SYLLABUS

DIPLOMA IN INDUSTRIAL FERMENTATION & ALCOHOL TECHNOLOGY
FIRST YEAR EXAMINATION

SUBJECT: ORGANIC CHEMISTRY (THEORY)
CODE: AT/101 **MAX.MARKS: 50**

1. Optical Isomerism:
Definition, Cause of optical activity and chirality, and R/S configuration. Enantiomers, Diastereomers, Racemic modification and Mesoisomers, Resolution of Racemic modifications.

2. Carbohydrates Monosaccharides:
Classification, properties and reactions of monosaccharides taking glucose as an example, Inter-conversions of monosaccharides, Configurations of aldopentoses and aldohexoses, Epimers and epimerisation, mutarotation , Cyclic structures of glucose and fructose (pyranose and furanose forms).

3. Amino Acids:
a. Classification, properties and chemical reactions, Maillard reaction, Major amino acids present in cane juice and molasses.
b. Nature of non nitrogenous organic acids present in sugarcane juice

Reference Books—1. Advanced Organic Chemistry By Behel & Behel, S. Chand & Co. Ltd, New Delhi
2. Organic Chemistry By Morrison &Byot, Pearson

SUBJECT: PHYSICAL CHEMISTRY (THEORY)
CODE: AT/102 **MAX.MARKS: 50**

1. Analytical Chemistry: Mole, Normality, Molarity, Molality, Formality, ppm, ppb, ppt, Mole fraction, Equivalent weight and numerical based on it.
2. Basic concepts of measurement of electrical conductivity and its relation with ions in solution. Strong and weak electrolyte, Specific conductivity, Molar conductivity, Equivalent conductivity. Application of conductance measurement conductivity based super heaters.
3. Acids and Bases: Arrhenius concept, Proton transfer theory, Lewis concept, Dissociation of weak acid, the pH Scale, pH measurement using Hydrogen electrode, Glass electrode, Buffer mixture of weak acid and its salts. Calculation of pH values of buffer mixtures. Henderson's equation.
4. Distribution law; Association and dissociation of solute, Principles of extraction and its application. Batch and continuous extraction.

Reference Books—1. Principles of Physical Chemistry By Puri, Sharma &Pathania, S. Nagin Chand & Co., Delhi
2. Physical Chemistry By Peter Atkins, Oxford Pub. House,U.K.
3. Physical chemistry by K.L .Kapoor Mcmillan publication

SUBJECT: AGRICULTURE CHEMISTRY (THEORY)
CODE: AT/103 **MAX.MARKS: 50**

1. **Sugarcane:** Recommended varieties in India and their main characteristics, seed rate, time and method of sowing, irrigation, fertilizer use, control of weeds, insect-pests and diseases, harvesting, processing and yield. Factors affecting sugar yield**;**
2. **Sugar beet:** Recommended varieties in India and their main characteristics, seed rate, time and method of sowing, irrigation, fertilizer use, control of weeds, insect-pests and diseases, harvesting, processing and yield
3. **Sweet Sorghum:** Recommended varieties in India and their main characteristics, seed rate, time and method of sowing, irrigation, fertilizer use, control of weeds, insect-pests and diseases, harvesting, processing and yield.

4. **Cassava:** Recommended varieties in India and their main characteristics, seed rate, time and method of sowing, irrigation, fertilizer use, control of weeds, insect-pests and diseases, harvesting, processing and yield.
5. **Sweet Potato:** Recommended varieties in India and their main characteristics, seed rate, time and method of sowing, irrigation, fertilizer use, control of weeds, insect-pests and diseases, harvesting, processing and yield.

Reference Books - 1.Morden Techniques of Raising Field Crop By Chhidda Singh, Prem Singh and Rajbir Singh, Hand book of Agriculture, ICAR.New Delhi.

