



Estd. 1962  
NAAC 'A' Grade

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दुरध्वनी (ईपीएबीएक्स) २६०९०००० (अभ्यास मंडळे विभाग- २६०९०९४)

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SU/BOS/Sci & Tech/719

Date: 05/10/2023

To,

**The Principal,**

*Rajarambapu College Of Sugar Technology, Islampur,  
Shivaji University, Kolhapur.*

**Subject:** Regarding minor change in Syllabus of **M.Sc. Part-I Sugar Technology & Alcohol Technology Programme** as NEP-2020 under Faculty of Science & Technology.

**Sir/Madam,**

With reference to the subject mentioned above, I am directed to inform you that the University have accepted and granted approval to minor change in Syllabus of **M.Sc. Part-I Sugar Technology & Alcohol Technology Programme** as NEP-2020 under Faculty of Science & Technology which is enclosed herewith.

This minor change in Syllabus of will be implemented from the academic year 2023-24 i.e.

You are therefore, requested to bring this to the notice, all students and teachers concerned.

Thanking you,

Yours faithfully,

  
Dr.S.M. Kubal

Dy. Registrar

Copy to :-

1	The Dean, Faculty of Science & Technology	8	Appointment Section
2	The Chairman, Respective, BOS	9	Centre for Distance Education
3	Exam Section	10	Computer Centre
4	Eligibility Section	11	Affiliation Section (U.G.)
5	O.E. I Section	12	Affiliation Section (P.G.)
6	O.E. II Section	13	P.G.Admission Section
7	O.E. III Section	14	P.G.Seminar Section

# **SHIVAJI UNIVERSITY KOLHAPUR**



## **Syllabus for**

**M.Sc. Part-I ALCOHOL TECHNOLOGY (Entire)**

**(Under Faculty of Science & Technology)**

**AS PER NEP-2020**

**(To be implemented from Academic Year 2023-24)**

## **M. Sc. (Alcohol Technology) NEP 2023-24**

**1. Title:** M. Sc. in Alcohol Technology, Shivaji University, Kolhapur, Syllabus as per NEP 2020.

**2. Faculty:** Faculty of Science and Technology

**3. Year of implementation:** For M. Sc. I (Semester I and Semester II): From June 2023 and for M. Sc. II (Semester III and Semester IV): From June 2024.

### **4. Vision:**

Leading edge Alcohol Technology for the Sugar and allied industries.

### **5. Mission:**

- a) To emerge as one of the most preferred institutes by providing high technical knowledge of sugar and allied industries.
- b) To impart quality education in the field of sugar and alcohol technology to achieve the needs of and allied industries.
- c) To prepare young technocrats with sound footing of basic technical & managerial skills.  
Research capabilities to lead and use technology for the progress of sugar and allied industries.

### **6. Core Values:**

- |                      |                      |                                |
|----------------------|----------------------|--------------------------------|
| 1. Quality Education | 2. Social Service    | 3. Sound Character             |
| 4. Global Competence | 5. Scientific Temper | 6. Environmental Consciousness |

### **7. Programme Outcomes:**

#### **Programme Outcomes- M.Sc.**

After the completion of two-year post-graduation program students will be able to acquire the following attributes.

**PO 1:** Domain Knowledge- Acquire advanced knowledge of in distillery scientific principles, theories, models and methods in the disciplines of their study.

**PO 2:** Application- Able to use scientific knowledge and tools deriving from domain knowledge alcohol production and sugar manufacturing.

**PO 3:** Problem Analysis- Able to identify, formulate and analyse complex problems and find out working solutions using scientific knowledge and tools distillery and sugar industry.

- PO 4:** Project Management- Able to handle individual and/or group tasks and use critical thinking, problem solving and research-related skills distillery and sugar industry.
- PO 5:** Individual and Team work- Able to function effectively as an individual and as a member in diverse teams and in multidisciplinary settings distillery and sugar industry.
- PO 6:** Communication Skills- Able to communicate effectively with the surrounding people and society at large and write reports, documents and make effective presentations distillery and sugar industry.
- PO 7:** Social Awareness- Able to demonstrate social values through acts of social commitment, display professional ethics and responsibilities showing appropriate consideration for public health, safety and welfare distillery and sugar industry.
- PO 8:** Social Awareness- Able to demonstrate social values through acts of social commitment, display professional ethics and responsibilities showing appropriate consideration for public health, safety and welfare distillery and sugar industry.
- PO 9:** Ethics and Human Values- Able to acquire human values and integrity of character and display moral behaviour distillery and sugar industry.
- PO 10:** Lifelong Learning- Able to recognize the need for and have the ability to engage in an independent and life-long learning in the context of drastic.

## **8. Programme Specific Outcomes:**

After the completion of the two-year postgraduate programme in Alcohol Technology students will be able to -----.

- PSO 1:** Learn about Alcohol Production and Sugar Manufacturing and alcohol structure, chemical names and physical and chemical properties.
- PSO 2:** Gain knowledge about soil formation, soil profile, soil properties and composition. Sugar properties, alcohol properties.
- PSO 3:** Understand general characteristics, morphology and physiology microorganism, plant virus and viral diseases, disease management and control.
- PSO 4:** Acquire knowledge of production of Alcohol, marketing and planning.
- PSO 5:** Understand the concept of ecology and interrelationship

among.

**9. The entire M. Sc. Programme will be of four semesters spread over two years.**

**10. Pattern of Examination:** Theory examination will be conducted Semester wise and Practical examination will be conducted annually.

**11. Fee Structure:** As per University rules and guidelines

**12. Eligibility for admission:**

Admission to the course for the candidate passing B. Sc. degree with Sugar technology/Physics/Chemistry/Mathematics, B. Tech. Food/Chemical Technology, B. E. Chemical Engineering/ Instrumentation / Mechanical Engineering.

Candidate will be selected through entrance exam and fulfilling the conditions laid by as per the University rules. Merit list will be prepared based on the Performance at entrance examination.

**13. Medium of Instruction:** English

**14. Structure of course:**

- Distribution of Marks – Internal evaluation: 20
- External evaluation: 80 (Semester exam)
  
- Total Marks for M. Sc. Degree
- Theory Papers: 1500
  
- Practical course: 700
  
- Total: 2200
- Total CGPA Credit: 88

**15. Scheme of Teaching and Examination:**

(Applicable to University Department and University affiliated colleges' centres).

