

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY**



**CIRCULAR NO.SU/B.Sc./10/2022**

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies and Ad-hoc Boards with recommendation of the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted the **following syllabi of Bachelor of Science with Regulation under the scheme of Choice Based Credit & Grading System** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Courses	Semester
1.	<b>B.Sc.Industrial Chemistry (Optional)</b>	<b>Ist and IInd semester</b>
2.	<b>B.Sc.Bioinformatics (Optional)</b>	<b>Ist and IInd semester</b>
3.	<b>B.Sc.Microbiology (Optional)</b>	<b>Ist to IVth semester</b>

This is effective from the Academic Year 2022-23 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,  
Aurangabad-431 004.  
REF.NO.SU/2022/ 7453-58  
Date:- 22.08.2022.

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*[Signature]*  
**Deputy Registrar,  
Academic Section.**

**Copy forwarded with compliments to :-**

- 1] **The Principal of all concerned Colleges,**  
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

**Copy to :-**

- 1] **The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.**
- 2] The Section Officer,[B.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
- 4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
- 5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.
- 6] The Public Relation Officer, Dr.BAMU,A'bad.
- 7] The Record Keeper, Dr.BAMU,A'bad.

**Dr. Babasaheb Ambedkar Marathwada University**  
**Aurangabad -431004 (MS) INDIA**



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**Undergraduate Bachelor Degree Program**  
**in Science ( B.Sc.)**  
**Industrial Chemistry (Optional Subject)**

**Course Structure and Curriculum**  
**(Outcome based Curriculum)**  
**Choice Based Credit System**  
**(Effective from Academic Year 2022-23)**

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**Dr. Babasaheb Ambedkar Marathwada University**  
**Aurangabad - 431004 (MS) INDIA .**

  
**Dean**  
**Faculty of Science & Technology**  
**Dr. Babasaheb Ambedkar Marathwada University**  
**Aurangabad**

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## 1. Preamble

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. **Dr. Babasaheb Ambedkar Marathwada University** proposes to offer a three year a Bachelor Program in Science (**B.Sc.**) with **Industrial Chemistry** as a one of the *optional subjects*. Each year is called an academic year and is divided into two semesters. Thus there will be a total of six semesters. The teaching learning process involves theory classes (Periods) of an hour duration and practical classes of three hours duration. The curriculum will be delivered through various methods including chalk and talk, power point presentations (ICT based), audio, video tools, E-learning/ E-content, virtual laboratories, simulations, field trips/ Industry visits, seminars (talks by experts), workshops, projects, models and class discussions. The assessment broadly comprises of Internal Assessment (Continuous Evaluation-CIA) and End Semester Examination (ESS). Each theory paper carries 50 marks with 20% marks for Internal Assessment and 80% for End Semester Examination. The internal assessment will be through MCQ, test, assignment, oral presentation, worksheets and short projects. The learning outcome based curriculum framework is designed around the CBCS and is intended to suit the present day needs of the students in terms of securing their path towards higher studies or employment in industries.

### **Introduction to B.Sc. Programme with Industrial Chemistry**

The choice based credit system (CBCS) offers flexibility of program structure while ensuring that students gets a strong foundation in the subject and gain in-depth knowledge of all aspects of the field. The new curriculum of **B.Sc.** with **Industrial Chemistry** offer courses in the areas of organic, inorganic, physical, materials, analytical and industrial chemistry. All the courses are having defined objectives and Learning Outcomes, which will help prospective students in choosing the elective courses to broaden their skills in the field of chemistry and interdisciplinary areas. The courses will train students with sound theoretical and experimental knowledge that suits the need of academics and industry. The courses also offers ample skills to pursue research as career in the filed of chemistry and allied areas. The core courses in Industrial Chemistry is designed to familiarize the students with the industrial processes involved in the commercial production of the products. The program also offers wide range of discipline specific electives, skill B.Sc. Industrial Chemistry. The Ability Enhancement and Environmental Science courses are to prepare students to improve their skills required in academic, research and in industrial projects.

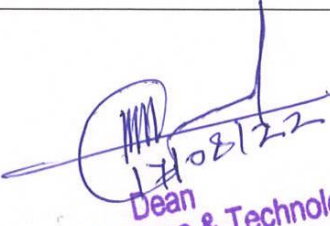
### **Aims of the Bachelors Degree Programme in B.Sc.with Industrial Chemistry**

Bachelor course in Industrial Chemistry offers the synergism of basic concepts of Chemistry with Industrial applications. The main objective of this degree course is to produce graduates with enhanced skills, knowledge and research aptitude to carry out higher studies or research and development in the various industrial areas. This degree course of Industrial Chemistry prepares the students for immediate entry to the workplace with sound theoretical, experimental knowledge in the area of fuels and energy, environment, health, foods, cosmetics, pharmaceuticals, polymers, petrochemicals and related multidisciplinary fields. Overall, the course offers basic foundation in chemistry which enables the students to understand the concepts in chemical manufacturing processing, engineering and industrial development.