SUBJECT: BIOCHEMISTRY (THEORY)
CODE: AT/104 **MAX.MARKS: 50**

1. **Introduction:** Significance of biochemistry to the living systems. Structure & functions of cell organelles – cell wall, cell membrane, nucleus, mitochondria, ribosome, endoplasmic reticulum, etc.
2. **Carbohydrates:** Outline of the structure and functions of carbohydrates important to living systems, metabolism of carbohydrates including glycolysis, HMP pathway, glyoxalate cycle, TCA cycle, Entner-Duodoroff pathway, gluconeogenesis .
3. **Proteins:** Outline of the structure of the common amino acids present in proteins, their general properties, metabolism of amino acids including deamination, transamination and decarboxylation, physical & chemical properties, classification and structure of proteins. Isolation, purification and estimation of proteins.
   Reference Books—1.Principles of Biochemistry by A. L. Lehninger, C.B.S.Publishers, Delhi
   2. Text Book of Biochemistry by West Todd, The Macmillan Co.Newyork

SUBJECT: ENGINEERING
CODE: AT/105 **MAX.MARKS: 100**
A. MECHANICAL ENGINEERING

1. **Properties of Steam**: Use of steam tables, specific volume, internal energy of steam, drynessfraction, dry, saturated and superheated steam calculations.
2. **Boiler:** Types of water-tube boilers, economiser and pre-heater, draught and chimney, boiler operation in brief and calculation of boiler efficiency. Incineration boilers:- Slop generation and use ZLD, General description, application with respect to Distilleries & draw back.
3. **Reciprocating Air Compressor**: Various uses of Air Compressor, Single Stage Compressor, Derivation of expression for work done and horse power,
   Elementary idea of two stage compressor.

Reference Books—1. Thermal Engineering by R.S. Khurmi, S. Chand & Co., NewDelhi

B. ELECTRICAL ENGINEERING

1. **DC Motor:** Principle of operation of DC motor, Construction features of DC motor, Classification of DC motors, Electromagnetic torque equation of DC motor, Losses in DC motor, Staring/ Braking of DC motor, Speed control of DC motors, Applications of DC motor
2. **DC Generator:** Principle of operation of DC generator, Construction features of DC generator, Classification of DC generators, EMF equation of DC generator, Losses in DC generator, Parallel operating conditions of DC generator
3. **Transformer:** Principle of operation of transformer, Construction features of transformer, EMF equation of transformer, Classification of transformers, Losses in transformer, Transformer efficiency, OC & SC tests of transformer, Transformer taps, Parallel operating conditions of transformer, Auto transformer, Instrument transformer, Applications of transformer

Reference Books-

1. **A Text Book of Electrical Technology by B.L. Theraja**
2. **Fundamental of Electric Machines by B.R. Gupta & Vandana Singhal**

SUBJECT: INSTRUMENTATION
CODE: AT/106 **MAX.MARKs: 50**

1. Basic Instrumentation and its Characteristics (Static and Dynamic)
2. Pressure and Vacuum measurement its application in Distillery. Calibration of Pressure and vacuum gauge.
3. Temperature Measurement and its application in distillery. Calibration of various temperature measuring instruments
4. Flow Measurement and instrumentation based on variable head and variable area, Electromagnetic Flow meter construction, working principle, theory, maintenance, accuracy and application. Mass flow meter consumption, working, principle, maintenance and application.
5. Level Measurement- Non contact type level measurement, DPT based level measurement (Ultrasonic & Radar).

Reference Books-1. Instrument Technology, Vol.1-4 by E.B. Jones, English Language Book Society, Butterworth's

2. Instrument Engineers hand Book by B.G. Liptak, Butterworths Heinmann Ltd., Oxford

3. Industrial instrumentation and control. – C.S. Rao
4. Industrial Instrumentation by S.K. Singh.

SUBJECT: CHEMICAL ENGINEERING
CODE: AT/107A **MAX.MARKS: 70**

1. **Introduction -** Study of elementary chemical engineering concepts – unit operations and unit process.
2. **Fluid mechanics**

(a) Classification of fluids and fluid flow phenomena.
(b) Pipeline flow. Bernoulli's equation. Friction losses and pressure drop in pipelines
(c) Mixing and agitation- Types of mixing equipment
(d) Transportation of fluids- Classification of pumps Power requirement. Head capacity and NPSH for pumps.