- ❖ Each unit in theory course shall comprise 15 lectures, each of 60 minutes duration and there shall be four lectures per theory course per week.
- ❖ Entire course of M. Sc. Alcohol Technology will be of 2200 marks.
- ❖ Examination of each theory course shall be of 100 marks (80 University

Examination + 20 Internal Assessments). University examination of 80 marks (3 hours' duration) will be conducted at the end of each Semester. Internal assessment of 20 marks will be conducted before the semester examination during each semester.

- ❖ Examination of practical course shall be annually and is of 600 marks.
- ❖ Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus

### 16. Standard of Passing:

There will be separate passing for theory courses and practical courses. Minimum 40% marks will be required for passing separately for theory and practical courses.

### 17. Nature of Theory & Practical question paper and scheme of marking:

#### Theory

Question No.	Type of Question	Total Marks (80)
Q.1.	Answer in one sentence (total 16 questions)	16
SECTION I		
Q.2.	Long Answer Type Questions. Attempt any two out of three.	16
Q.3.		16
Q.4.		16
SECTION II		
Q.5.	Short answer type questions. Attempt any two out of three.	16
Q.6.		16
Q.7.		16

#### Practical

Practical Examination will be annual and of 300 marks.

**M. Sc. I: (MMATP103 Major) Practical I: Alcohol Technology I – 100 marks**

(MMATP104 Minor) Practical II: Microbiology I – 50 marks

(MMATP203 Major) Practical III: Alcohol Technology II – 100 marks

(MMATP204 Minor) Practical IV: Microbiology II – 50 marks

**Field Project: 100 marks**

**M. Sc. II: (MMATP 303 Major) Practical I: Alcohol Technology – III – 100 marks**

**(MMATP 304 Minor) Practical II: Microbiology III – 50 marks**

**(MMATP 403 Major) Practical III: Implant Training – 100 marks**

**(MMATP 404 Minor) Practical IV: Research Project – 50 marks**

## **M. Sc. Programme Structure of Alcohol Technology**

### **NEP-2020 with Multiple Entry and Multiple Exit Option**

#### **M. Sc. Part I (Semester I & II) (Academic Year-2022-23)**

Year 2 Yrs. PG)	Level	Semester	Major		Research Methodology (RM) (04 Credits)	OJT/FP (04 Credits)	Research Project	Cumulative Credits	Degree
			Mandatory Degree (20 Credits)	Elective					
I	6. 0	Sem I	MMAT 101: 4 Credits MMAT 102: 4 Credits MMATP 103: 4 Credits MMATP 104: 2 Credits	MEAT 106: 4 Credits	RM 105: 4 Credits	---	---	22	PG Diploma
		Sem II	MMAT 201: 4 Credits MMAT 202: 4 Credits MMATP 203: 4 Credits MMATP 204: 2 Credits	MEAT 206: 4 Credits ---	---	FP205: 4 Credits	---	22	
Cumulative Credits for PG Diploma			40	---	---	04	---	44	Exit Option

### **Abbreviations:**

**PG:** Post Graduation, **Yrs.:** Years, **Sem.:** Semester, **MMAT:** Major Mandatory Alcohol Tech, **MMATP:** Major Mandatory Alcohol Tech Practical, **MEAT:** Major Elective Alcohol Tech, **RM:** Research Methodology, **OJT:** On Job Training, **FP:** Field Project.

**M. Sc. Programme Structure (NEP-2020) of Alcohol Technology**

**M. Sc. Part I (With effect from June 2023)**

<b>Semester I (Duration – Six Month)</b>										
<b>Sr. No.</b>	<b>Course Code &amp; Title of Course</b>	<b>Teaching Scheme</b>			<b>Examination Scheme</b>					
		<b>Theory &amp; Practical</b>			<b>University Assessment (UA)</b>			<b>Internal Assessment (IA) &amp; Practical</b>		
		<b>Lecture Per week</b>	<b>Hours Per week</b>	<b>Credits</b>	<b>Maximum Marks</b>	<b>Minimum Marks</b>	<b>Exam Hours</b>	<b>Maximum Marks</b>	<b>Minimum Marks</b>	<b>Exam Hours</b>
1	MMAT 101: Alcohol Technology-I	4	4	4	80	32	3	20	8	1
2	MMAT 102: Microbiology	4	4	4	80	32	3	20	8	1
3	MMATP 103: Alcohol Technology-I	---	8	4	100	40	4	---	---	---
4	MMATP 104: Microbiology-I	---	4	2	50	20	2	---	---	---
5	RM105: Research Methodology	---	4	4	80	32	3	20	8	1
6	MEAT 106: Applied Chemistry	4	4	4	80	32	3	20	8	1
	MEAT 106: Bio-Chemistry									
	<b>TOTAL</b>	---	---	<b>22</b>	<b>470</b>	---	---	<b>80</b>	---	---

**Abbreviations:**

**PG:** Post Graduation, **Yrs.:** Years, **Sem.:** Semester, **MMAT:** Major Mandatory Alcohol Tech, **MMATP:** Major Mandatory Alcohol Tech Practical, **MEAT:** Major Elective Alcohol Tech, **RM:** Research Methodology, **OJT:** On Job Training, **FP:** Field Project.



## M. Sc. Programme Structure (NEP-2020) of Alcohol Technology

### M. Sc. Part I (With effect from June 2023)

<b>Semester II (Duration – Six Month)</b>										
<b>Sr. No.</b>	<b>Course Code &amp; Title of Course</b>	<b>Teaching Scheme</b>			<b>Examination Scheme</b>					
		<b>Theory &amp; Practical</b>			<b>University Assessment (UA)</b>			<b>Internal Assessment (IA) &amp; Practical</b>		
		<b>Lecture Per week</b>	<b>Hours Per week</b>	<b>Credits</b>	<b>Maximum Marks</b>	<b>Minimum Marks</b>	<b>Exam Hours</b>	<b>Maximum Marks</b>	<b>Minimum Marks</b>	<b>Exam Hours</b>
1	MMAT 201: Alcohol Technology-II	4	4	4	80	32	3	20	8	1
2	MMAT 202: Applied Microbiology	4	4	4	80	32	3	20	8	1
3	MMATP 203: Alcohol Technology-II	---	8	4	100	40	4	---	---	---
4	MMATP 204: Microbiology-II	---	4	2	50	20	2	---	---	---
5	FP205: Field Project	---	8	4	---	---	---	100	40	---
6	MEAT 206: Industrial Fermentation-I	4	4	4	80	32	3	20	8	1
	MEAT 206: Pollution Prevention & Control									
<b>TOTAL</b>		---	---	<b>22</b>	<b>390</b>	---	---	<b>160</b>	---	---

### Abbreviations:

**PG:** Post Graduation, **Yrs.:** Years, **Sem.:** Semester, **MMAT:** Major Mandatory Alcohol Tech, **MMATP:** Major Mandatory Alcohol Tech Practical, **MEAT:** Major Elective Alcohol Tech, **RM:** Research Methodology, **OJT:** On Job Training, **FP:** Field Project.

