DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/Sci./C.B.C. & G.S./P.G. Syll./39/2015

It is hereby inform to all concerned that, the revised Curriculum under **Choice Based Credit and Grading System** submitted by the various Ad-hoc Boards which are run at college level only and recommended by the Dean, Faculty of Science, the Hon'ble Vice-Chancellor has accepted the same on behalf of the Academic Council under Section-14[7] of the Maharashtra Universities Act, 1994 as under :-

[1]	M.Sc. Forensic Science Ist Year, Semester-I & II Progressively
[2]	M.Sc. Electronics Ist & IInd Year, Semester-I to IV Progressively
[3]	M.Sc. Industrial Automation Ist & IInd Year, Semester-I to IV Progressively [Under Innovative Programme of U.G.C.]
[4]	M.Sc. Industrial Chemistry Ist & IInd Year, Semester-I to IV Progressively
[5]	M.Sc. Herbal Technology Ist & IInd Year, Semester-I to IV Progressively [Under Innovative Programme of U.G.C.]
[6]	M.Sc. Biophysics Ist & IInd Year, Semester-I to IV Progressively
[7]	M.Sc. Bioinformatics Ist & IInd Year, Semester-I to IV Progressively
[8]	M.Sc. Plant Breeding & Molecular Genetics Ist & IInd Year, Semester-I to IV Progressively
[9]	M.Sc. Plant Biotechnology Ist & IInd Year, Semester-I to IV Progressively
[10]	M.Sc. Geology Ist & IInd Year, Semester-I to IV Progressively.

This is effective from the Academic Year 2015-16 & onwards as appended herewith.

All concerned are requested to note the contents of the 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/S.S./C.B.C. & G.S. /
P.G.Syll./2015/9893-10142
Date:- 20-07-2015.

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Director,
Board of College and
University Development.

Copy forwarded with compliments to:-

1] The Principals, affiliated concerned colleges,
Dr. Babasaheb Ambedkar Marathwada University

Copy to :-

1] The Controller of Examinations,
2] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter, Dr. Babasaheb Ambedkar Marathwada University,
3] The Superintendent, [M.Sc. Unit],
4] The Programmer [Computer Unit-1] Examinations,
5] The Programmer [Computer Unit-2] Examinations,
6] The Record Keeper.

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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Curriculum under Choice Based Credit & Grading System

M.Sc. I Year

Industrial Chemistry

Semester–I & II

[Effective from 2015-16 & onwards]

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Syllabus

M.Sc. Industrial Chemistry

Semester I & II

Course Structure

M.Sc. First Year

M.Sc. I Semester

Paper No.	Title	No. of Lecture	Marks	Credits
IC - 101	Basic Concepts & Process Calculations	60	50	4
IC – 102	Unit Operation in Chemical Industrial	60	50	4
IC – 103	Mechanism in Organic Reactions	60	50	4
IC – 104	Computational Methods of Data Analysis	60	50	4

M.Sc. II Semester

Paper No.	Title	No. of Lecture	Marks	Credits
IC -205	Quality Assurance Techniques	60	50	4
IC –206	Unit Operation in Chemical Industries II	60	50	4
IC –207	Design of Organic Synthesis	60	50	4
IC –208	Pollution & Methods of Pollution Control	60	50	4
IC –209	Lab. Course – I	135	50	4.5
IC –210	Lab. Course – II	135	50	4.5
IC –211	Lab. Course – III	135	50	4.5
IC - 212	Lab. Course – IV	135	50	4.5

Exam. of Lab. Course I & II will be conducted at the end of semester II alongwith Lab. Course III & IV.