3. **Heat Transfer**

(a) Heat transfer without change of phase- conduction and convection
(b) Heat transfer by change of phase-Mechanism of boiling and condensation

Reference Books 1. Introduction to Chemical Engineering by Badger &Banchero
2. Unit Operation of Chemical Engineering by W.L.Mcab& J.C. Smith Pub.-McGraw Hill Book Co. Ltd., Newyork

SUBJECT: BIOCHEMICAL ENGINEERING
CODE: AT/107B **MAX.MARKS: 30**

1. **Water**
   Basic Quality Requirements of Water; Production Requirements of Water in Distilleries; Water Sourcing; Borehole water; Surface water; The Principal Characteristics and Requirements of a Distillery Water Supply; Production (Mashing) water; Product water; Process water; Service water; Boiler water ; Cooling tower water; General cleaning water ; Water Usage Ratios, Conservation Methods and Costs; Water Treatments
2. Antifoams and automatic control of foam. Separation of cells, filtration, centrifugation, ultrasonic disintegration, lyophilisation.

Reference Books— Methods in Microbiology Vol-III by J.R. Norris & D.W. Ribbons, Academic Press Inc., London

SUBJECT: DRAWING & DESIGN
CODE: AT/108 **MAX.MARKS: 50**

Genearl/layout of molasses & grain based distillers.

Fundamentals of Drawing:
Basic Consideration in Process equipment designs; Code of Practice (BIS) for unified pressure nozzles; Distillery design and its mechanical properties and strength.

Conventional lines- Description of conventional lines, Reading of different scales and their uses. Dimentioning rules, Symbols of different materials.Orthographic projection and definition; Orthographic views; First & Third angle-projection; Isometric/oblique views.

PRACTICAL

1. Orthographic projection-Ist angle and 3rd angle.
2. Drawings of isometric view and determination of additional views.
3. Different types of welded joints & welding symbols.
4. Flow Diagram of distillery.

Reference Books—1.Machine drawing by P.S. Gill

2.Machinery &Equipments of Cane Sugar Factory by Tromp, Twentieth Century Pub., New Delhi, 3. Machine drawing by P.S. Gill

SUBJECT: APPLIED MICROBIOLOGY (THEORY)
CODE: AT/109 **MAX.MARKS: 50**

1. Introduction: Importance of microorganisms, occurrence, kinds of microorganisms, Historical developments in microbiology.
2. Morphology & Classification: Isolation of pure culture, identification & maintenance of cultures.
3. Control of Microorganisms: Physical methods: filtration, irradiation, sterilization etc., chemical methods: antimicrobial agents, germicides, antibiotics, etc.

Reference Books—General Microbiology by M. J. Plezar, Tata McGraw Hill Pub. Co. Ltd., New Delhi.

SUBJECT: INDUSTRIAL FERMENTATION & ALCOHOL TECHNOLOGY
CODE: AT/110 **MAX.MARKS: 100**

1. Introduction: Fermentation, types of fermentations and role of microorganism and other condition on fermentation.
2. Raw Materials for fermentative production of alcohol:
3. Molasses: Composition, storage, spontaneous combustion, grades and classification of molasses, clarification of molasses.
4. Other Saccharine Materials: cane juice, beet juice, sweet sorghum, mahua flowers, fruits' juices, etc.
5. Starchy and Cellulosic Materials.
6. Isolation and purification of cultures.
7. Outline of alcohol production by batch fermentation process
8. Alcohol production by continuous fermentation process
9. Modern Techniques of Fermentation: Batch, Semi-continuous, Continuous (Biostil, Multicont or Cascade, Encillium), Melle- Bionet process of yeast Cell Recycling, Bacterial Fermentation &lmmobilised Cell Technique, etc.
10. Production of industrial and power alcohol by azeotrotic distillation. Membrane technology and molecular sieves.
11. Production of grain spirit.
12. Chemical control, Theoretical Yield, Fermentation & Distillation, Efficiency, etc. including calculation.
13. Working of distillery-I
14. Working of brewery- I