## **M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-I) (NEP2020)**

**(Introduced from Academic Year 2023 – 24)**

**Title of Course: Alcohol Technology-I**

**Course Code: MMAT101**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand chemical Properties of alcohol.
2. Acquire knowledge of alcohol formulations Acquire skill of using different devices which are used in alcohol application.
3. Acquire knowledge of Molasses: Major Raw material used in Alcoholic Fermentations.
4. Acquire knowledge of Details of Alcoholic Fermentation from Cane Molasses.

### **Unit 1. Introduction of Alcoholic beverages (15)**

History and development of Alcoholic Beverages

Overview of fermentation and microorganisms: - Yeast, Lactic acid bacteria, Molds and Spoilage.

Alcoholometry:

Proof spirit, (British and USA) over proof, under proof, specific gravity of alcohol strength of alcohol in terms of concentration – related examples and solution

### **Unit 2. Basics concepts related to Alcohol Technology (15)**

Molasses, Total reducing sugar, Fermentable/Unfermentable sugar, Residual sugar, Wort, Brix, Specific gravity, Distillation, Industrial alcohol, Proof spirit, Strength of spirit, Reflux, Reduction of spirit, blending of spirit, Vaporization, Saccharification, Scaling, Scrubber, Starch, Sucrose, Rectification, Gelatinization, liquefaction, Reboiler, DDGS, DWGS, Spent wash, ZLD systems etc.

### **Unit 3. Molasses: Major Raw material used in Alcoholic Fermentations (15)**

Molasses: Definition, Different sources of molasses; Sugar cane molasses production, Characteristics and uses of molasses: Molasses for production of alcohol, yeast, acetone, glycerin, cattle feed- (process), Composition of molasses, F/N ratio, Grades of molasses, Factor Affecting composition of molasses, storage of molasses, Pre-clarification of molasses, effect of various components of molasses on alcoholic fermentation, control of adverse effect of composition of molasses.

## **Unit 4. Details of Alcoholic Fermentation from Cane Molasses**

**(15)**

Process of Batch fermentation, factor influencing efficiency of fermentation, characteristics of Batch Fermentation Process, Control over fermentation operation, contamination control, design and material of construction of fermenters, maintenance of fermenter and operational conditions on plant scale, flowsheet of Batch Fermentation process, Efficiency of Fermentation and Attenuation data calculations – Related examples and solutions.

Prevention of losses of alcohol during fermentation, post-fermentation practices/scrubbing etc. Post clarification of fermented wash; advantages and disadvantages.

### **Reference Books:**

1. The Alcohol Text Book- Lyons & Kelsall
2. Alcoholometry- Satyanarayana Rao
3. Hand Book of Fermentation & Distillation-A.C. Chatterjee
4. Distillation- H.C. Barron.
5. Technical excise manual- Excise Dept., Govt. of India.
6. By-products of Sugar Industry- Paturao

## **M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-I) (NEP2020)**

**Title of Course: Microbiology**

**Course Code: MMAT102**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand type's microorganism.
2. Learn bacterial structure chemical names and physical and chemical properties. Acquire knowledge of yeast formulations.
3. Get knowledge of Microscopy and Staining.
4. Acquire knowledge of Yeast Microbiology.

## **Unit 1: History and Scope of Microbiology**

**(15)**

Historical developments of microbiology and scope of microbiology.

Important contribution

- a) Brief account of organization and classification of microorganisms. Differences between prokaryotic and eukaryotic cell

- b) Overview of bacterial cell structure (size, shape, arrangement membrane, cell wall, cytoplasmic inclusions, mesosomes, flagella and motility, slime, capsule, pile, chemo taxis, endospore)
- e) Distribution of microorganism in nature and their beneficial and harmful effects

## **Unit 2: Microscopy and Staining**

**(15)**

Principles and Applications of Microscopy: (i) Compound microscope (ii) fluorescence and (iii) immune fluorescence microscopy, a) image formation, b) Ray diagram, c) special feature, d) magnification e) numerical aperture, f) resolving power, g) working distance Introduction to bright field microscopy, dark field microscopy, phase contrast and electron (transmission and scanning) microscopy Staining of Microorganisms

i) Definition of dye and stain, classification of stain –acidic, basic and neutral stains ii) Principal, Procedure, mechanism and application of staining procedure:

- 1) Simple staining, 2) negative staining, 3) differential staining: Gram staining and acidfast staining 4) Special staining methods- cell wall (Chances method), capsule (Manuals method), Endospore staining

## **Unit 3: Microbial Nutrition and Pure Culture Techniques**

**(15)**

Microbial Nutrition

- a) Modern concepts of Microbial nutrition, nutritional categories of microorganism, transport of nutrients to the cell (osmosis, facilitated diffusion, passive transport active transport.
- b) Microbial Culture media- Definition, media components (water, various C&N sources, minerals, chelators, growth factors, precursor, inducers, inhibitors antifoaming agents, buffers)  
Common components of media & their function –peptone yeast extract, vitamin, NaCl, agar etc.

Media formulation & optimization, Sterilization of media (filtration and autoclaving) Ex. of commonly used carbon and nitrogenous sources, factors influencing their choices

c) Classification of Microbial Culture Media

Living media, non-living media –i) Natural ii) Synthetic iii) Semi synthetic

iv) Differential v) Enriched vi) Selective vii) Enrichment

A) Pure Culture Techniques

Pure culture definition and its importance, Methods for isolation of pure culture

i) Streak plate ii) Pour plate iii) Spread plate

B) Maintainers of pure culture

## **UNIT 4: Yeast Microbiology**

**(15)**

Definition, yeast morphology and taxonomy, comparison with other microorganisms, yeast cell structure and functions of various cellular components of yeast.