M.Sc. Second Year

M.Sc. III Semester

Paper No.	Title	No. of Lecture	Marks	Credits
IC -301	Instrumental Methods of Analysis	60	50	4
IC –302	Equipment Designing	60	50	4
IC –303	Process Economy & Industrial Organization	60	50	4
IC –304	Waste Management & Effluent Treatment	60	50	4

M.Sc. IV Semester

Paper No.	Title	No. of Lecture	Marks	Credits
IC -401	Dyes & Dye Intermediates	60	50	4
IC –402	Pharmaceuticals	60	50	4
IC –403	Polymers, Cosmetics & Perfumery	60	50	4
IC –404	Agro Chemicals & Petro Chemicals	60	50	4
IC –405	Lab. Course – V	135	50	4.5
IC –406	Lab. Course – VI	135	50	4.5
IC –407	Lab. Course – VII	135	50	4.5
IC –408	Lab. Course – VIII	135	50	4.5

Exam. of Lab. Course V & VI will be conducted at the end of semester IV alongwith Lab. Course VII &VIII.

M.Sc. Industrial Chemistry
(Course Structure)

M.Sc. First Year

M.Sc. I Semester

Paper No.	Title	No. of Lecture	Marks	Credits
IC - 101	Basic Concepts & Process Calculations	60	50	4
IC – 102	Unit Operation in Chemical Industrial	60	50	4
IC – 103	Mechanism in Organic Reactions	60	50	4
IC – 104	Computational Methods of Data Analysis	60	50	4

M.Sc. II Semester

Paper No.	Title	No. of Lecture	Marks	Credits
IC -205	Quality Assurance Techniques	60	50	4
IC –206	Unit Operation in Chemical Industries II	60	50	4
IC –207	Design of Organic Synthesis	60	50	4
IC –208	Pollution & Methods of Pollution Control	60	50	4
IC –209	Lab. Course – I	135	50	4.5
IC –210	Lab. Course – II	135	50	4.5
IC –211	Lab. Course – III	135	50	4.5
IC - 212	Lab. Course – IV	135	50	4.5

Exam. of Lab. Course I & II will be conducted at the end of semester II alongwith Lab. Course III & IV.

M.Sc. I year

Semester-I Paper- IC - 101 Basic concept & Process Calculations

Teaching hours 60 clock hours Credits 04

1. **Scope of Industrial Chemistry:**
   Classification of industries objectives of industrial chemistry, Difference between Chemistry & Industrial Chemistry. 10
2. **Dimensions & Units.**
   Basic chemical calculations, atomic weight molecular weight, mole, composition of liquid mixtures & gaseous mixture.Stoichometric& composition relations ships & chemical equations. 10
3. **Material Balance:**
   Techniques of material balance direct approach, Algebraic equations, Using tie elements, case studies in unit operation & Unit process with bypass & recycles. Steam properties of steam, Boilers, classification & efficiency liquid phase reactions, Gas phase reactions with/without recycle & bypass. 20
4. **Energy Balance:-**
   Law of conservations of Energy, Thermo Chemistry, Heat capacity sensible heat latent heat, Enthalpy calculations involving physical & chemical changes. Mixing & separations operations & chemical processes. 20
   Note:- 25% weightage should be given to problems.

Books:-

1) Stoichiometry for Chemical Engineering Jonson
2) Stoichiometry [Bhatt &Vora] Tata McGraw Hill.
3) Chemical engineering [Coulson & Richardson]
4) Introduction to chemical Engineering [Cabe& Smith]

Paper- IC - 102 Unit operation in Chemical Industries I

Teaching hours 60 clock hours **Credits 04**

(1) **Momentum transfers operations**:

Fluid dynamics, viscosity of fluids & Newton law shell balance; techniques for velocity, distribution in laminar flow in pipes & falling new Bernoulji's equation Equations for pressure drop in Laminar & turbulent flow thourgh packed beds & fluidized equipment beds. Pipes & fittings equivalent length. Measurement of flow of fluids, punips& gas moving equipment mixing agitation operations dry blending mixing of immiscible fluids & suspension of solids in liquids. 20

(2) Heat Transfer:

Mechanism of study state heat transfer solids & cylinders, conductance through solids in series, convection, forced & natural converction; mechanism of boiling & condensation, radiations heat transfer & its applications, Unsteady heat transfer & simple cases with negligible internal resistance in cooling & heating Equation of energy exchange & heat transfer equipments like heat exchange condensers double pipe & shell & tube exchange condensers, double pipe & shell & tube exchanges, 1,2 and 2-4 pass exchangers. 15

(3) Mass Transfer Principle:

Molecular diffusion in gases, liquids & solids flicks law & diffusion coefficient of pure component & mixtures mass transfer across heterogeneous gas- liquid system mass transfer coefficient & overall mass transfer coefficient Principles of mass transfer in chemical reactions. 15

(4) **Mixing of solids & pastes:**

Types of mixer for solid & pastes criteria of mixer effectiveness Mixing power viscous material & pastes types of on Newtonian fluds time-dependent fluids, Thixotropic fluids. Reopectic fluids.Boundary layer flow & turbulence. 10

Note:- 25% weight-age should be given to numerical problems.

Books:

1. Fundamental of Industrial Chemistry [Farooqui MM & Quadri SH]
2. Transport processes & Unit operations [C.J.Gearkoplis]
2.Chemical Engineering [Coulson & Richardson]
3. Introduction to chemical engineering [Maccabe& Smith]
4. Introduction to chemical engineering [Badger &Banchero]
5. Unit operations-II [K.A. Garhane]
6. Chemical process industries [Shreves& Norris]
7. Chemical? Engineers Hand book.[Robert perry]

Paper-IC - 103 Mechanism in organic reactions.

Teaching hours 60 clock hours Credits 04

1) **Reaction Intermediates**
Classification of reagents, formation, stability structures & reactions of intermedia carbocation, carbanions, free radicals, carbenes, nitrenes, arynes,ylids&Non classical carbocalions. 05

2) **General methods of Determining reaction rates & mechanism.**
Types of mechanism types of reactions, thermodynamic & kinetic requirements of thermodynamic control, Hammonds postulate, Curtin Hammet Principal, Potential energy diagramme, transition states & intermediates; methods of determing mechanism isotope effect, identification of products, study of catalyst, stereo chemical evidences. 15

3) **Aromaticity**
Huckels rule & concept of aromaticity, annulene, hetero annulenes& fullerenes. 04

4) **Hetrocyclic Compounds.**
Synthesis & Reactivity of furan, thiophenepyrrole, pyridine, quinoline, isoquinolineindole.Pyrazole, isoxazoles, oxazole; thiazole pyrimidine. 08

5) **Organic acids & bases.**
Bronsted& Lewis concepts, Effect of substituents on strength of acids & bases Hammet equation, significance of sigma & rho, taft equation Hard & soft acids & bases. 05

6) **Stereo Chemistry.**
Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity Elements of symmetry Chirality, molecules with more than one chiral centre, thereoerythreo isomers, methods of resolution, optical activity enantiotropic&diastereotopic atoms, group & faces, stereo specific & stereo selective synthesis Asymmertric synthesis optical activity in the absence of chiral carbon biphenyl, allenes&spiranes, chirality to helical shape. Stereo chemistry of the compounds containing nitrogen, sulphur phosphorus, E-Z & R-S Nomenclature. 20

7) **Protecting groups.**
Principals of protecting of alcohol, amine, carbonyl & carboxyl groups. 03

SEMESTER – I

Paper –IC – 104 Computational Methods of data analysis.

Unit 1 Computer Programming:

Elements of basic language, functions and subroutines Graphics Commands, Commands for accessing hardware (data acquisition)

Visual Basic:- Introduction, different control and their properties applications, windows introduction and applications. 10

Unit 2 Application Package for Report Generation and Presentations. 20

MS-Office: Introduction to word Power Point.

MS-Word: Documents and Manipulation saving and printing Incorporation of graphs, tables. Pictures and chemical structures with the documents

Excel:- Spread sheets, report generation cell manipulations, data base management Graphical representation of tabulated data pie charts, bar & Line graphs, surface and 3d graphs.