2. **Course Structure & Curriculum for Bachelor of Science  
(B.Sc.) with Industrial Chemistry (Optional Subject)**

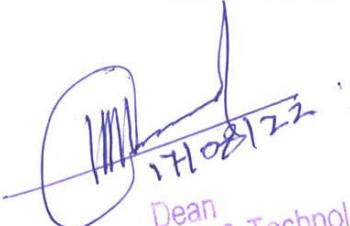
**(Choice Based Credit System)**

<b>Dr. Bababasaheb Ambedkar Marathwada University Aurangabad</b> Choice Based Credit System (CBCS) Curriculum for Faculty of Science & Technology Course Structure & Scheme of Examination B.Sc. Three Year Undergraduate Degree Program								
<b>B.Sc. (Industrial Chemistry) : Semester I</b>								
	Course Code	Course Title	Teaching Time/ Week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1A) Core Courses	IC-111	Core course (Theory Paper-I) <b>Fluid Mechanics &amp; Unit Operations-I</b>	2 hours	2	50	10	40	20
	IC-112	Core course (Theory Paper-II) <b>Material Balance &amp; Process Calculations</b>	2 hours	2	50	10	40	20
	IC-121	Lab Course 1 (based on IC-111 & IC-112)	3 hours	1.5	50	10	40	20
Ability Enhancement Compulsory Coursees (AECC-1)	XXX-131	Communication Skills in <b>English-I</b>	3 hours	3	50	10	40	20
	XXX-132	<b>Marathi/Hindi/Urdu/Sanskrit</b> A student can opt for any one of These languages( <b>SL-I</b> )	3 hours	3	50	10	40	20
Non-Credit Course	XXX-113	<b>Environmental Studies</b>	2 hours	2*				
			15	11.5	250	50	200	100
Total Credits for Semester I : 11.5 ( Theory : 10 ; Laboratory : 1.5 )								

  
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## B.Sc. (Industrial Chemistry) : Semester II

	Course Code	Course Title	Teaching Time/ Week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1B) Core Courses	IC-211	Core course (Theory Paper-III) <b>Heat Transfer &amp; Aspects of Industrial Chemistry</b>	2 hours	2	50	10	40	20
	IC-212	Core course (Theory Paper-IV) <b>Energy Balance &amp; Process Calculations</b>	2 hours	2	50	10	40	20
	IC-221	Lab Course 2 (based on IC-211 & IC-212)	3 hours	1.5	50	10	40	20
Ability Enhancement Compulsory Courses (AECC-2)	XXX-231	Communication Skills in <b>English-II</b>	3 hours	3	50	10	40	20
	XXX232	<b>Marathi/Hindi/Urdu/Sanskrit</b> A student can opt for any one of These languages(SL-II)	3 hours	3	50	10	40	20
Non-Credit Course	XXX-213	<b>Constitution of India</b>	2 hours	2*				
	XXX-214	<b>Environmental Studies</b>	2 hours	2*				
			17	11.5	250	50	200	100
<b>Total Credits for Semester II: 11.5 ( Theory : 10 ; Laboratory : 1.5 )</b>								

  
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## B.Sc. (Industrial Chemistry) : Semester III

	Course Code	Course Title	Teaching Time/ Week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1C) Core Courses	IC-311	Core course (Theory Paper-V) <b>Unit Operations-II</b>	2 hours	2	50	10	40	20
	IC-312	Core course (Theory Paper-VI) <b>Chemical Reaction Engineering</b>	2 hours	2	50	10	40	20
	IC-321	Lab Course 3 (based on IC-311)	3 hours	1.5	50	10	40	20
	IC-322	Lab Course 4 (based on IC-312)	3 hours	1.5	50	10	40	20
Skill Enhancement Course (SEC-1)	XXX-313	SEC-1 Any one skill to be chosen out of two SEC-1(A), SEC-1(B) <b>SEC-1(A)- _____</b> <b>SEC-1(B)- _____</b>	2 hours	2	50	10	40	20
Ability Enhancement Compulsory Courses (AECC-3)	XXX-331	Communication Skills in <b>English-III</b>	3 hours	3	50	10	40	20
	XXX-332	<b>Marathi/Hindi/Urdu/Sanskrit</b> A student can opt for any one of These languages(SL-III)	3 hours	3	50	10	40	20
Non-Credit Course	XXX-333	<b>Computer Ability</b>	2 hours	2*				
			18	15	350	70	280	140
<b>Total Credits for Semester III: 15 ( Theory : 12 ; Laboratory : 3 )</b>								