A) Nutritional requirements of yeast, Factors (Physical Requirements) That Should Be Considered Regarding Yeast Nutrition; yeast growth curve and measurement of growth; factor affecting growth, phases of yeast growth, determination of cell mass, cell number, generation time etc., Timings for nutrient addition during alcoholic fermentations

B) Yeast reproduction, *Saccharomyces cerevisiae* life cycle; mechanism of budding

**Recommended Books:**

1. General Microbiology, IV edn.- Stanier, Adelberg and Ingraham, Mac Millan Press.
2. General Microbiology- Plezar, Tata McGraw Hill Pub.Co. Ltd., New Delhi.
3. Prescott's Microbiology Vedn. - Prescott 2002.
4. Bergey's Manual of Systematic Bacteriology, Springer.
5. Foundations in Microbiology- Talaro and Chess, McGraw Hill.

**M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-I) (NEP2020)**

**Title of Course: Alcohol Technology- I**

**Course Code: MMATP103**

**Total Credits: 04**

1. Determination of brix, specific gravity and pH of molasses.
2. Determination of moisture, total solids, content of molasses.
3. Determination of moisture suspended solids, dissolved solids and ash content of molasses.
4. Determination of nitrogen by colorimetric method.
5. Estimation of calcium content of molasses by: EDTA method
6. Determination of reducing sugar content in molasses.
7. Determination of Total Reducing Sugars in molasses by DNSA method
8. Estimation of proteins by Biuret method.
9. Determination of Total Reducing Sugars in molasses by Lane & Eynon Method.
10. Determination of ethyl alcohol content of spirit by Specific gravity method
11. Determination of ethyl alcohol content of spirit by Sikes hydrometer
12. Separation and identification of chemical compounds by paper chromatography.
13. Separation and identification of chemical compounds by TLC.

## **M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-I) (NEP2020)**

**Title of Course: Microbiology-I**

**Course Code: MMATP104**

**Total Credits: 02**

### **Basic requirements of a microbiology laboratory**

#### **1. Apparatus**

- a) Petri-plate      b) Pipette      c) Erlenmeyer flask d) Glass spreader
- e) Wire loop      f) Cotton plug

#### **2. Equipments: Handling and use of,**

- 1) Compound microscope      2) Bunsen burner      3) Autoclave      4) Hot air oven
- 5) Incubator      6) Refrigerator      7) Centrifuge

#### **3. Stains and staining procedures:**

- i) Spore staining (Darner's process)    ii) Flagella staining (Bailey's method)    iii) Nucleus staining (Giemsa's method)

#### **4. Preparation and sterilization of culture media like**

- i) Nutrient agar      ii) Nutrient broth      iii) Starch agar    iv) Potato dextrose agar
- v) MacConkey's agar      vi) malt extract medium,
- vii) Molasses agar medium etc.,

#### **5. Demonstration of technique for pure culture of micro-organisms**

- i) Strak plate method    ii) Pour plate method    iii) Spread plate method

#### **6. Isolation and development of a pure yeast culture.**

#### **7. Preparation of bacterial culture slides and staining by Gram stain.**

#### **8. Dilution and plating of culture for total viable cell count**

#### **9. Differential counting of living and dead yeast cells by direct microscopic examination**

# M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-I) (NEP2020)

**Title of Course: Research Methodology**

**Course Code: RM105**

**Total Credits: 04**

## **Unit 1: Research Methodology (15)**

- Introduction to research methodology
- Formation of problems
- Formation of Hypothesis
- Research Design- Explorative, Descriptive, Diagnostic & Experimental
- Data Processing and classification
- Types of research

## **Unit 2: Sampling Techniques and Testing of Hypothesis (15)**

Concept of Data collection & Sampling, Methods of Sampling – Simple Random sampling, stratified random sampling, cluster sampling. Advantages & Limitations of sampling. Concept of testing of hypothesis

1. Testing of population mean and equality of two population means for large samples.
2. Testing of population proportion and equality of two population proportions.
3. Testing of population mean and equality of two population means for small samples.
4. Chi-square test for – i) testing independence of two attributes  
ii) testing variance

## **Unit 3: Computer Applications (15)**

History and generations of computers; (I, II, III, IV and V), Hardware; CPU, input, output, storage devices, classifications of computers; analog computers, digital computers, mainframe computers, miniframe computers, microcomputers. Memory: Primary memory or main memory; magnetic core memory, RAM, ROM, Secondary memory or auxillary memory. The students will learn how to operate a PC. Execution of linear regression, X-Y plot, statistical data interpretation.

## **Unit 4: Scientific Writing (15)**

Different forms of Scientific writing - Articles in Journals, Research notes, Review articles & Dissertations, Conference presentation, Bibliographies. Drafting titles, sub-titles and formatting tables. Use & guidelines of appendices. Parts of Research report articles – introduction, review of literature, methodology, results & discussions and conclusions.

## **Reference Books:**

- 1) Research Methods and Techniques, C. R. Kothari (2019) New Age International Publishers.
- 2) Research Methodology – A Step by step Guide for Beginners 2nd edition Kumar Ranjit, Pearson Education, Singapore, 2005.
- 3) Introduction to Research and Research Methodology, M. S. Sridhar.
- 4) Practical Research Methods, Catherine Dawson, UBS Publishers Distribution, New Delhi 2002.
- 5) Computer Education by Prof. Lalini Varanasi, Prof. V. Sudhakar, and Dr. T. Mrunalini, Neelkamal Publications PVT. LTD.
- 6) Basic Computing Principles by B. West, BPB Publications, New Delhi
- 7) A Hand Book of Research Methodology, R. P. Devdas & K. Kulandaivel
- 8) Research Methods, S. P. Gupta
- 9) Methods of Research, C. V. Good & D. E. Scafes.

## **M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-I) (NEP2020)**

**Title of Course: Applied Biochemistry**

**Course Code: MEAT106**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand the Biochemistry of Living Cells.
2. Learn Carbohydrate structure chemical names and physical and chemical properties. Acquire knowledge of yeast formulations.
3. Acquire knowledge of Biochemistry of Carbohydrates.
4. Acquire knowledge of Basic concept of Chemistry.

