

NATIONAL SUGAR INSTITUTE

MINISTRY OF CONSUMER AFFAIRS, FOOD & PUBLIC DISTRIBUTION
DEPARTMENT OF FOOD & PUBLIC DISTRIBUTION
Government of India
KANPUR



सत्यमेव जयते

ACADEMIC BULLETIN

2018

For

**DIPLOMA IN INDUSTRIAL
FERMENTATION & ALCOHOL
TECHNOLOGY COURSE
(D . I . F . A . T .)**

**INDUSTRIAL FERMENTATION AND ALCOHOL
TECHNOLOGY COURSE
(D.I.F.A.T.)
ACADEMIC CALENDAR**

1.	Admission	July-2018
2.	First Year Theory & Practical Classes	July-2018 to October -2018
3.	Events organized by Games & Sports, Cultural, Scientific Society	August/ September-2018
4.	First Year Examination	Up to 15th November-2018
5.	Educational Tour	20th November-2018 to 30th November -2018
6.	In plant Training	December- 2018 to March 2019
7.	Summer Vacation	1st April 2019- 15thApril 2019
8.	Second Year Theory & Practical Classes	16th April-2019, October - 2019
9.	Submission of in plant Training Report	In first week of May-2019
10.	Second Year Examination	October/ November- 2019
11.	Campus Interview through placement Cell.	As per the demand and Convenience of the industry.

Note:

- 1. The working of the Institute is from Monday to Friday i.e. five days in a week.**
- 2. The Institute also observed holidays for Central Government Offices in Kanpur.**

1. **RULES FOR ATTENDANCE AND LEAVE**

1.1 A student is required to put in a minimum of 75 percent attendance during each session in each subject. Non-compliance of this may render him debarred from appearing at the Diploma Examination.

1.1.1 Ordinarily, leave for 15 days is admissible to a student in an academic year.

1.2 Application of leave for absence must be handed over at the education section on the prescribed form in advance.

1.3 Application for leave must be counter signed by the Hostel Warden or the approved guardian.

1.4 Application for sick leave must be accompanied by a certificate from the Medical Officer of the Hostels.

1.5 Absence without leave by a student drawing a scholarship may result in the cancellation or reduction of his scholarship.

2. **RAGGING : *Ragging is strictly prohibited vide directions of Hon'ble Supreme Court in SLP No2495 of 2006 dated 16.05.2007 and in Civil Appeal No 887 of 2009, dated 08.05.2009. Any student found guilty of ragging and /or abetting ragging is liable to be punished.***

3. **EDUCATIONAL TOUR**

Students of D.I.F.A.T. Course are required to proceed on educational tour to Distilleries, Breweries, Engineering works or other industrial units in order to acquaint themselves with their working and thus add to their knowledge . The educational tour is an essential part of the training programme and every student is required to participate in the tour. No exemption from Educational Tour is given. Students not proceeding on Educational Tour shall be detained in the same class **Failed Students are required to repeat the educational tour.**

4. **FACTORY TRAINING**

Students of the D.I.F.A.T. Course are sent for factory training to Distilleries from January to March which enables them to supplement their theoretical knowledge with practical aspects. The Institute recommends the factories receiving students for practical training, to give them suitable stipends, lodging, accommodation etc., during the course for their training at the factory.

5. SCHEME OF EXAMINATIONS

5.1 The examinations are held at the appropriate time as per Institute's calendar. Class tests may also be held during the middle of the session. Marks obtained at these tests and examinations as well as the marks assigned for class work and lecture notes of each student will be recorded for his class marks in each term.

5.2 Classification of Results:

It is necessary to pass in each subject separately in Theory, Practicals and Sessionals. The minimum pass marks in theory 35% and 50% in Practicals and Sessionals. The candidate would be declared to have passed a particular course in case he secures a minimum of 50% marks in aggregate. The division to students at the end of examinations are given according to the following standards:-

First Division	75% and above
Second Division	60% and above
Third Division	50% and above

5.3 Supplementary Examination

5.3.1 If a candidate fails in maximum of any two subjects at the First/Second/Final year examination but secures 50% marks in aggregate, he will be allowed to appear in the supplementary examination for these two subjects.

5.3.2 A candidate allowed to appear in the supplementary examination would be provisionally promoted to the next higher class and in case he fails in the supplementary examination also, he would be reverted to the lower class on declaration of supplementary examination results.

5.3.3 The student who passes in the said examination of any course in supplementary examination will be declared as "PASSED" and no division will be awarded to him.

5.4 Re-admission of Failed Students

If a candidate fails in First/Second year examinations (including supplementary examination). He/she will be permitted to take the re-admission again in the following year, provided he/she attends the Institute as a regular student in the same class in which he/she had failed. If a student fails three times in a particular class he will be not re-admitted in that class in the Institute. If after failing in the class once a candidate does not take re-admission in the same class in the immediate next session his/her case will not be considered in future for re-admission.