## B.Sc. (Industrial Chemistry) : Semester IV

	Course Code	Course Title	Teaching Time/ Week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1D) Core Courses	IC-411	Core course (Theory Paper-VII ) <b>Unit Operations-II</b>	2 hours	2	50	10	40	20
	IC-412	Core course (Theory Paper-VIII) <b>Chemical Reaction Engineering</b>	2 hours	2	50	10	40	20
	IC-421	Lab Course 5 (based on IC-411)	3 hours	1.5	50	10	40	20
	IC-422	Lab Course 6 (based on IC-412)	3 hours	1.5	50	10	40	20
Skill Enhancement Course (SEC-2)	XXX-413	SEC-2 Any one skill to be chosen out of two SEC-2(C), SEC-2(D) <b>SEC-2(C)-_____</b> <b>SEC-2(D)-_____</b>	2 hours	2	50	10	40	20
Ability Enhancement Compulsory Coursees (AECC-4)	XXX-431	Communication Skills in <b>English-IV</b>	3 hours	3	50	10	40	20
	XXX-432	<b>Marathi/Hindi/Urdu/Sanskrit</b> A student can opt for any one of These languages(SL-IV)	3 hours	3	50	10	40	20
Non-Credit Course	XXX-333	<b>Computer Ability</b>	2 hours	2*				
			18	15	350	70	280	140
<b>Total Credits for Semester IV: 15 ( Theory : 12 ; Laboratory : 3 )</b>								



## B.Sc. (Industrial Chemistry) : Semester V

	Course Code	Course Title	Teaching Time/Week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSE-1A) Discipline Specific Elective	IC-511	DSE-1A(1) (Theory Paper-IX) (Select any one paper from A1/B1/C1/D1) <b>A1-Unit Processes in Organic Synthesis</b> B1- _____ C1- _____ D1- _____	2 hours	2	50	10	40	20
	IC-512	DSE-1A(2) (Theory Paper-X) (Select any one paper from A2/B2/C2/D2) <b>A2-Process Equipment Design</b> B2- _____ C2- _____ D2- _____	2 hours	2	50	10	40	20
	IC-521	Lab Course 7 (based on IC-511)	3 hours	1.5	50	10	40	20
	IC-522	Lab Course 8 (based on IC-512)- <b>Design Thesis</b>	3 hours	1.5	50	10	40	20
Skill Enhancement Course (SEC-3)	XXX-513	SEC-3 Any one skill to be chosen out of two SEC-3(E), SEC-3(F) SEC-3(E)- _____ SEC-3(F)- _____	2 hours	2	50	10	40	20
Non-Credit Course	XXX-514	<b>Professional Ethics and Moral Values</b>	2 hours					
			14	9	250	50	200	100
<b>Total Credits for Semester V: 9 ( Theory : 06 ; Laboratory : 3 )</b>								

## B.Sc. (Industrial Chemistry) : Semester VI

	Course Code	Course Title	Teaching Time/ Week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSE-1B) Discipline Specific Elective	IC-611	DSE-1B(1) (Theory Paper-XI) (Select any one paper from A3/B3/C3/D3) <b>A3-Unit Processes in Inorganic Synthesis &amp; Industrial Safety</b> B3- _____ C3- _____ D3- _____	2 hours	2	50	10	40	20
	IC-612	DSE-1B(2) (Theory Paper-XII) (Select any one paper from A4/B4/C4/D4) <b>A4-Process Instrumentation &amp; Plant Utility</b> B4- _____ C4- _____ D4- _____	2 hours	2	50	10	40	20
	IC-621	Lab Course 9 (based on IC-611)	3 hours	1.5	50	10	40	20
	IC-622	Lab Course 10 (based on IC-612) <b>Design Thesis</b>	3 hours	1.5	50	10	40	20
Skill Enhancement Course (SEC-4)	XXX-613	SEC-4 Any one skill to be chosen out of two SEC-4(G), SEC-4(H) SEC-4(G)- _____ SEC-4(H)- _____	2 hours	2	50	10	40	20
			12	9	250	50	200	100
<b>Total Credits for Semester VI: 9 ( Theory : 06 ; Laboratory : 3 )</b>								
<b>Total Credits for three years : Sem I (11.5) + Sem II (11.5) + Sem III (15) + Sem IV (15) + Sem V (09) + Sem VI (09) = 71 Credits.</b>								

### 3. Vision

To develop the department of Industrial Chemistry as center of excellence in all aspects of higher education, research and development of basic technology in Chemical Sciences.

### 4. Mission

To achieve the vision, the department of Industrial chemistry of all affiliated colleges will:

1. Provide a platform for the students with a broad spectrum of diversity to achieve academic excellence with in-built employability in the emerging areas of Industrial Chemistry.
2. Establish a unique learning environment to enable the students to face the challenges in the emerging areas of Industrial Chemistry.
3. Identify the gaps between academics and industry, and design the courses to impart technical and life skills as per the requirements of the region so as to improve employability and develop entrepreneurial capabilities.
4. Adopt a perennial process for bringing excellence in teaching pedagogy by providing ICT based state-of-the-art infrastructural facilitation.
5. Provide a student-centric learning environment and establish a platform for inclusive research leading to the development of creative thought processes amongst students keeping in mind societal needs.
6. Provide ethical and value based education by promoting activities addressing societal needs.

### 5. Program Educational Objectives (PEOs) :

The objectives of B.Sc. (Industrial Chemistry) are as-

**PEO 1:** Industrial Chemistry graduates will be well prepared for successful careers in the profession or in research & innovation at an industry and/or in government in one or more of discipline of chemistry and /or sub disciplines of Chemistry.