Reference Books—1. Industrial Fermentations By L.A. Under Koeffler, Chemica Pub.Co.,Newyork 2.Comprehensive Biotechnology Vol.3 By M. M. Young, Pergamon Press Ltd., Oxford

PRACTICAL EXAMINATION IN FIRST YEAR

SUBJECT: ORGANIC CHEMISTRY (PRACTICAL)
CODE: AT/111 **MAX.MARKS: 50**

1. Qualitative analysis of Mono - saccharides and preparation of their osazone derivatives.
2. Determination of Starch in main feedstocks of grain based distillery.

SUBJECT: BIOCHEMISTRY(PRACTICAL)
CODE: AT/112 **MAX.MARKS**: 5**0**

1. Determination of Total Reducing Sugars in molasses by Lane & Eynon Method.
2. Determination of Total Reducing Sugars in molasses by different colorimetric Methods (demonstration experiment).
3. Formal Titration of Amino acids.
4. Determination of Diastatic Power of Malt.
5. Determination of Oxygen Absorption (OA) Value of effluent samples.
6. Determination of Nitrite content of Water.

SUBJECT: APPLIED MICROBIOLOGY (PRACTICAL)
CODE: AT/113 **MAX.MARKS: 50**

- Handling and use of microscope.
- Microscopic examination of microorganisms like bacteria, yeast, fungi etc.
- Preparation and sterilization of culture media like nutrient agar medium, malt extract medium, molasses agar medium etc., preparation of slants and stabs.
- Acquaintance with different microbiological techniques like inoculation, streaking, plating, stabing etc., aseptic handling of culture media and pure cultures.

SUBJECT: IND. FERM. & ALCO. TECH. (PRACTICAL)
CODE: AT/114 **MAX.MARKS: 100**

1. Determination of brix, specific gravity and pH of molasses.
2. Determination of moisture, total solids, suspended solids, dissolved solids and ash content of molasses.
3. To determine nitrogen content of molasses by Kjeldahl method.
4. Determination of nitrogen by colorimetric method. (Demonstration)
5. To determine total phosphorous content of molasses(Demonstration)
6. Determination of phosphorus content by Fiske and Subbarowmethod . (Demonstration)
7. Estimation of calcium content of molasses by : EDTA method

SYLLABUS

DIPLOMA IN INDUSTRIAL FERMENTATION & ALCOHOL TECHNOLOGY
SECOND YEAR EXAMINATION

SUBJECT: ORGANIC CHEMISTRY (THEORY)
CODE:AT/201 **MAX.MARKS: 50**

1-Alcohols:

Nomenclature, Classification, Methods of preparation, General properties and chemical reactions , Distinction between primary, secondary and tertiary alcohol, Distinction between ethyl and methyl alcohol, amyl alcohol and its isomers, Alcohols of fusel oil, Preparation of anhydrous alcohol by azeotropic distillation, Industrial production of ethyl alcohol from petroleum gases, Chemicals derived from ethyl alcohol, Gasohol

2-Carbohydrates – II :

Disaccharides:

Classification, nomenclature and general methods for determination of their structure, Preparation, isolation and detailed study of the structure of maltose, cellobiose, lactose, sucrose, melibiose & trehalose.

Oligosaccharides and polysaccharides:

Classification,Occurrence,detailed study of the structures and their uses with examples. (Raffinose , Cellulose, Starch, and Dextran)

Reference Books—1. Advanced Organic Chemistry ByBehel&Behel,
S. Chand & Co. Ltd, New Delhi
2. Organic Chemistry By Morrison &Byot, Pearson