FIRST YEAR EXAMINATION

<u>Subject</u>	<u>Maximum Marks</u>
<u>THEORY</u>	
Organic Chemistry	50
Physical Chemistry	50
Agriculture Chemistry	50
Biochemistry	50
Engineering	100
Electrical Engineering	50
Mechanical Engineering	50
Instrumentation.	50
Chemical & Biochemical Engineering (70+30).	100
Drawing & Design.	100
Applied Microbiology.	50
Industrial Fermentation & Alcohol Technology.	100
SESSIONAL	
Class Marks.	200
<u>GRAND TOTAL</u>	<u>900</u>

SECOND YEAR EXAMINATION

<u>Subject</u>	<u>Maximum Marks</u>
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THEORY

Organic Chemistry.	50
Physical Chemistry	50
Agriculture Chemistry	50
Biochemistry	50
Engineering	100
Electrical Engineering	50
Mechanical Engineering	50
Instrumentation.	50
Chemical & Biochemical Engineering (70+30).	100
Drawing & Design.	50
Applied Microbiology.	50
Industrial Fermentation & Alcohol Technology.	100
Technical Essay	50

PRACTICAL

Organic Chemistry.	50
Biochemistry	50
Applied Microbiology	50
Industrial Fermentation & Alcohol Technology.. . . .	100

SESSIONAL

In plant Factory Training (Factory Report) - - -	50
1/3 rd Marks of First Year Examination - - -	300
Class Marks.	200
Viva-Voce	50
Educational Tour	50

<u>GRAND TOTAL</u> .	<u>1600</u>
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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 & Boyd, 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 numericals 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 superheaters.
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. Modern Techniques of Raising Field Crop

By Chhidda Singh, Prem Singh and Rajbir Singh

2. 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, dryness fraction, 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:- 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. D.C. Generator: Basic principle, classification, construction and working, EMF equation, losses in generator, efficiency.

2. D.C. Motor: Basic principle, construction, classification, electromagnetic torque, application of DC motor.
3. Transformer: Principle, types, losses and efficiency.

Reference Books—1. A text book of electrical technology by B.L. Thareja, S. Chand & Co.

2. Fundamentals of electric machines by B.R. Gupta and VandanaSinghal

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, level measurement.
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.

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.

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 & Banchemero

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

Fundamentals of Drawing:

Basic Consideration in Process equipment designs; Code of Practice (BIS) for unified pressure nozzles; Method of construction of distillery design and its mechanical properties and strength.

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

PRACTICAL

1. Orthographic projection-1st 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 & Immobilised Cell Technique, etc.
10. Production of industrial and power alcohol by azeotropic 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, Chemical Pub.Co.,Newyork

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 : 50

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 By Behel & Behel,
S. Chand & Co. Ltd, New Delhi

2. Organic Chemistry By Morrison & Boyd, 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. λ_{max} and its determination/factor affecting λ_{max} .
3. Heterogeneous system, phase rule and its limitation, application to binary liquids, partially miscible and immiscible liquid, upper and lower consolute 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 ; Environmental and Agronomic Factors influencing the Growth of Barley ; Climate ; Soil ; Soil nutrients ; Crop competitors – weeds, pests and diseases ; 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; Effects of light on dormancy ; Presence and absence of inhibitors ; Shifts in oxidative pathways ; Genetic controls ; Overcoming dormancy ; Types of dormancy

2. Agronomic Factors influencing Yield of Maize, Wheat, Rye/Mustard, Rice.

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, C₃ cycle and C₄ 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. New York**

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. **Condensers-** 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 etc

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

B.ELECTRICAL ENGINEERING

1. Induction Motor: Principle, Types of induction motors and their application, Maintenance of induction motors.
2. A.C. Generator. Principle, construction and testing.
3. Study of electrical system of Distillery, generation , utilization.

Reference Books—1. A text book of electrical technology by B.L. Thareja,S. Chand & Co.

2. Fundamentals of electric machines by B.R.Gupta and Vandana Singhal

SUBJECT : INSTRUMENTATION

CODE : AT/206 MAX.MARKS : 50

1. Analytical Instrumentation (pH, gas analysis, conductivity, Turbidity etc)
2. Control Valves - The basic design features, respective merits and typical distillery applications of the following types of valve: butterfly diaphragm; gate globe; Design features and applications in distillery plant of the following types of valve: pressure relief pressure reducing; anti-vacuum
3. Control valves :- Construction, Types, flow characteristics , valve body material & selection of control valve.

4. Process Control System – Open and closed Loop; on and off control; P, PI, PD, PID controller; PLC, DCS, SCADA
5. 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

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.

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 CO₂ ; 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 CO₂ from fermentation vessels ; Processing of CO₂ purity 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

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 triiodomethane(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 Photometric 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.