**PEO 2:** Industrial Chemistry graduates will be academically prepared to provide feasible and sustainable solutions for real-life problems and become licensed professional chemists in due course and will contribute effectively in serving the society.

**PEO 3:** Industrial Chemistry graduates will be engaged in professional activities to enhance their own achievement and simultaneously contribute in service of humankind.

**PEO 4:** Industrial Chemistry graduates will be successful in higher education in Chemical Sciences and in management, if pursued.

**PEO 5:** Industrial Chemistry graduates will be successful leaders with quality to handle all kind of diverse circumstances through nurturing them in interdisciplinary and multidisciplinary learning environment.

## **6. Programme Outcomes (POs) :**

Program Outcomes (POs) are attributes of the graduates that describe the professional career accomplishments that the programs designed. The PSOs of the B. Sc. program in Industrial Chemistry are designed in such a way that at the end Dr.BAM University has been designed to fully meet all the 12 Program Outcomes:

**PO 1: Scientific Knowledge :** Apply knowledge of Chemistry and Chemistry specializations to solution of complex scientific problems.

**PO 2: Problem Analysis :** Identify, formulate, research literature, and analyze complex scientific problems reaching substantiated conclusions using principles of chemistry.

**PO 3: Design /Development of Solutions :** Design of solutions for complex scientific problems and design of chemical processes that meet the specified needs with appropriate considerations of public health and safety, and cultural, societal, and environmental considerations.

**PO 4: Conduct of investigations complex problems :** Use research based methods including design of experiments, analysis and interpretation of data and synthesis of chemical products leading to logical conclusions.

**PO 5: Modern tool usage :** Create, select, and apply appropriate techniques, resources, and modern scientific and IT tools including prediction and modelling complex scientific activities with an understanding of limitations.

**PO 6: Environment and sustainability :** Understand the impact of the professional scientific solutions in the societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.

Some of the major attributions of an Industrial Chemistry graduate include:

**PO7- Disciplinary Knowledge:** In depth knowledge of basic and applied area of Industrial Chemistry. Capability to demonstrate knowledge and understanding of major chemistry concepts, theoretical principles and experimental findings and ability to use modern instrumentation techniques with chemical analysis and separation.

**PO8-Communication skills:** Excellent communication skills to transmit complex technical information related to chemistry in a clear and concise written and verbal manner as oral presentations and compilation in the form of scientific reports.

**PO9- Critical thinking:** Able to employ critical thinking and efficient problem solving skills in the basic areas of chemistry (analytical, organic, inorganic, physical and material). Students will become efficient in managerial skills, able to employ critical thinking, analytical reasoning, problems solving and interpretation and documentation of laboratory experiments at a level suitable to succeed at an entry level position in chemical

industry or a chemistry graduate program. They will be able to identify and explore new areas of research and planning, execute and report the results of an experiment or investigation, critical thinking and scientific inquiry in the performance, design.

**PO10 Problem solving:** Develop scientific logics and approaches towards problems with critical reasoning.

**PO11-Analytical reasoning:** Able to enhance the ability to assimilate, discuss scholarly articles and research papers showcasing interdisciplinary areas of Industrial Chemistry and capability for asking questions relating to issues and problems in the field of industrial chemistry.

**PO12- Research related skills:** Will develop ability to scale up chemical products and techniques developed at laboratory to the industrial level. The course will take students beyond chemistry knowledge into the world of industrial Professionals.

## 7. Program Specific Outcomes (PSO's):

**B.Sc. (Industrial Chemistry)** Programme Specific Outcomes (PSOs)- After successful completion of three-year degree program in Industrial chemistry a student should be able to:

**PSO 1 :** Understand the fundamental concepts, Aspects of industrial chemistry , principles and processes underlying the academic field of Industrial chemistry, its different streams (*Unit operations I & II, Mass transfer, Heat transfer, Fluid mechanics, Chemical reaction engineering, Industrial safety , process equipment design, Process instrumentation, Plant utilities, and chemical process principles*) and its linkages with related disciplinary areas/subjects.

**PSO 2 :** Demonstrate the procedural knowledge that creates different types of professionals in the field of Industrial chemistry and related fields such as *pharmaceuticals, chemical industry, teaching, research, environmental monitoring, product quality, consumer goods industry, food products, cosmetics industry, polymers & petrochemicals, etc.*

**PSO 3 :** Employ critical thinking and the scientific method to *design, carry out, record and analyze the results* of Industrial chemistry experiments and get an awareness of the impact of industrial chemistry on the environment and the society.

**PSO 4 :** Use chemical techniques relevant to *academia and industry, generic skills and global competencies, including knowledge and skills* that enable students to undertake further studies in the field of industrial chemistry or a related field and work in the chemical and non-chemical industry sectors.

**PSO 5:** Undertake hands on *lab work and practical activities* which develop problem solving abilities required for successful and bright career in industry.