SUBJECT: PHYSICAL CHEMISTRY (THEORY)
CODE: AT/202 **MAX.MARKS: 50**

1. Thermodynamics: First law of thermodynamics, Internal Energy, Enthalpy & Heat Content, Second law of thermodynamics, Entropy, Free Energy, Chemical Potential.
2. Colorimeters and spectrophotometers-their principle, working diagrams, Beer-lambert's law and its derivation, colour and its measurement. Factors affecting colour measurement. lamda max and its determination/factor affecting lamda max.
3. Heterogeneous system, phase rule and its limitation, application to binary liquids, partially miscible and immiscible liquid,upper and lower consulate Temperature.
   a- Phase diagram for one component system. b- Azeotrope
4. Adsorption; Difference between adsorption and absorption, Adsorbent, Adsorbate Chemisorption and Physisorption, Factors influencing Adsorption. Active carbon, adsorption of colouring matter on active carbon.

Reference Books—1. Principles of Physical Chemistry By Puri, Sharma &Pathania, S. Nagin Chand & Co., Delhi
2. Physical Chemistry By Peter Atkins, Oxford Pub. House,U.K.
3. Physical chemistry by K.L. Kapoor Mcmillan publication

SUBJECT: AGRICULTURE CHEMISTRY (THEORY)
CODE: AT/203 **MAX.MARKS: 50**

1. **Barley:** The Physiology and Morphology of Barley**,** Barley plant development, Barley fertilization, Two- and Six-rowed barley, Barley grain development, post-fertilization, Structure of the barley grain, Composition of cereal grains.
2. Environmental and Agronomic Factors influencing the Growth of Barley, Climate, Soil, Soil nutrients, Crop competitors – weeds, pests and diseases.
3. Harvesting and Storage of Barley, Yield of Barley, Moisture at harvesting, Barley drying, Barley storage, Dormancy, Reasons for dormancy, Mechanism of dormancy, Barrier effects of seed coats.
4. Effects of light on dormancy, Presence and absence of inhibitors, Shifts in oxidative pathways, Genetic controls, Overcoming dormancy, Types of dormancy.

5. Agronomic Factors influencing Yield of Maize, Wheat, Rye/Mustard, Rice.
6. **Rice:-** Recommended varieties in India and seed rate, time and method of sowing, irrigation, fertilizer use, control of weeds, insect-pests and diseases, harvesting, processing and yield.
7. **Maize:** Recommended varieties in India and seed rate, time and method of sowing, irrigation, fertilizer use, control of weeds, insect-pests and diseases, harvesting, processing and yield.

Reference Books:

1. **Modern Techniques of raising field crops by Chhida Singh,Prem Singh and Rajbir Singh**
2. **Hand book of Agriculture,ICAR.New Delhi.**

SUBJECT: BIOCHEMISTRY (THEORY)
CODE: AT/204 **MAX.MARKS: 50**

1. **Nucleic Acids:** Outline of the structure & functions of purine & pyrimidine bases, nucleosides and nucleotides, structure and biosynthesis of nucleic acids, protein biosynthesis.
2. **Lipids:** Outline of the structure and functions of fatty acids, glycerides, steroids and phospholipids, brief outline of fatty acid biosynthesis & breakdown.
3. **Enzymes:** Nature, occurrence, classification of enzymes, outline of enzyme kinetics, competitive, non-competitive and uncompetitive inhibition.
4. **Bioenergetics :** Brief account of electron transport chain, oxidative phosphorylation photophosphorylation, Z scheme, C_3 cycle and C_4 pathway.

Reference Books—1.Principles of Biochemistry by A. L. Lehninger, C.B.S.Publishers, Delhi, 2. Text Book of Biochemistry by West Todd, The Macmillan Co.Newyork

SUBJECT: ENGINEERING
CODE: AT/205 **MAX.MARKS: 100**

A. **MECHANICAL ENGINEERING**

1. **Steam Turbines-** Classification of turbines and their working, compounding of steam turbines, advantages and disadvantages of velocity compounding , losses in steam turbines ,governing of steam turbines.
2. **Condensors-** Introductions, elements of steam condensing plant, advantages of condensers, types of steam condensers, air leakage, its effects on the performance of condensers and methods of its removal. Vaccum efficiency thermodynamic analysis of condensers, Design of condensers.
3. **Pump:** Types of pumps, construction and working of reciprocal and centrifugal pump, Selection of a pump.
4. Steam consumption in Distilleries including steam requirement for MSDH system & multiple effect evaporator Including configuration both in integrated & standalone system etc

