical detergents and sterilants</li> <li>• The influence of time, temperature and concentration</li> <li>• The operating principles and diagrammatic representation of typical CIP systems</li> <li>• Design features which promote a hygienic working environment</li> </ul>

## Unit 15: Plant Maintenance Philosophy

Topics	Candidates should understand and be able to demonstrate familiarity with:
Approaches and tasks	<ul style="list-style-type: none"> <li>• The business motives for an effective maintenance system</li> <li>• The relationship between corrective and preventative maintenance</li> </ul>

Performance improvement	<ul style="list-style-type: none"> <li>The key features of a typical performance orientated maintenance system</li> </ul>
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## Unit 16: Health and Safety

Topics	Candidates should understand and be able to demonstrate familiarity with:
Health and safety	<ul style="list-style-type: none"> <li>Industry standards and personnel issues</li> </ul>
Carbon dioxide	<ul style="list-style-type: none"> <li>The evolution of carbon dioxide from fermentation vessels and the hazards associated with carbon dioxide and the observance of safety precautions</li> </ul>
Fire and explosion risks	<ul style="list-style-type: none"> <li>Flammability and explosion risks of alcohol during distillation</li> <li>Fire and explosion dangers at stills, in storage and operations involving spirits</li> <li>Dust explosion and health risks</li> </ul>
Steam	<ul style="list-style-type: none"> <li>The potential dangers of steam and steam distribution systems</li> </ul>
Chemicals	<ul style="list-style-type: none"> <li>The hazards associated with chemical cleaning and sterilising agents</li> <li>Good practices for the storage and handling of chemicals</li> <li>Use of personal protective clothing</li> <li>Procedures in case of accidental spillage or discharge of chemicals</li> </ul>
Packaging	<ul style="list-style-type: none"> <li>Awareness of all health and safety issues relating to packaging lines</li> </ul>

## Unit 17: Distilling and the Environment

Topics	Candidates should understand and be able to 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 in distilling</li> </ul>
Energy conservation	<ul style="list-style-type: none"> <li>• The principal energy consuming activities in a distillery</li> <li>• Typical energy reduction strategies</li> <li>• Main uses of steam in distilling</li> <li>• Hot water recovery systems</li> </ul>
Water quality and water conservation	<ul style="list-style-type: none"> <li>• Sources of water: borehole, surface, municipal/ public</li> <li>• Principal water consuming activities: process water, utility water, cooling water and their specification</li> <li>• Reliability and consistency of supply</li> <li>• Appearance, odour and taste</li> <li>• Dissolved salts and their importance</li> <li>• Typical water conservation strategies: reuse, recovery and conservation considerations in the use of water</li> </ul>
Waste streams: effluent and packaging waste	<ul style="list-style-type: none"> <li>• Sources of effluent and control strategies</li> <li>• Government controls on discharge to the environment and to public sewer</li> <li>• Factors affecting decision on in-house or off-site treatment</li> <li>• Charging systems and their influence on above decision</li> </ul>

	<ul style="list-style-type: none"><li>• Strategies to minimise packaging material and encourage recycling</li></ul>
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