**PSO 6 :** Understand *safety aspect of chemicals, transfer and measurement of chemicals, preparation of solution* and find out the green route for chemical reaction for sustainable development.

**PSO 7 :** Create an awareness of the *impact of industrial chemistry on the environment, society and development* outside the scientific community.

**8. Eligibility:** Candidates seeking admission to the first semester of B.Sc. in

Industrial Chemistry must possess the following eligibility criteria.

- a. Must have passed 12 th Science. or
- b. Must have passed MCVC . or
- c. Two years ITI or
- d. Students having three years diploma (from polytechnic college) in Chemical Engineering/Related branch of engineering are eligible to get direct admission to the second year of B.Sc.

**9. Duration:** The duration of the course will be of Six semesters (Three Years).

**10. Medium of Instructions :** English

**11. Choice Based Credit System (CBCS)**

The choice based credit system ( CBCS) is going to be adopted by the university. This provides flexibility to make the system more responsive to the changing needs of our students and to suit the present day needs of the students in terms of securing their path towards higher studies or employment in industries. The credit based system also facilitates the transfer of credits. Students will have to earn 71 credits from Industrial Chemistry optional subject for the award of three year undergraduate degree Bachelor of Science (B.Sc.).

**12. Credit-to-contact hour Mapping:**

- a) One credit would mean the equivalent of 15 periods of 60 minutes each for a theory lecture.
- b) For lab course/workshop/internship/field work/project. The credit weightage for equivalent hours shall be 50% that of theory lectures.

**13. Attendance:** Students must have 75 % of attendance in each course for appearing examination, otherwise he/she will be strictly not allowed for appearing the semester examination of each course. Frequent absence from regular lecture/practical course may lead to disqualification from continuous internal assessment (CIA) process in respective subject.

**14. Evaluation Methods/Scheme of Examination, Earning Credits, Grading System**

**Evaluation Methods**

- The assessment will be based on 20:80 ratio of continuous internal assessment( CIA) and Semester-end Examination(SEE) . There would be combined passing in CIA and SEE. In case of failure in SEE in a

particular course(s), the exam will be conducted in an immediate subsequent semester.

- In case a student fails in a certain course(s) in a particular semester and the same course(s) are modified /revise/removed from the curriculum in due course, the student will have to appear as per the newly framed curriculum and / or pattern in a subsequent semester, at his/her own responsibility.

### **Continuous Internal Assessment (CIA)**

There will be 20 marks for Continuous Internal Assessment. Two internal tests ( 20 marks each) will be conducted during the semester as a part of a continuous assessment. At the end of the semester, an average of two tests will be considered for the calculation of final marks.

### **Semester End Examination (SEE)**

- The semester-end theory examination for each theory Course will be for 40 marks. The total marks shall be 50. (40 Marks of SEE + 10 Marks of CIA)
- Semester-end examination (SEE) time table will be declared by the University ( as per the university annual calendar). The paper setting and assessment of theory courses, laboratory courses and research projects will be done by external examiners appointed by the university.
- Pattern of semester end examination question paper will be as below:
  - The semester-end examination of the theory course will have two parts ( 10+30=40Marks)
  - Part A will be consisting of 5 questions having 2 marks each (multiple choice questions/fill in the blanks/answer in sentence ) as compulsory questions and it should cover entire course curriculum ( 10 marks)
  - Part B will carry 8 questions (06 marks for each question) ( 02 questions from each of 04 units) and students will have to attempt any 05 questions out of 08 ( 30 Marks).
  - 20 to 30 % weightage can be given to problems/numerical wherein the use of a non-programmable scientific calculator may be allowed.

### **Earning Credits**

At the end of every semester, a letter grade will be awarded in each course for which a student had registered. A student's performance will be measured by the number of credits that he/she earned by the weighted Grade Point Average (GPA). The SGPA

( Semester Grade Point Average) will be awarded after completion of the respective semester and the CGPA ( Cumulative Grade Point Average) will be the final exit.

## Grading System

The grading reflects a student-own proficiency in the course. A ten point rating scale shall be used for the evaluation of the performance of the students to provide letter grade for each course and overall grade for the Bachelor Program. Grade points are based on the total number of marks obtained by him/her in all heads of the examination of the course.

The grade points and their equivalent range of marks are shown in Table-1.

**Table -1 : Ten Point grade and grade description**

Marks Obtained (%)	Grade Point	Letter Grade	Description
91-100	10 ( 9.01 - 10.00)	<b>O</b>	Outstanding
81-90	9.0 (8.01 - 9.00)	<b>A+</b>	Excellent
71-80	8.0 ( 7.01 - 8.00)	<b>A</b>	Very Good
61-70	7.0 (6.01 - 7.00)	<b>B+</b>	Good
51-60	6.0 ( 5.01 - 6.00)	<b>B</b>	Above Average
41-50	5 (4.01 - 5.0)	<b>C</b>	Average
40	4.0	<b>P</b>	Pass
< 40	0.0	<b>F</b>	Fail
	0.0	<b>AB</b>	Absent

- Non-appearance in any examination/assessment shall be treated as the students have secured zero marks in that subject examination/assessment.
- Minimum P grade ( 4.00 grade points) shall be the limit to clear / pass the course / subject. A student with F grade will be considered as “ failed” in the concerned course and he/she has to clear the course by appearing in the next successive semester examinations.
- Every student shall be awarded grade points out of maximum 10 points in each subject ( based on 10 point scale). Based on the grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed . Results will be announced at the end of each semester and CGPA will be given at final exit.