Reference Books—1. Thermal Engineering by R.S. Khurmi, S. Chand & Co., NewDelhi

B.ELECTRICAL ENGINEERING

1. Principle of operation of induction motor, Construction features of induction motor, Classification of induction motors, Slip-torque curve of induction motor, Losses in induction motor, Starting/ Braking of induction motors, Single phasing of induction motor
2. Principle of operation of synchronous generator, Construction features of synchronous generator, Excitation system of synchronous generator, Classification of synchronous generator, Parallel operating conditions of synchronous generator, Applications of synchronous generators
3. Concept of power generation, power transmission and power utilization in distillery.

Reference Books-

1. **A Text Book of Electrical Technology by B.L. Theraja**
2. **Fundamental of Electric Machines by B.R. Gupta & Vandana Singhal**

SUBJECT: INSTRUMENTATION
CODE: AT/206 **MAX.MARKs: 50**

1. Process Control System – Open and closed Loop Control Systems; on and off control; P, PI, PD, PID

controller; Introduction to PLC, DCS, SCADA.

2. Introduction to Pneumatics, Current to Pressure converter, Pneumatic amplifier and its application tothe Industry.
3. Control valves: - Construction, Types, flow characteristics, valve body material & selection of control valve.
4. Different Control schemes used in distillery i.e. Reflux to Distillate ratio control, temp control of a distillation column tray, reflux drum level control etc. Various closed loop control in a distillation column.
5. Analytical Instrumentation (pH, conductivity, Turbidity etc.)

Reference Books—1. Instrument Technology, Vol.1-4 by E.B. Jones, English Language Book Society, Butterworths

2. Instrument Engineers hand Book by B.G. Liptak, ButterworthsHeinmann Ltd., Oxford

3. Industrial instrumentation and control. – C.S. Rao.

4. Process Control Instrumentation Technology by Curtis D. Johnson, Pearson Publicaiton.

SUBJECT: CHEMICAL ENGINEERING

CODE: AT/207A **MAX.MARKS: 70**

1. Heat Transfer

(a) Basics of heat transfer.

(b) Effect of Non condensable gases on condensation

(c) Heat transfer equipment- Single pass and multipass heat exchangers, vaporizers, reboilers and condensers.

2. Distillation

(a) Types of distillation processes-Batch and continuous, Equilibrium, azeotropic and extractive, steam distillation.

(b) Fractional distillation of binary mixture- theoretical/actual plates, plate efficiencies (overall, point and Murphree), minimum and optimum reflux ratio

3. Health & Safety - Fire and explosion risks of ethanol ; Flash points of aqueous alcohol solutions ; Flammable and explosive concentrations of alcohol vapour ; Fire and explosion risks of alcohol, and their prevention, in batch and continuous distillation in storage and maturation in blending and packaging in leakage or spillage ; Carbon dioxide ; Physiological effects of CO_2 ; Dangers of working in fermentation vessels and surrounding areas ; Safety precautions

