CVM UNIVERSITY

(Established under Gujarat Private Universities
(Second Amendment) Act : 2019 Gujarat Act No. 20 of 2019)

FACULTY OF SCIENCE

Courses of Study

Master of Science

(Industrial Chemistry)

Effective from June 2020

CVM UNIVERSITY

Programme& Subject: M.Sc (Industrial Chemistry)

Syllabus with effect from – June - 2020

R.PG.IC.1: A candidate who has obtained the degree of Bachelor of Science of the University or of any other University recognized as equivalent thereto with Industrial Chemistry, Industrial Chemistry (vocational), Chemistry, Applied Chemistry, Polymer Science , Industrial Polymer Chemistry or any branch of Chemistry or Chemistry as one of the major subject or have studied at least two theory subjects of Chemistry/Industrial Chemistry during graduation in B.Sc and B.Pharm /B Tech / BE., can be admitted to the examination for the degree of M.Sc. in the respective subject (Industrial Chemistry) as per the regulation prescribed in that behalf.

The degree of Master of Science will be taken by papers and practicalsonly.

R.PG.IC.2: The examination of the various theory papers and laboratory work will be conducted under semester system. For this purpose each academic year will be divided into two semesters.

R.PG.IC.3: Candidates will be examined in each Theory paper for 100 marks and practical's for 200 marks wherever prescribed at the end of each semester. There shall be a viva-voce examination of 50 marks at the end of each semester to be held by the university.

For deciding result of M.Sc. examination in each semester the ratio between the internal assessment and external assessment will be 30:70.

1. **Theory:** There are four theory courses in a semester each of 100 marks. Of these 30 marks are assigned to internal assessment. The breakup of these 30 marks of each course shall be as under:

    - Internal Tests 20 Marks
    - Quiz/Weekly tests 05 Marks
    - Seminar / Assignment 05 Marks

2. Practicals: The practical courses in each semester carry 200 marks. Of these 60 marks are assigned to internal assessment.

The breakup of these 60 marks for internal assessment shall be as under

- Tests = 40 Marks
- Weekly attendance, Regularity, Lab. Skill, Journal = 10 Marks

- Viva = 10 Marks

R.PG.IC.4: Candidate shall be required to attend at least 80% of total theory, lectures and practicals under each of the courses during the semester.

R.PG.IC.5: The Head of department in consultation with other teachers of the department will prepare in the beginning of the year a detailed scheme of internal exams, seminars, weekly tests, assignments, quizzes, etc. and the same will be announced to the candidates. The records of the test examinations as well as seminars, weekly tests, quizzes, assignments etc. will be maintained by the department concerned.

Every candidate shall maintain a regular record of his/her practical work which shall be duly certified by his/her teacher(s) from time to time.

R.PG.IC.6: Candidates will be required to obtain at least 40% marks in the internal evaluation separately in each head of passing. A candidate who fails to obtain 40% marks in not more than two heads of passing, may be allowed to appear at the university examination by the head of department concerned on the recommendation of the committee appointed by him/her to assess the candidate's overall performance.

(Note: A head of passing will mean a course in theory or practicals)

R.PG.IC.7: A candidate desirous of appearing at each semester examination may forward his application in the prescribed form to Registrar through the Head of the University Post-Graduate Department /Principal concerned on or before the date prescribed for the purpose under the relevant ordinances.

R.PG.IC.8: The final result for the award of the degree will be declared on the basis of the grand total marks of all the Theory papers, Practicals and viva-voce prescribed for all semester's examinations for the said degree.

R.PG.IC.9: Only those students who fail in not more than two heads of passing at each semester examination be allowed to keep terms at the next semester. No Candidate will be allowed reappear in course in which he/she has already passed.

R.PG.IC.10: The standard of passing:

The standard of passing at the M.Sc. degree examination will be as under:

To pass any semester for the M.Sc. degree, a candidate must obtain at least 40% marks at the University Examination and 40% marks in the aggregate of University and Internal examination in each course of theory, practical and 40% marks in viva-voce Examination.