## **Computation of SGPA (Semester Grade Point Average) and CGPA (Cummulative Grade Point Average)**

Grade in each subject / course will be calculated based on the summation of marks obtained in all five modules.

The computation of SGPA and CGPA will be as below :

- Semester Grade Point Average (SGPA) is the weighted average points obtained by the students in a semester and will be computed as follows.

$$\text{SGPA} = \frac{\text{Sum}(\text{Course Credits}) \times \text{Number of Grade Points in Concerned course gained by the students}}{\text{Sum (Course Credits)}}$$

The SGPA will be mentioned on the grade card at the end of every semester.

- The Cumulative Grade Point Average (CGPA) will be used to describe the overall performance of a student in all semesters of the course and will be computed as under –

$$\text{CGPA} = \frac{\text{Sum (All Six Semester SGPA)}}{\text{Total Number of Semester}}$$

The SGPA and CGPA shall be rounded off to the second place of decimal.

### **Grade Card**

Results will be declared by the University and the grade card (containing the grades obtained by the students along with SGPA) will be issued by the university after completion of every semester. The grade card will be consisting of following details.

- Title of the courses along with code opted by the student.
- Credits associated with the course.
- Grades and grade points secured by the students.
- Total credits earned by the student in a particular semester.
- Total credits earned by the students till that semester.
- SGPA of the student.
- CGPA of the student ( at final exit)

### **Cummulative Grade Card**

The grade card showing detail grades secured by the student in each subject in all semesters along with overall CGPA will be issued by the University at final exit.

# Semester I

**B.Sc. (Industrial Chemistry) : Semester I**  
**IC-111: Fluid Mechanics & Unit Operations-I**

Total Credits: 02

Contact Hours: 30 (Clock Hours)

Marks: 50

**Learning Objectives of the Course:** The students are expected to learn -

1. Flow of Fluids, different types of flow,
2. Application of Fluid Statics
3. Fluid Flow Phenomena
4. Basic Equations of Fluid Flow
5. Transportation & Metering of Fluids

**Learning Outcomes of the Course :**

CO1: The students understood about classification & properties of fluids & flows.

CO2: The students acquire knowledge of application of different types of Manometers.

CO3: The students known about different types of flow of fluids.

CO4: The students can derive easily basic equations used in fluid mechanics.

CO5: The students are knowing the different types of accessories used for pipe fittings, classification of pumps, Rotameter and their applications.

**Course Contents : Fluid Mechanics:**

**Unit I - Flow of Fluids: 10 Periods**

Definitions of fluids, Classification of fluids, Properties of fluids, Fluid Pressure, Pressure Head, Hydrostatic equilibrium for compressible and incompressible fluids.

**Unit II- Application of fluid statics: 05 Periods**

Manometers, U-tube manometer, Inclined Manometer, Differential Manometer, Continuous gravity decanter.

**Unit III-Fluid Flow Phenomena: 10 periods**

Types of flow, Laminar flow, Shear Rate and Shear Stress, Turbulence-Reynolds number & Transition from Laminar to Turbulent flow, Reynolds experiment, Boundary layers, Flow in boundary layers, Laminar and Turbulent flow in boundary layers.

**Unit IV- Basic Equations of fluid flow: 5 periods**

Equation of Continuity, Bernoulli's equation, Pump work in Bernoulli's equation and its application.

**Unit V : Transportation and**

**Metering of fluids: 15 periods**

Transportation of fluids: Pipe, Tubing, Fittings & valves. Pumps: Classification of Pump, Developed head, Power requirement, Suction lift and cavitations, Positive- displacement pumps, Reciprocating pumps, Rotary pumps, Centrifugal pumps, Centrifugal pump theory, Ideal pump, Actual pump performance, Power consumption, Efficiency. Air Binding and Pump Priming, Losses in Centrifugal Pump, Centrifugal Pump troubles & Remedies, Pump fails to start pumping, Pump is working but not up to the capacity and pressure, Pump starts and then stop pumping, Pump takes too much power.

Metering of fluids: Full bore meters- Principle, Construction and Working, Advantages and Disadvantages of Venturimeter , Orifice meter , Pitot Tube, Rotameter.

Refferance Book: 1) Unit Operation I by K.A.Gavhane. 2) Unit Operation I by Mc Cabe Smith.