Reference Books— 1. Introduction to Chemical Engineering by Badger &Banchero

2. Unit Operation of Chemical Engineering by W.L.Mcab& J.C. Smith Pub.-McGraw Hill Book Co. Ltd., Newyork

SUBJECT: BIOCHEMICAL ENGINEERING

CODE: AT/207B **MAX.MARKS: 30**

1. Effluents and Co-products

Effluent composition ; The meaning, and relevance to distillery effluent of: biological oxygen demand ; chemical oxygen demand; suspended solids ; pH ; Relative contributions of different departments to composition of effluent : Typical of water use in spirit production; effluent volume from spirit production BOD and COD (dichromate) of main effluent streams; suspended solids of main effluent streams; pH and temperature range; Effluent analyses BOD, COD total suspended solids; Awareness of official requirements for effluent discharges; Precautions and requirements for disposal of used detergents/sanitizers. Effluent treatment; Calculation of effluent treatment. The basic principles of treatment of effluent discharges pH control prior to treatment; aerobic digestion (bio-filters); anaerobic digestion spraying on farmland; discharge to sea; Environmental implications of these methods; Removal of copper from effluent (precipitation, electrolysis); Processing of distillery stillage (spent wash); Processing of co-products;Separation of solids and liquid of spent wash decanter centrifuge; Factors affecting their capacity to clarify to desired solids concentration; Evaporation: basic principles of natural- and forced-circulation evaporators; falling film evaporator; multiple effect evaporation. Drying of animal feed; disc dryer drum dryer; spray dryer, cyclone dryer, Energy efficiency in processing; Separation of useful sub-products ; Preparation as fodder or fertilizer; Preparation as substrate for further distilled products. Carbon dioxide; Collection of CO_2 from

fermentation vessels ; Processing of CO_2purity requirements ; layout of purification plant knowledge of the function of each column

2. Mixing, type of impellers, processes affected by mixing.

Reference Books— Methods in Microbiology Vol-III by J.R. Norris & D.W. Ribbons, Academic Press Inc.,London

SUBJECT: DRAWING & DESIGN
CODE: AT/208 **MAX.MARKS: 50**

General Layard from AT/108

Welds & Welded Joints:

Types of welding, types of welded joints, welding symbols and their standard location.

Pipe Joints & Fittings:

Types of Pipes, classification of pipe joints- screw joint, welded joint, flange joint, Pipe fitting- Expansion joint, classification of valves, some common features of valves, valves & valve sheet.

PRACTICAL

4. Different types of pipe joints and their fittings.
5. Principal condenser of Rectifier column.
6. Tray layout, drawing of Bubble & Tunnel caps.
7. Rectification Column.
8. Flow Diagram of distillery.
9. Practice on computer aided drafting on auto CAD lab

Reference Books—1.Machine drawing by P.S.Gill
2.Machinery &Equipments of Cane Sugar Factory by Tromp, Twentieth Century Pub., New Delhi, 3. Machine drawing by P.S.Gill

SUBJECT: APPLIED MICROBIOLOGY (THEORY)
CODE: AT/209 **MAX.MARKS: 50**

1. Microbial Physiology: Natural & laboratory environment, growth media, factors affecting growth, determination of cell mass and cell number, phases of microbial growth, mean generation time, bacterial sporulation.
2. Properties of Yeast :Yeast morphology, The principal organelles of the yeast cell and their functions: cell wall nucleus ; cytoplasm plasma membrane ; mitochondrion vacuole ; Mechanism of reproduction by budding ; Characteristics of culture yeasts ; Principles of yeast classification ; concept of genus and species cell and spore morphology ;fermentation and aerobic growth tests ; Identification of *Saccharomyces cerevisiae*and yeasts of natural fermentations.
3. Nutritional requirements of yeast : The sources of carbon, nitrogen, salts, metal ions and growth factors ; Their importance for healthy yeast growth and fermentation ;The role of molecular oxygen ; purity requirements of air Components of wort which are not utilised by yeast
4. Hygiene - Plant cleanliness and sterility ; Cleanliness/sterility requirements of different stages of the process ; Influence of process plant surfaces**:** cast iron, copper, stainless steel, wood ; Importance of design features of pipe work and fittings ; Principles of layout and operation of a cleaning-in-place system ; The range and main constituents of cleaning and sterilizing agents ; Safety requirements for handling detergents and sanitizers ; Advantages and disadvantages of hot vs cold sterilization ; Detection and quantification of residual surface contamination: visual inspection rinse sampling ;swab sampling; Types of spoilage organism ; Micro-organisms which can spoil wort/must and fermentation, their origin and effects *Acetobacter*and *Gluconobacter ; Escherichia* and *Enterobacter ; Lactobacillus* and other lactic acid bacteria : good and bad effects ; *Obesumbacterium*and *Zymomonas ;*Wild yeasts

Reference Books—General Microbiology by M. J. Plezar, Tata McGraw Hill Pub.Co.Ltd., New Delhi.