Award of Classes:

1) Those successful candidates will be placed in Pass Class with E if they obtain at least 40% or more marks but less than 50% marks (4.00≤CGPA<5.00) in the aggregate of all semesters examinations taken together.

2) Those successful candidates will be placed in Second Class with D if they obtain at least 50% or more marks but less than 60% marks (5.00≤CGPA<6.00) in the aggregate of all semesters examinations taken together.

3) Those successful candidates will be placed in First Class with C if they obtain at least 60% or more but less than 70% (6.00≤CGPA<7.00)marks in the aggregate of all semester's examinations taken together.

4) Those successful candidates will be placed in First Class with B if they obtain 70% or more but less than 80% (7.00≤CGPA<8.00) in the aggregate of all semester's examinations taken together.

5) Those successful candidates will be placed in First Class with A if they obtain 80% or more but less than 90% (8.00≤CGPA<9.00) in the aggregate of all semester's examinations taken together.

6) Those successful candidates will be placed in First Class with O if they obtain more than 90% (CGPA≥9.00) in the aggregate of all semester's examinations taken together.

R.PG.IC.11: A candidate who fails in more than two courses in a particular semester will not be admitted for further study at a subsequent semester and will be required to clear the courses in which he/she has failed. A candidate failing in not more than two courses at any semester examination will be promoted to the subsequent semester according to the following scheme:

A candidate failing in the First Semester in maximum two subjects will be permitted to pursue his/her study in the second Semester; candidate will not be permitted to go to the third Semester if he/she has not cleared all the backlogs of First semester and will not be permitted to Fourth semester if he/she has not cleared all the backlogs of Second semester.

R.PG.IC.12: As per UGC rules any student will be permitted to appear in the exams up to two years after his /her completion of course to clear his backlogs in any subjects in any semester. After two years if he/she is not able to clear the backlogs, one has to reregister and pursue the M.Sc course again.

CVM UNIVERSITY

COURSE STRUCTURE

Effective from June 2020

Programme & Subject: M.Sc. Industrial Chemistry

Semester 1

Course type	Course code	Name of course	Theory/ Practical	Credit	Contact hours per week	Exam duration in hrs	Component of marks		
							Internal	External	Total
							Total/ passing	Total/ passing	Total/ passing
Core	**101310101**	Industrial Analysis - I	**P**	**4**	**6**	**3**	**30/12**	**70/28**	**100/40**
	101310102	Chem Engg Practicals - I	**P**	**4**	**6**	**3**	**30/12**	**70/28**	**100/40**
	101310103	Industrial Management & Psychology	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310104	Mass Transfer Operations	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310105	Industrial Organic Chemistry	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310106	Comprehensive Viva – Voce	**-**	**1**	**1**	**-**	**-**	**50/20**	**50/20**
Electives	**101310107**	Technology of oleo Chemicals & Surfactants	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310108	Water Pollution Control Technology	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**

CVM UNIVERSITY

COURSE STRUCTURE

Effective from June 2020

Programme & Subject: M.Sc. Industrial Chemistry

Semester 2

Course type	Course code	Name of course	Theory/ Practical	Credit	Contact hours per week	Exam duration in hrs	Component of marks		
							Internal	External	Total
							Total/ passing	Total/ passing	Total /passing
Core	**101310201**	Industrial Analysis - II	**P**	**4**	**6**	**3**	**30/12**	**70/28**	**100/40**
	101310202	Chem. Engg. Practicals - II	**P**	**4**	**6**	**3**	**30/12**	**70/28**	**100/40**
	101310203	Unit Processes	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310204	Heat Transfer Operations and Stoichiometry	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310205	Petrochemical technology	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310206	Comprehensive Viva – Voce	**-**	**1**	**1**	**-**	**-**	**50/20**	**50/20**
Electives	**101310207**	Technology of Paint Manufacturing, Printing Inks & Heavy Duty Protective Coatings	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310208	Air Pollution Control Technology	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**