**B.Sc. (Industrial Chemistry) : Semester I**  
**IC-112: Material Balance & Process Calculations**

Total Credits: 02

Contact Hours: 30 (Clock Hours)

Marks: 50

**Learning Objectives of the Course:**

The students are expected to learn -

1. Units & dimensions, basic quantities, derived quantities.
2. Basic Chemical Calculations, problems.
3. Material Balances without Chemical Reaction , problems solving
4. Material Balances with Chemical Reaction, problem solving

**Learning Outcomes of the Course :**

CO1: The students are learned different units used in systems & its use.

CO2: The students can explain mole concept, Atomic & Mass weight & physical properties of solid, liquid, & gases.

CO3: The students can solve the problems on Material Balances without chemical reaction

CO4: . The students can solve the problems on Material Balances with chemical reaction

CO5 : Students knows the various methods used for expressing the mixture composition for solid, liquid and gases.

**Course Contents:**

**Unit I -Units and Dimensions: 05 Periods**

Introduction, Dimensions & Systems of Units, Fundamental Quantities, Derived Quantities, Conversions & Problems.

**Unit II -Basic Chemical Calculations: : 10 Periods**

Introduction, Mole, Atomic Mass & Molar Mass, Equivalent Mass, Solids, Liquids & Solutions, Important Physical, Properties of Solutions, Gases & Problems

**Unit III -Material balances without chemical reactions: : 15 Periods**

Classification of Material Balance Problems, Material balances without chemical reactions, Outline of Procedure for Material Balance Calculations, Distillation, Evaporation, Absorption, Extraction, Drying, Filtration, Mixing, Crystallization and Problems on Material Balances .

**Unit IV - Material Balances with Chemical Reactions: : 10 Periods**

Stoichiometry, Stoichiometric Equations, Stoichiometric Coefficients, Stoichiometric ratio, Limiting reactant, Excess reactant, Conversion, Yield and Selectivity and Problems on Material Balances with Chemical Reactions.

**Unit V –Problems:.: 05 Periods**

Material balance problems on chemical reactions.

ReferenceBooks: 1. Introduction to Process Calculation- K.A.Gavhane  
2. Stoichiometry-B.I.Bhatt & S.M.Vora

**B.Sc. (Industrial Chemistry) : Semester I**  
**IC-121 : Lab Course 1 (based on IC-111 & IC-112)**

Marks : 50

Credits : 1.5

Every candidate appearing for the examination must produce a journal showing that he/she has completed 06 experiments during the academic year. The journal must be certified at the end of the semester /year by the Head of the department.

**List of Experiments to be taken: (Any Six)**

1. To Determine the Co-efficient of Venturimeter.
2. To Determine the Co-efficient of Orifice meter.
3. To Study the Characteristics of Centrifugal Pump.
4. To Verify Hagen-Poiseuille's Equation.
5. To Study the Pipe Fittings Test Rig.
6. To Study the Thermal Conductivity of Bad Conductor.
7. Determination of Acid Value of Lubricating oil.
8. Determination of Saponification Value of Lubricating oil.
9. Determination of Viscosity of Lubricant by Red Wood Viscometer.
10. Determination of Flash & Fire Point of Lubricating oil by a)  
Cleveland's Apparatus (Open Cup)  
b) Abel's Apparatus (Closed Cup)  
c) Pensky-Marten's Apparatus (Closed Cup).
11. Determination of NaOH & Na<sub>2</sub>CO<sub>3</sub> in the given alkali mixture solution
12. Determination of Alkalinity of Water sample .

## Semester II

## B.Sc. (Industrial Chemistry) : Semester II

### IC-211: Heat Transfer & Aspects of Industrial Chemistry

Total Credits: 02

Marks: 50

Contact Hours: 30 (Clock Hours)

**Learning Objectives of the Course:** The students are expected to learn -Conduction, Convection & Radiation 2. Heat Exchange Equipments 3. Fuels & Water analysis, Glass, Ceramics & Cement

#### Learning Outcomes of the Course :

CO1: Students understood the various forms of heat transfer.

CO2. They know the various types of heat exchange equipments used in industries & the overall heat transfer coefficients.

CO3: The students can define solid, liquid & gaseous fuels & refining of Petroleum cracking. Also, knows chemical & physical examination of water.

CO4: The students know physical & chemical properties of glass, ceramics, Cement & its applications.

#### Course Contents :

##### Unit I : Heat Transfer : 10 periods

**Conduction:** Basic law of Conduction, Thermal conductivity, Compound resistances in series, Heat flow through a Cylinder. **Convection:** Classification of Convection. **Radiation:** Absorptivity, Reflectivity and Transmissivity, Kirchhoff's law, Laws of black body radiation, Stefan-Boltzmann law, Heat Transfer by radiation.

##### Unit II : Heat Exchange Equipments: 10 periods

Single pass tubular condenser, Double pipe heat exchanger, Counter Current and Parallel flow, Energy Balances, Enthalpy balances in heat exchangers, Enthalpy balances in total condensers, Overall Heat Transfer Coefficients, LMTD, Individual Heat Transfer Coefficient, Calculation of Overall Coefficients from individual coefficients, fouling factors.

##### Aspects of Industrial Chemistry : Unit III : Fuels- : 10 Periods

Introduction, Calorific Value, Classification & properties of fuels.