### **Unit 1: a. Biochemistry of Living Cells: (15)**

Introduction of living world, five kingdom classification, Cell, Modern Cell theory, Cell types, Significance of biochemistry to the living systems. Introduction to bio molecules and cellular pool, Introduction to Metabolism

#### **b. Enzymes –**

General Properties, Mechanism of enzyme catalyzed reaction, nomenclature and types of enzymes. Introduction to enzyme kinetics: outline of enzyme kinetics, competitive, non competitive and uncompetitive inhibition

**c. Vitamins:** Classification, types, sources, structure, function & coenzyme function of vitamins.

### **Unit 2: Alcohols (15)**



Introduction, Nomenclature, Classification, Methods of preparation, General properties and chemical reactions of alcohols

Types of alcohol-

- **Monohydric alcohol** – Types, Structure and uses.
- **Dihydric alcohols** – Nomenclature, methods of formation of Ethylene glycol – from ethylene, ethylene dibromide & ethylene oxide, physical & Chemical reactions of ethylene glycol, Reaction with hydrogen halide; Oxidation tetra acetate, HIO<sub>4</sub> & Nitric acid.
- Uses of ethylene glycol
- **Trihydric alcohol** - Nomenclature, methods of formation of glycerol – from fats & oils synthesis from elements carbon & hydrogen. Physical properties.
- Chemical reaction of glycerol – reaction with electro positive metals, reaction with hydrogen halides (HCL & HI ) reactions with concentric nitric acid in presence of concentric sulphuric acid. Reactions with potassium hydrogen sulphate. Uses of glycerol.
- 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,
- Detail study of reactions involved, manufacturing process, uses, list of manufacturers Acetaldehyde, Acetic acid, Acetic Anhydride, Butanol, Ethyl acetate, Butyl acetate, acetone, Ethyl ether, Diethyl oxalate.

### Unit 3. Biochemistry of Carbohydrates

(15)

Carbohydrates: Definition, functions and their importance in the living systems, Classification of Carbohydrates:

**a. Monosaccharides:** Classification, properties and reactions of monosaccharide's taking glucose as an example,

Inter-conversions of monosaccharide's, Configurations of aldopentose's&aldohexoses, Epimers& epimerization, mutarotation, Cyclic structures of glucose, fructose (pyranose & furanose forms).

**b. Disaccharides:**

Classification, nomenclature and general detailed study of the structure and functions of maltose, cellobiose, lactose, sucrose, melibiose & trehalose

**c. Oligosaccharides and Polysaccharides:**

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

**d. Overview of the Metabolism of Carbohydrates**

Including glycolysis, EMP pathway, glyoxalase cycle, TCA cycle, Entner-Duodoroff pathway, gluconeogenesis Reducing and Non-reducing

#### **Unit 4: Basic concept of Chemistry**

**(15)**

- Normality, Molarity, Molality, Mole fraction, ppm, ppb, ppt, weight fraction, Equivalent weight and numerical based on it
- 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.
- Optical Isomerism: Definition, Cause of optical activity and chirality, and R/S configuration. Enantiomers, Diastereomers, Racemic modification and Mesosomas, Resolution of Racemic modifications

#### **Reference Books:**

1. A Guide Book to Mechanism in Organic Chemistry - Sykes, Orient-Longmans.
2. Organic Reaction Mechanism- Ahluwalia.
3. Basic Principles of Organic Chemistry - Roberts and Casoria, Benjamin
4. Stereochemistry of Carbon Compounds- Eliel, McGraw-Hill
5. Organic Stereochemistry- Hallas, McGraw-Hill.
6. Organic Chemistry- Morrison and Boyd, Prentice Hall.
7. Analytical Chemistry for Technicians, Fourth Edition- John Kenkel
8. Stereochemistry Of Organic Compounds- Nasipuri
9. Bio-Chemistry and Molecular Biology- Wilsons And Walker Cambridge University

### **M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-I) (NEP2020)**

**Title of Course: Applied Chemistry**

**Course Code: MEAT106**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the

Student will be able to

1. Understand chemical alcohol.
2. Acquire skill of using different devices which are used in alcohol application.
3. Acquire skill of Proteins and Amino Acids
4. Acquire skill of Chromatographic Method

## Unit 1: Fundamentals of Organic Reaction Mechanism

(15)

Introduction, Meaning of reaction mechanism, curved arrow notation,

- Nature of covalent bond Fission, Types of Reagents,
- Types and sub types of organic reaction,
- Reactive Intermediates – carbonation, Carbanion Carbon free radicals Carbene, Arynes, Nitrates.

## Unit 2: A: Molecule of Life: Water

(15)

Importance of water in living systems, Properties of water, Weak Interactions in Aqueous Systems, Ionization of Water, Weak Acids, and Weak Bases (alkalinity and acidity of water),

Types of water based on hardness, causes and sources of hardness, Buffering against

pH Changes in Biological Systems, Water as a Reactant

### B: Lipids, Nucleic Acids and Vitamins

- Lipids:** Outline of structure and functions of fatty acids, Types of fatty acids and their importance; Classification of lipids: - simple, complex, derived lipids - structure & example; phospholipids, glycolipids & steroids- structure, composition.
- DNA:**The genetic material, DNA its organization, Outline of structure, Nucleoside, nucleotide: definition and structure, Watson Crick model of DNA structure, RNA & DNA, Overview of Central Dogma of life; DNA Replication, transcription and translation process.
- .Introduction to Chromosomes and the concept of Gene: Chromosomes: Structure and shapes of metaphase chromosomes histone, Nucleosome and packing of DNA into chromosome.

## Unit 3. Proteins and Amino Acids

(15)

### a. Proteins:

Classification of proteins, functions of proteins, Biological importance, Common properties of proteins, colour reactions of proteins, Methods for protein Isolation, purification and quantification. Structure of proteins: Primary, Secondary, Tertiary, Quaternary

### b. Amino Acids:

Outline of structure of common amino acids present in proteins, classification, their properties and chemical reactions, Maillard reaction

Metabolism of amino acids: Transamination, deamination and decarboxylation of amino acids,

Composition of cane juice and molasses with special reference to carbohydrates, proteins and Amino.