Power Point:-Application of power point for the presentation reports and slides.

Unit 3 Computer for Industrial Chemistry 15

a) Introduction to CACHE (Computer Aids for Chemical Engineering) committee programe for various industrial applications.
b) Computer interfacing with instruments and as laboratory information systems.
c) Computer in Fault Tree Analysis
d) Computer in communications.

Unit 4 15

Internet: Basic Concepts, Importance in Chemical Industry, Design and maintenance of small web site.

E-Mail: Basics Methodology & Usage.

Note: 25% Weight-age should be given to applied questions.

Book Recommended.

1. Rajaraman V, Fundaments of Computer, Frentice-Hall of India-New Delhi 1996.
2. Sanders D.H."Computers today, McGraw---1988
3. Operating System Manual (Provided by the manufacturer)
4. RajaramanV."Analysis& Design of information System".
5. P.K.Sinha"Fundamentals of Computers".
6. Microsoft office 97 NED SNELU-1998. Comdex computer Publishing.
7. "Microsoft office 99 "Gini Courier Annette Marquis 1997, BPB Publication.

Laboratory Course – I
IC - 209

135 Hours Credit 4.5

1) Determination of acetyl salicyclicacid in commercial aspirin tablet by P^H titration.
2) Determination of sucrose by polarimeter.
3) Determination of millequivalent of sulphate ion present in the given solution of FAS by ion-exchange method.
4) Separation of iron-cobalt- by ion exchange chromatography.
5) Estimation of Na^+ & K^+ by flame photometry.
6) Estimation of iron-by 1:10 phenonthroleinspectrophotometricaly
7) Preparation of following organic compounds
   (i) Dibevizalacetone
   (ii) 2,4,6, trinitrophenol
   (iii) Phenaction
   (iv) 1-phenyl-azo-2-napthal.
   (v) Anthranilic acid from phthalimide.

8) Determination of percentage composition of binary mixture by Abbe's refractometer.

Semester – II

Paper – IC - 205 Quality assurance techniques

Teaching hours 60 clock hours **Credits 04**

1) **Quality assurance** :- [05]
Meaning of quality, quality process models triple role concepts of quality, customer requirement of quality, assurance, quality management ISO 9000 Series

2) **Sampling**:- [05]
Sample, theory of sampling, types of sampling, preparation of test samples, storage & Preservation of test sample

3) **Titrimetric methods of analysis** [20]
Types of titration, requirement for titration's, theory involved in the use of indicators (acid-base, metallochromic, Redox & Universal indicators) Numerical problems on stoichiometry of acid base & Redox titrations.

4) **Chromatographic techniques** [30]

(a) Introduction, classification, Principle & techniques of paper & thin layer chromatography

(b) Ion exchange chromatography.
Types of exchangers, Ion exchange equilibria, Ion exchange capacity, technique & application.

(c) Gas Chromatography Theory instrumentation & application

(d) H.P.L.C. (High Pressure Liquid Chromatography)
Theory, instrumentation & applications.

(e) Gel permeable & size exclusion Chromatography.
Theory technique & applications.

(f) Super critical fluid Chromatography.
Theory & applications.

Notes:15% weight-age should be given to numerical problems.

Books:

1) Instrumental methods of Analysis [Skoog& West]
2) Instrumental methods of Chemical Analysis Willard [Merit & Dean]
3) Separation methods [M.N. Shastri]
4) Analytical Chemistry [Gary Chrisstran]
5) Instrumentals methods of analysis [Ewing]
6) Analytical Chemistry by [Kemedy]
7) Instrumentals methods of analysis [B.K. Sharma]
8) Instrumentals methods of analysis [ChatwalAnand]
9) Brophysical methods [Nath&Uppaddhya]
10) Quality assurance [Anjalelly]

Paper- IC - 206 **Unit operation in Chemical industries-II**

Teaching hours 60 clock hours **Credits 04**

1) **Ultra filtration:-** [07]
Theory of filtration, pressure & vacuum filtration, filter aids & media, washing of filter, Ultra filtration membrane processes. Types of equipment for ultra filtration, flux equation for Ultra filtration, Effect of processing valuables in Ultra filtration.