1. **Solid Fuels:** Properties, composition & Analysis of Coal
2. **Gaseous Fuels:** Classification, Natural gas, LPG
3. **Liquid Fuels:** Petroleum, composition & classification, Definition of Flash point & fire point, knocking, Octane Number, aniline point, refining of petroleum cracking, thermal & catalytic cracking, reforming, thermal & catalytic cracking.

##### Unit IV : Water Analysis: 10 Periods

Chemical & physical examination of water, Chemical substances affecting potability, color, Turbidity, odour, taste, temperature, PH conductivity, suspended solid, acidity, alkalinity, free chlorine, calcium & magnesium, Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand and Dissolved solids.

##### Unit V : Glass, Ceramics & Cement: 15 periods

**Glass:** Introduction, physical & Chemical Properties of Glass, Characteristics, Raw Materials, Chemical Reactions, Methods of Manufacture of Glass & Uses.

**Ceramics:** Introduction, Classification and general properties of ceramics, basic raw material, manufacturing process, manufacture of porcelain and china, Refractories, classification, properties, Manufacture of refractories, manufacture of fire clay bricks.

**Cement:** Introduction, Composition, Types of Cement, Raw Materials, Manufacture of Cement by Wet & Dry Process, Reactions in the Kiln, Setting of Cement, Testing & Uses of Cement.

**Reference Books:** 1. Unit Operations of Chemical Engineering- McCabe Smith, 2. Unit Operations-I (Fluid Flow & Mechanical Operations)- K. A. Gavhane, 3. Unit Operations-II (Heat & Mass Transfer)- K. A. Gavhane 4. Heat Transfer- K. A. Gavhane, 5. Principles of Heat Transfer & Mass Transfer- S. D. Dawande 6. Industrial Chemistry- B. K. Sharma.

**B.Sc. (Industrial Chemistry) : Semester II**  
**IC-212 : Energy Balances & Process Calculations**

Total Credits: 02

Contact Hours: 30 (Clock Hours)

Marks : 50

**Learning Objectives of the Course:**

The students are expected to learn-

1. Recycle Operations
2. Energy Balances
3. Vapor Pressures

**Learning Outcomes of the Course :**

CO1: Students are knowing recycle stream, ratio, & purging operations.

CO2: The students knows the various forms of energy, Heat capacity, Heat of formation & Heat of mixing.

CO3: the students knows the effect of temperature on vapor pressure.

**Course Contents :**

**Unit I : Energy balances: 10 Periods**

Forms of Energy, Kinetic Energy, Potential Energy, Internal Energy, Heat, Work, General Energy Balance Procedure, Energy Balances on Closed Systems, Heat Capacity, Relation between  $C_p$  &  $C_v$  for an Ideal Gas, Empirical equation for Heat Capacities, Mean Molal Heat Capacities of Gases,

**Unit II : Energy balances: 10 Periods**

Heat Capacities of gaseous mixture, Enthalpy Changes Accompanying Chemical Reactions, Heat of Reaction, Heat of Formation, Standard Heat of Formation, Heat of Combustion, Hess's law of Constant Heat Summation, standard Heat of reaction from heat of formation, Standard Heat of Reaction from Heats of Combustion, Effect of temperature on Heat of Reaction, Effect of Pressure on Heat of Reaction,

**Unit III : Energy balances: 10 Periods**

Adiabatic Process, Adiabatic Reaction, Adiabatic Reaction Temperature, Phase Change Operation, Latent Heat of Vaporization, Latent Heat of Fusion, Latent Heat of Sublimation, Energy Balance during Phase Change Operation, Heat of solution and Heat of Mixing. (Numerical)

**Unit IV : Recycle Operations : 05 Periods**

Recycle Streams, Purging operation, Recycle ration.

**Unit V : Vapor Pressures : 10 Periods**

Vaporization, Boiling Point, Vapor Pressures of solids, effect of temperature on vapor pressure .

**Reference Books:** 1. Introduction to Process Calculation- K.A.Gavhane

1. Stoichiometry-B.I.Bhatt & S.M.Vora
2. Chemical Process Principal- Hougen & Watson



**B.Sc. (Industrial Chemistry) : Semester II**  
IC-213: Lab Course 1 (based on IC-211 & IC-212)

Marks: 50

Credits : 1.5

Every candidate appearing for the examination must produce a journal showing that he/she has completed 04 experiments during the academic year. The journal must be certified at the end of the semester /year by the Head of their department.

**List of Experiments to be taken: (Any Four)**

1. Determination of hardness of water.
2. Determination of percentage of iron in cement (Volumetrically).
3. Determination of amount of available chlorine in Bleaching powder.
4. Estimation of calcium in limestone.
5. Determination of dissolved oxygen (DO),
6. Determination of chemical oxygen demand (COD) in given wastewater sample.
7. To measure the density of various liquids by pycnometer .
8. To Determine the Chloride Content of water by Mohr's Method.

The students should work on a mini-project and submit it at the time of examination along with the project report.