## Unit 4: Chromatographic Method

(15)

Introduction, Classification of chromatographic method, introduction of the terms used in chromatography

- Principle methods and applications of Paper chromatography, TLC, HPLC, GC.
- Uses of chromatography in alcohol industry.
- 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 acids.

### Recommended Books:

1. Text Book of Biochemistry-West and Todd, The Macmillan Co. Newyork
2. Text Book of Biochemistry-West and Todd, The Macmillan Co. Newyork
3. Advanced Organic Chemistry- Behel&Behel, S. Chand & Co. Ltd, New Delhi
4. Organic Chemistry- Morrison &Byot, Pearson
5. Principles of Biochemistry- Lehninger, C.B.S. Publishers, Delhi

## M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-II) (NEP2020)

**Title of Course: Alcohol Technology- II**

**Course Code: MMAT201**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand Basic of distillation.
2. Learn alcohol structure chemical names and physical and chemical properties. Fermentation
3. Understand Basic of Wines.
4. Understand Basic of Effluent and Effluent treatment systems adapted in distilleries

## Unit 1: Basics of Distillation

(15)

**Distillation:** theory, Introduction to Types of distillation process:

- i) pot & continuous distillation, ii) Atmospheric and MPR distillation; Relative

volatility & liquid vapor equilibrium diagrams,

- **Laws of Distillation:** Daltons, Raoul's & Henry laws
- **Distillation equipments:** Columns (its design & construction, its maintenance), trays, condenser, Reboiler (Types and MOC)

## **Unit 2: Continuous fermentation**

**(15)**

- Theoretical aspects of continuous fermentation,
- Continuous Vs Batch Fermentation Systems
- Various types of continuous fermentation systems,
- **Single Fermenter Continuous System (Biostil):** Process Details with flow diagrams, Operational aspects, details of plant & machinery. Merits & demerits of the technology
- **Cascade continuous Fermentation system:** Process details with flow diagram, operational aspects, details of plant & machinery, merits and demerits of technology
- **Higher-up continuous fermentation process without yeast recycling:** Process Details with flow diagrams, Operational aspects, details of plant & machinery. Merits & demerits of the technology
- Yeast Flocculation Continuous Fermentation System (Penicillium -NCL): Merits & Demerits of technology,
- Contamination control with special reference to continuous fermentation process.

## **Unit 3. Wines**

**(15)**

- Introduction, History of wine, present international and national status of wine production, Process of wine making: grapes varieties and harvesting, must treatment, alcoholic fermentation, post fermentation operations, microbiological stabilization, Sulphur dioxide addition, economic future.
- i. Detailed Red wine production stages - harvesting to bottling,
- ii. Detailed White wine production stages - harvesting to bottling
- iii. Sparkling wine production stages - Traditional method, transfer process method, Tank method and Carbonation.
- Classification of wine- table wines, sparkling wine, dessert wines, aperitif wine, pop wine
  - Nutritional and therapeutic value of wine: Chemical contents of grapes and wine in relation to nutrition, Contribution of Antioxidant with respect to human health, Comparison of Red, white and sparkling wine at nutritional point of view.
- Overview of world and Indian wine scenario: The current and future wine prospectus in India

## **Unit 4. Effluent and Effluent treatment systems adapted in distilleries**

**(15)**

Quality of effluent based on various technologies adapted for alcoholic fermentations (Batch/Fed batch/Continuous), IS specification of effluent: Effluent composition; The meaning, and relevance to distillery effluent of: biological oxygen demand; chemical oxygen demand; suspended solids; pH;

**Overview of conventional treatments: Aerobic treatments, Anaerobic treatments:** aerobic digestion (bio-filters); anaerobic digestion spraying on farmland; discharge to sea; Environmental implications of these methods;

**Advances in the effluent treatment systems: ZLD systems**

**a. Manufacturing of methane gas (biogas production),** Raw material requirement of biogas plant, Design & capacity of biogas plant, Moisture free methane generation, Compositions of biogas

**b. Solid waste treatments:** Composting, Types of composting, Factors affecting composting process, Requirements for composting (land), Economics consideration in composting process, analysis of the produced composted material c. Incineration boilers for spent wash treatments.

### **Reference books:**

1. The Alcohol Text Book-Jacques T. P. Lyons & D.R. Kelsall
3. Hand Book of Fermentation & Distillation—A.C. Chatterjee
4. Distillation H.C. Barron.
5. By-Products Of Sugar Industry- Paturao
6. Hand book of alcohol technology- S.V. Patil
7. Industrial alcohol technology hand book- NPCS Board of consultant & engineer
8. Pascal Ribereau, (2000) Hand book of enology volume—I
9. Ron S. Jockson (2000) Wine science principles practices & perception
10. C. S. Ough (1992) Wine making Basics
11. Roger B. Boulton (1996) Principles and practices of winemaking

## **M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-II) (NEP2020)**

**Title of Course: Applied Microbiology**

**Course Code: MMAT202**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand isolation and identification and maintains of yeast.
2. Learn yeast structure chemical names and physical and chemical properties.
3. Acquire knowledge of Contamination and its control in alcoholic fermentations.
4. Acquire knowledge of Hygiene in alcohol industry.

## **Unit 1: Isolation, identification and maintenance of yeast**

**(15)**

- Yeast isolation and culturing: Habitat Description; Characteristics of culture yeasts; Principles of yeast classification; concept of genus and species cell and spore morphology; Identification of *Saccharomyces cerevisiae* and yeasts involved in natural fermentations, different methods for identification; fermentation and aerobic growth (Biochemical) tests for yeast identification; Molecular identification of yeasts (rDNA sequencing);
- Yeast propagation and maintenance, principle and practices, Tips for handling yeast cultures, Methods used for preservation and maintenance of the yeast cultures: storage at reduced temperature, storage on agar slopes, Storage under liquid nitrogen, Storage in a dehydrated form: dried culture, Lyophilization, Quality control of preserved stock cultures,

## **Unit 2: Production yeast strains and strain improvement**

**(15)**

- Industrial applications of yeast; Difference between wild strain and industrial strain; Different production yeast strains used in the industry and their Characteristics; Screening for industrially important yeast strains, primary screening and secondary screening. Detection and assays;
- Production strains improvement of industrial micro-organisms: Introduction of strain improvement, its application, advantages and disadvantages, methods of strain improvement, factor affecting in strain improvement program, targeted stain improvement, (mutagenesis, recombination, genetic engineering),

## **Unit 3: Contamination and its control in alcoholic fermentations**

**(15)**

- Factors affecting alcoholic fermentation
- Introduction to contamination,
- Potential source of contamination: stock culture, water, air, molasses, chemical, additives
- Effect of microbial contaminants on alcoholic fermentations: Types of contaminants: yeast, bacteria, viruses, Pathogenic Fungi;
- Methods for Detection of specific contaminants (molecular, biochemical)
- Control of microbial contaminants; by physical and chemical agents; Antimicrobial substances controlling contamination in industrial alcoholic fermentation and their mode of action, Introduction to antibiotics, Mechanism of various antibiotics.