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COURSE STRUCTURE

Effective from June 2020

Programme & Subject: M.Sc. Industrial Chemistry

Semester 3

Course type	Course code	Name of course	Theory/ Practical	Credit	Contact hours per week	Exam duration in hrs	Component of marks		
							Internal	External	Total
							Total/ passing	Total/ passing	Total /passing
Core	**101310301**	Synthesis Planning 1	**P**	**4**	**6**	**3**	**30/12**	**70/28**	**100/40**
	101310302	Synthesis Planning - II	**P**	**4**	**6**	**3**	**30/12**	**70/28**	**100/40**
	101310303	Spectroscopy & Instrumental Techniques	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310304	Process Safety Management & Transportation of Fluids	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310305	Pharmaceutical Technology	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310306	Comprehensive Viva – Voce	**-**	**1**	**1**	**--**	**-**	**50/20**	**50/20**
Electives	**101310307**	Processing Of Oils & Fats To Utility Products	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310308	Industrial Polymers	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**

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COURSE STRUCTURE

Effective from June 2020

Programme & Subject: M.Sc. Industrial Chemistry

Semester 4

Course type	Course code	Name of course	Theory/ Practical	Credit	Contact hours per week	Exam duration in hrs	Component of marks		
							Internal	External	Total
							Total/ passing	Total/ passing	Total /passing
Core	**101310401**	Project	**P**	**8**	**12**	**3**	**60/24**	**140/56**	**200/80**
	101310402	Introduction To Reaction Engineering And Steam Generation	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310403	Process Development In Chemical Industries	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310404	Technology Of Chemical Process Industries	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310405	Comprehensive Viva – Voce	-	**1**	**1**	-	-	**50/20**	**50/20**
Electives	**101310406**	Advanced Analytical Chemistry	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**
	101310407	Natural products	**T**	**4**	**4**	**3**	**30/12**	**70/28**	**100/40**

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: I

Syllabus with Effect from: June 2020

Paper Code: 101310101	**Total Credit: 4**
Title Of Paper: Industrial Analysis - I	

Unit	**Description in Detail**	**Weightage (%)**
	Details of practical to be worked out by department	100

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: I

Syllabus with Effect from: June 2020

Paper Code: 101310102	**Total Credit: 4**
Title Of Paper: Chemical Engineering Practicals - I	

Unit	**Description in Detail**	**Weightage (%)**
	Practicals based on various mass transfer operations. Details of practicals to be worked out by department.	100

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: I

Syllabus with Effect from: June 2020

Paper Code: 101310103	**Total Credit: 4**
Title Of Paper: Industrial Management & Psychology	

Unit	Description in detail	Weightage (%)
1	Human Resource Management**:** Introduction, Acquisition of Human resources, Development of human resources.	25
2	Financial & Marketing Management**:** Nature and scope of financial management, financial statement and analysis, funds flow, cash flow, cost concepts, financial planning, investment planning and analysis, budgeting and business plan. Introduction, analyzing marketing opportunities, developing marketing strategies, planning marketing programmes.	25
3	Operational Management**:** Introduction, Organization of manufacturing; Production planning & control; material management.	25
4	Psychology in Industry: Organizational behavior, Attitude, Frustration, Morale and group processes, Stress management, Leadership, Fatigue, Types of conflicts and their resolutions.	25

References:

1. Marketing Management, Philip Kotter, Prentice- hall India 9th edition.
2. Personal or Human Resource & Personnel Management, D.A Decenzo, S.P. Robbins, PH India pub. 3rd edition.
3. Industrial Marketing Strategy, Fredrick Webster,3rd edition, John Wiley & Sons.
4. N. R. F Maier, Psychology in industry, Oxford and I B H Publishing co.
5. T. W. Harwell., Industrial Psychology, Oxford and I B H Publishing co.
6. Keith Davis & John W. Newsyrom, Human Behaviour at work, 8th Edn. McGraw Hill
7. V.O. Jenks, Human Relations in Organizations Haper& Row (1990)
8. M. L. Blum, J. C. Naylor, Industrial Psychology, CBS Publishers