SUBJECT: INDUSTRIAL FERMENTATION & ALCOHOL TECHNOLOGY
CODE: AT/210 MAX.MARKS: 100

1. Fusel oil formation and separation.
2. Scaling problem in distillery.
3. Alcoholometry : Reduction and blending of spirits, denaturation, obscuration & shrinkage, potable liquors, country liquors & Indian Made Foreign Liquors.(IMFL)
4. Production of compressed bakers' yeast,
5. Brewing technology: Malting, mashing, fermentation and pasteurization of beer, defects of beer.
6. Manufacture of wine: types of wines, maturation and fining of wine & production of champagne.
7. Vinegar fermentation
8. Citric acid fermentation.
9. Manufacture of different antibiotics by fermentation.
10. Manufacture of Vitamins – Riboflavin and Vitamin B-12 by fermentation.
11. Miscellaneous fermentations – lactic acid, acetone-butanol, etc.
12. Different method of spent wash treatment including bio-methanation, incineration and bio composting.
13. Working of distillery-II
14. Working of brewery-II
15. Effluent treatment Plant of grain and Molasses based Distillery
    Different method of spent wash treatment in Molasses based distillery including bio-methanation, incineration and bio-composting. Spent wash treatment in grain based distilleries
16. Condensate Polishing Unit (CPU) Technologies: Various CPU technologies generally used in distillery industry.
17. Water Mass balance- Fresh water requirement, Generation of Condensates, Spent lees and spent wash, Recycling and re-usage.

Reference Books—1. Industrial Fermentations By L.A. Under Koeffler, Chemical Pub.Co.,Newyork
2.Comprehensive Biotechnology Vol.3 By M. M. Young, Pergamon Press Ltd., Oxford

SUBJECT: ORGANIC CHEMISTRY (PRACTICAL)
CODE: AT/211 MAX.MARKS: 50

1. Qualitative analysis of Disaccharides and preparation of their osazone derivatives.
2. Detection of Primary, Secondary and Tertiary hydroxyl groups and preparation of triiodommethane(Iodoform)
3. Determination of higher alcohols and methanol in alcoholic beverages.

SUBJECT: BIOCHEMISTRY(PRACTICAL)
CODE: AT/212 MAX.MARKS: 50

1. Determination of Chemical Oxygen Demand (COD) Value of effluents by colorimetric & titrimetric methods.
2. Determination of Dissolved Oxygen(DO) Value and Biochemical Oxygen Demand(BOD) value of effluent samples.
3. Isolation of enzymes from different sources. (Demonstration Experiment)
4. Determination of proteins by Lowry and Bieuret method. (Demonstration Experiment)
5. Principle and operation of instruments used in biochemistry and industrial fermentations: pH meter, Lyophilizer, Ordinary and Refrigerated Centrifuges, COD Digestion cum Photometeric Unit, UV-Visible and IR-Spectrophotometers, Ultracentrifuge.

SUBJECT: APPLIED MICROBIOLOGY (PRACTICAL)
CODE: AT/213 **MAX.MARKS: 50**

1. Isolation and development of a pure yeast culture.
2. Preparation of bacterial culture slides and staining by Gram stain.
3. Dilution and plating of culture for total viable cell count
4. Differential counting of living and dead yeast cells by direct microscopic examination.

SUBJECT: IND. FERM. & ALCO. TECH. (PRACTICAL)
CODE: AT/214 **MAX.MARKS: 100**

1. Determination of fermentation efficiency of yeast growing on molasses medium.
2. Determination of ethyl alcohol content of spirit by:
   (a) Specific gravity method (b) Alcoholometer (c) Colorimeter
3. Determination of total, volatile and fixed acids in spirit.
4. Determination of aldehyde content of spirit.
5. Determination of ester content of spirit.
6. Determination of fusel oil content of spirit.