## **Unit 4: Hygiene in alcohol industry**

**(15)**

- a) Sterilization and disinfection:** definition of sterilization and disinfection;
- b) Physical agents:** moist heat, dry heat, osmotic pressure, radiations (UV, X ray and gamma rays);
- c) Chemical agents:** characteristics of ideal disinfectant, selection of chemical antimicrobial agents phenol and phenol compound, alcohol.

**d) 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;

### **Reference Books:**

Stanier, R.Y. Adel berg, E.A. and Ingraham, J.L. (1984), General Microbiology, IV edition. MacMillan Press.

1. Bergey's manual of systematic bacteriology (Springer)
2. Foundations in microbiology by Talaro and chess McGraw Hill.
3. T. Satyanarayana, Gotthard Kunze - Yeast Biotechnology: Diversity and Applications; (Springer)
4. K.A. Jacques, T.P. Lyons, D. R. Kelsall - The Alcohol Textbook-Nottingham University Press (2003) Nottingham University Press (4<sup>th</sup> Edition).
5. Katherine Smart - Brewing Yeast Fermentation Performance-(2002), Wiley-Blackwell (2<sup>nd</sup> Edition)
6. Chris Boulton, David Quain: Brewing yeast and fermentation-Wiley-Blackwell (2001)

## **M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-II) (NEP2020)**

**Title of Course: Alcohol Technology: II**

**Course Code: MMATP203**

**Total Credits: 04**

1. Determination of fermentation efficiency of yeast grow in on molasses medium.
2. Determination of total, volatile and fixed acid in spirit.
3. Determination of aldehyde content of spirit.
4. Determination of ester content of spirit.
5. Isolation of amylase enzyme and study of effects of different factors on its activity.
6. Determination of cell count of molasses fermented broth.
7. Effect of temperature on enzyme activity.
8. Effect of substrate concentration on enzyme activity.
9. Preparation of wine from grapes.
10. Determination of pH and total acidity of wine.
11. Determination of alcohol content in wine.
12. Determination of total sulphur dioxide contend of wine.
- 13 Determination of BOD content of given distillery spent wash.
- 14 Determination of COD content of given distillery spent wash.



## **Reference Books:**

1. The Alcohol TextBook – Lyons&Kelsall
2. Hand Bookof Fermentation &Distillation-A.C.Chatterjee
3. Handbook of alcohol technology-S.V.Patil
4. Industrial alcohol technology hand book-NPCSBoard of consultant &engineer
5. Handbook of enology volume–I-Pascal Ribereau
6. Alcoholometry -Satyanarayana Rao

## **M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-II) (NEP2020)**

**Title of Course: Microbiology-II**

**Course Code: MMATP204**

**Total Credits: 02**

1. Isolation and purification of yeast from flowers, fruits and berries.
2. Cell wall staining of bacteria.
3. Measurement of growth of bacteria.
4. Measurement of proteolysis activity of yeast.
5. Preparation of culture media and sterilization.
6. Preparation of MGYM medium for growth and identification of yeast.
7. Preparation of MGYM slant.
8. Enumeration of micro-organisms by four quadrant method.
9. Enumeration of micro-organisms by using spread plant technique.

## **ReferenceBooks:**

1. Handbook of Microbiology-Lyons&Kelsall
2. Microbiological Applications: A L laboratory Manualin General Microbiology Harold J. Benson, Mc Graw-Hill
3. Microbiology: AL aboratory Manual, Global Edition-Cappuccino, James, Welsh, Chad-Pearson Education Limited.

## **M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-II) (NEP2020)**

**Field Project: Credits: 04**

**Course Code: FP205**

# M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-II) (NEP2020)

**Title of Course: Industrial Fermentation**

**Course Code: MEAT206**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand basics of fermentation.
2. Learn types of fermentation structure chemical names and physical and chemical properties.
3. Acquire knowledge of Cell Immobilization.
4. Acquire knowledge of Biochemistry of alcoholic fermentation.

## **Unit 1. a. Basics of Fermentation (15)**

Introduction: Fermentation, Aerobic and anaerobic fermentations, industrially important fermentation products, Role of fungi in various fermentations, Examples of various fermentations using fungi role of microorganisms, Factors affecting fermentation.

### **b. Fermenter design and types of fermenters**

- i) Basic components of fermenters for microbial cell culture, body construction material.
- ii) Types of fermenter. Mechanical- wild of fermenter, Rotating disc fermenter, trickling generator, Hydrodynamic deep jet fermenter. Pneumatic-air lift fermented, bubble-cap fermenter, cylindroconical vessels, ucetator, cogitator. Photo-bioreactor tower and packed fermenters, cyclone column  
**Scale of operation:** Introduction, Lab scale, Bench scale, Pilot scale production level.

## **Unit 2: Types of Fermentation (15)**

- Introduction to Batch, Semi-continuous (Fed Batch), Continuous etc.,
- Submerged fermentation/liquid state fermentation (Sm F/LSF), Solid state fermentation
- History of solid-state fermentation: Comparison of solid state fermentation with other types of fermentations,
- Importance of solid-state fermentation, the industrial production of various SSF based products. Principles of Solid-State Fermentation Engineering and Its Scale-Up: Design and Scale-Up of Solid-State Fermentation Bioreactors, Factors Affecting Solid-state Fermentation
- Xanthan Production by SSF; Bacterial Cellulase Production by SSF
- Applications of Saccharification Using Fungal Solid-State Fermentation

### **Unit 3. Cell Immobilization**

**(15)**

Introduction of cell immobilization, Immobilization system

- i) Surface attachment of cell ii) Entrapment within porous matrices
- iii) Containment behind a barrier iv) Self ingemination of cells
- i) Mass transport phenomenon in immobilized cell system.
- ii) Reaction and diffusion in immobilization cell system.