2) **Drying:-** [08]
Types of dryer & its application, recapitulation, bound, unbound & free water drying,Process drying mechanism & calculation of drying time, Vapour pressure of water & humidity, Adiabatic saturation temperature, Twin drum dryer, spray dryer.

3) **Evaporation:-** [08]
Types of evaporation, Jacked, horizontal & vertical tube evaporators, forced circulation Evaporator, effect of various parameters, Scale formation multiple effect evaporators Boiling points & Duhring's rule Recapitulating.
Temperature Drops & capacity of multiple effect evaporator – step-by- step calculationMethods for triple effect evaporator, condenser for evaporator

4) **Mechanical Size reduction**:- [07]
Particle size measurements, equipment of size reduction (Jaw crashers, Gyratory crasher, Roll crusher. Ball mill hammer, mill grinder, revolving grinding mill)

5) **Membrane Separations**:- [08]
Types of membrane separation processes. Dialysis, gas permeation membrane process, Models for gas separation by membranes Effects of process variables on gas separation, Reverse osmosis & Ultra filtration membrane process, Application to equipments& Models.

6) **Solid Liquid Separations**:- [06]
Setting, sedimentations, thickening, filtration, vacuum pressure & centrifugation Equipment for solid liquid separation, Introduction to electrostatic precipitators.

7) **Distillation:** [09]
Single stage equilibrium, contact for vapour-liquid systems, simple distillation & steamdistillation, distillation with reflux, McCabeThiele methods of calculation of theoretical plates in distillation & absorption plate towers. Principle of fractional distillation usingenthalpy, concentration methods.

8) **Extraction:-** [07]
Single stage liquid extraction processes,continuous, multistage counter current extraction, Principles & equipment for liquid solid. Leaching, equilibrium reaction single Stage & counter current multistage leaching equipment, liquid-liquid extraction.

Books:

1. Text book of Industrial Chemistry [Farooqui MM & Quadri SH]

Paper- IC - 207 Destination Organic Synthesis

Teaching hours 60 clock hours **Credits 04**

1) **Nucleopelic substitution** [08]
SN^1, SN^2,mixed SN^1& SN^2& SET mechanism, Neighboring group participation by π&σ bonds & Lone pairs,SNAr, SN^i mechanism benzyne& $S_{RN}{}^1$ mechanism

2) **Electrophylic substitution Reactions** [07]
SE^2& SE^1 mechanism Electrophilic substitution accompanied by double bond shift,Arenium ion mechanism,ortho/para ratio, ipso attack

3) **Addition reactions** [08]
Mechanism & stereo chemical aspects of addition Reactions involving electro phyles,Nudeophylefree radicals region &chemoselectivity. Addition to carbon neteromultiple Bond.

4) **Elimination Reaction**: [07]
E_2 ,E_1 & E_1 CB mechanism, orientation of the double bond.

5) **Name reaction & Rearrangements** [15]
Favorski rearrangement, stork enamine reaction, Michael addition, Mannich reaction, Sharpless asymmetric epoxidation, Ene reaction, Baeyer-Villegar reactions, Hoffmann, Schmidt, Lossen, Curtius, Beckmann & Fries rearrangement, Reimer Tiemann, Reformatsky& Grignard reaction,Claisen rearrangement, Friedel-Craft reactions, witting reaction, Wolff-KishnerMeerwein-Pondorf-Verly& Birch reductions.