Bioreactor dying.

Physiological effects of microbial cell (yeast) immobilization: Beer production using immobilization cell technology – a case study.

### **Unit 4. Biochemistry of alcoholic fermentation**

**(15)**

#### **a. Biochemistry of alcoholic fermentation:**

Transport of carbohydrates in yeast, Aerobic and anaerobic metabolic pathways in Yeast for sugar dissimilation, Importance of Pentose Phosphate pathway in yeast cell, Inter relationship between sugar uptake during alcoholic fermentation (Pasteur and Crabtree Effect).

Stoichiometry of alcohol production Outline of alcohol production by batch fermentation process

#### **b. Carbon sources in alcoholic fermentations:**

Important carbohydrates for production of alcohol; Molasses, cane juice, beet juice, sweet sorghum, mahua flowers, fruits' juices, etc.; Starchy and Cellulosic Materials Unit: Culture stability and autolysis.

### **Reference Books:**

1. Industrial Fermentations by L.A. Under Keffler, Chemical Pub. Co., New york.
2. Hong Zhang Chen (auth.) - Modern Solid-State Fermentation\_ Theory and Practice- Springer Netherlands (2013)
3. Trzcinski, Antoine Prandota - Biofuels from food waste \_ applications of saccharification using fungal solid-state fermentation-CRC Press (2018)

## **M. Sc. Alcohol Technology (Part-I) (Level-8.0) (Semester-II) (NEP2020)**

**Title of Course: Pollution Prevention & Control**

**Course Code: MEAT206**

**Total Credits: 04**

**Course Outcomes:** Upon successful completion of this course, the student will be able to

1. Understand types of pollution.
2. Learn types of pollution and its sources
3. Learn Preliminary, primary, secondary & tertiary treatments of waste water.
4. Acquire knowledge of Air pollution-classification and source of air pollution air pollution.

**Unit 1. (15)**

Importance of environments. Biosphere and layers of atmosphere. Hydrological & nutrient cycles Types of pollution, damages from Environmental pollution. Need of environmental legislations and Environmental acts. Function of state & central pollution control boards.

**Unit 2. (15)**

Source of waste water, classification and characterization of waste water. Physical & chemical characteristics of waste. BOD, COD and their importance Types of water pollution and their effects. Sampling and method of analysis

**Unit 3. (15)**

Preliminary, primary, secondary & tertiary treatments of waste water, Sludge treatments and disposal. Advance waste water treatments. Recovery of material from process effluents. Application to industries. Norms and standard of treated water.

**Unit 4. (15)**

Air pollution-classification and source of air pollution air pollution. Air quality criteria and standards effect of air pollution on health. vegetation and material. Air pollution control methods. Equipments used in industries. Solid waste treatments-origin classification and microbiology, properties and their variation. engineering system for solid waste managements. Generation, Handling, storage collection, transport compositing and land filling. Noise pollution-source and determination of level.noise control criteria and noise exposure index administrative and engineering control, Acoustic absorptive material.

**Reference Books:**

1. Environmental Pollution Control Engineering - C.S. Rao
2. Pollution Control in Process Industries - S.P. Mahajan,
3. Introduction to Environmental Engineering -Davis
4. Waste Water Engineering Treatment Disposal Reuse- Metcalf & Eddy
5. Environmental Engineering - G.N. Pandey and G. C. Carney
6. Industrial pollution – Technologies for Abatement and Control– R N Mukherjea, etal
7. Hand Book of Waste Management in Sugar Mills and Distilleries – Ashwani Kumar

<b>M. Sc. Semester – I</b>		
<b>Course Code</b>	<b>Major Mandatory</b>	
MMAT101	Alcohol Technology – I (4Credits)	MSU0325MML802G1
MMAT102	Microbiology (4Credits)	MSU0325MML802G2
MMATP103	Practical Alcohol Technology I (4Credits)	MSU0325MMP802G1
MMATP104	Practical Microbiology-I (2Credits)	MSU0325MMP802G2
RM105	Research Methodology (4Credits)	MSU0325RML802G
MMET106 (Any one)	<b>Major Elective</b>	
	Applied Biochemistry (4Credits)	MSU0325MEL802G1
	Applied Chemistry (4Credits)	MSU0325MEL802G2
<b>M. Sc. Semester – II</b>		
<b>Course Code</b>	<b>Major Mandatory</b>	
MMAT201	Alcohol Technology – II (4Credits)	MSU0325MML802H1
MMAT202	Applied Microbiology (4Credits)	MSU0325MML802H2
MMATP203	Alcohol Technology II (4Credits)	MSU0325MMP802H1
MMATP204	Microbiology -II (2 Credits)	MSU0325MMP802H2
FP205	Field Project (4Credits)	MSU0325RML802H
MMET206 (Any one)	<b>Major Elective</b>	
	Industrial Fermentation -I (4 Credits)	MSU0325MEL802H1
	Pollution Prevention & Control (4 Credits)	MSU0325MEL802H2

Old Course				Equivalent Course		
Sem No.	Course Code	Title of Old Course	Credit	Course Code	Title of New Course	Credit
I	87767	Alcohol Technology-I	4	MMAT101	Alcohol Technology-I	4
I	87768	Microbiology	4	MMAT102	Microbiology	4
I	-----	Practical Alcohol Technology-I	4	MMATP103	Alcohol Technology-I	4
I	-----	Practical Microbiology- I	4	MMATP104	Microbiology- I	2
I	-----	-----	----	RM105	Research Methodology	4
I	87769	Applied Bio-Chemistry	4	MMET106	Applied Bio-Chemistry	4
I	87770	Applied Chemistry	4	MMET106	Applied Chemistry	4
II	90068	Alcohol Technology-II	4	MMAT201	Alcohol Technology-II	4
II	90069	Applied Microbiology	4	MMAT202	Applied Microbiology	4
II	-----	Alcohol Technology-II	4	MMATP203	Alcohol Technology-II	4
II	-----	Microbiology-II	4	MMATP204	Microbiology-II	2
II	-----	-----	-----	FP205	Field Project	4
II	90070	Industrial Fermentation-I	4	MMET206	Industrial Fermentation-I	4
II	90071	Applied Instrumentation	4	MMET206	Pollution Prevention & Control	4