6) **Reagents in Organic Synthesis** [15]
Use of following reagents in Org. synthesis & functional group transformations, ComplexMetal hydrides, Lithium isopropyl amide (LDA), 1,2 Dithiane, (reactivity Umpolung),Trimethylsillyl iodide, tri-n-butyl tin hydride, Woodward & Prevost hydroxylation,Osmium tetraoxide, DDQ, Selenium dioxide Phase transfer catalyst, crown ethersMerrifield resin Peterson's synthesis,Wilkinson's catalyst, Bakers yeast.

Books:

1) Organic synthesis concept methods & starting material [J Fuhrhop&Penzillin]
2) Some Modern methods of Organic Synthesis [W. Carruthers]
3) Advance Org. Chem. Reaction mechanism [J. March]
4) Designing Organic Synthesis [Warren]
5) Org. reaction mechanism by [P.S. Kalsi]
6) Org. Chemistry [Stanley Pines]
7) Advanced General Org Chem [S.K. Ghosh]

Paper- IC - 208 **Industrial Pollution and Pollution control**

Teaching hours 60 clock hours **Credits 04**

1) **Environmental Chemistry**:- [10]
Environmental segments atmospheric structh, Photochemical smog, global warming green house effect, consequences of global warming, ozone layer depletion and its effect

2) **Air Pollution**:- [20]
Introduction, classification of air pollution, sources and effect of air pollution on man and Environment, industry and energy related air pollution, particulate matter sulphur oxides, Effect of particulate matter and sulphur oxides, Control technology of particulate matter and sulphur oxides Transport related air pollution carbon monoxide nitrogen oxide and Atmospheric lead effect of carbon monoxide and nitrogen oxide and lead control of Automobile emissions, Acid rain.

3) **Water pollution**:- [20]
Water reserves classification of water pollutants & their effect (including heavy metal)Physicochemical measurements like temperature. Color, odour, suspended solid, TDS,P^H, Acidity, alkalinity, DO, COD & BOD.

4) **Soil Pollution**:- [05]
Sources of soil pollution, effect of soil pollution, pesticides & Pollution control

5) R & D Pilot Plants, Scale up process, safety & health management, standard code of Process industries pollution legislature . [05]

BOOKS:-

1) Environmental Chemistry – [Colin Baird]
2) Environmental Chemistry – [A.K. Dey]
3) Industrial Chemistry & Pollution – [S.S. Dara]
4) Environmental Pollution Control Engg. – [C.S. Rao]

Paper- IC –211

Laboratory Course- III

135 Hours Credit 4.5

1) Estimation of glucose in honey sample.
2) Estimation of sodium benzoate in food material.
3) Estimation of iron in cement sample (Titrimetry).
4) Estimation of Mn in steel (Colorimetrically).
5) Estimation of Aluminum in bauxite (Gravimetrically.)
6) Estimation of Vitamin-C in commercial soft drink.
7) Estimation of benzaldehyde in the sample of bitter almond oil.
8) Determination of cholesterol in egg by colorimetry.
9) Estimation of ester in peppermint oil.
10) Estimation of chlorophyll content of leaf by colorimetry.
11) Analysis of milk for its lactose content.
12) Performance of centrifugal pumps.
13) Performance of CSTR.
14) Performance of rate of drying curve.
15) Performance of Venturi meter & Orifice meter.

Paper- IC –212

Laboratory Course- IV

135 Hours Credit 4.5

1) Estimation of dissolved oxygen by Winkler's method.
2) Determination of Chemical Oxygen Demand of water sample.
3) Estimation of Nitrite in the given water sample by colorimetry.
4) Removal of heavy metals using column Chromatography
5) Batch Adsorption studies of acetic acid by silica.
6) Determination of Hammett constant for substituted benzoic acids.
7) Determination of sodium and potassium in the given sample by flame photometry.
8) Three step preparation of organic compound (any three)

Project Report

IC-212

135 Hours Credit 4.5

In Organic, Inorganic drugs, dyes, polymer, fertilizer, paints & pigment, Chemical, fiber / textile, food & beverage, Pollution, or on any tropic related to chemical sciences.