CVM UNIVERSITY

Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: I

Syllabus with Effect from: June 2020

Paper Code: 101310104	**Total Credit: 4**
Title Of Paper: Mass Transfer Operations	

Unit	Description in detail	Weightage (%)
1	Liquid-Liquid Extraction**:** Choice of solvent for extraction, Binodal solubility curves, Calculations for single stage and multi stage cross & counter current extraction, Differential Extractors, Dimensionless analysis using Rayleighs and Buckingham Π method.	25
2	Drying: Rate of batch drying, calculations for cross and through circulation drying, Rate of drying for continuous driers, Hold up in rotary driers. Filtration: Theory of Filtration, Filtration Calculations, Filtration in centrifuge	25
3	Distillation: Mass transfer coefficients, Ficks law of diffusion, various types of distillation & distillation equipment and its calculation, Reflux Ratio, Enrichment and weeping effect in column, Enthalpy concentration method in the design of multistage tray towers and packed towers.	25
4	Gas absorption**:** Choice of solvent for absorption, Effect of L/G ratio for Absorbers, Co-current & counter current absorption, HETP in continuous contact equipment. Equipment for gas-liquid absorption, Calculations for leaching operation.	25

References :

1. Mass Transfer Operations, Robert Treybal, McGraw Hill Co. 3rd Edition.
2. Unit Operations of Chemical Engineering, W. Mc.Cabe, J.Smith, McGraw Hill Co 7th edition.
3. Chemical Engineering, Vol. 1 to VI , Coulson & Richardson, Pergamon Press. 3rd edition.
4. Fundamentals of Engg. Heat & Mass Transfer, R.C.Sachieve,Wiley Ltd.
5. Basic Principles and Calculations in chemical engg., D.HimelBlan,Prentice Hall
6. Chemical Engg. Handbook, Robert Perry. 7th edition.

CVM UNIVERSITY

Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: I

Syllabus with Effect from: June 2020

Paper Code: 101310105	**Total Credit: 4**
Title Of Paper: Industrial Organic Chemistry	

Unit	Description in detail	Weightage (%)
1	Preparations and applications of following reagents: Aluminum tertiary butoxide, Boron trifluoride, DCC, Ozone, Platinum, Palladium, Selenium.	25
2	Organic reaction mechanism: Introduction, meaning of organic reaction mechanism, Nature of fission of covalent bond, bond formation, types of organic reaction, classification of reagents, reaction intermediate, concept used in organic reaction mechanisms.	25
3	Name reactions: Aldol condensation, Cannizzaro reactions, HoubenHoesch, Knoevenagel, Wurtz, Wurtz-fittig.	25
4	Name reactions: Diels alder reactions, Perkin, Dakin, Wolf kishner, Leucarts, Meerwin-Pondorff-Verly.	25

References :

1. Industrial Organic Chemistry, K. Wissermel, H J Arpe, 3rd Edition, Willey pub.
2. Organic Synthesis based on Name reaction and unnamed reaction, A. Hassner& C. Stummer, Pergamon press. 2nd edition
3. Advanced Organic Chemistry- Reaction Mechanism & Structure, J. March, John Wiley & Sons. 4th edition
4. Organic Chemistry Vol 1 &Vol 2, I. L. Finar, Long man Scientific. 5th edition
5. Reaction mechanism and reagents in organic chemistry, Gurdeep R. Chatwal, Himalaya publishing house.
6. Organic chemistry, warren, oxford university press

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: I

Syllabus with Effect from: June 2020

Paper Code: 101310107	**Total Credit: 4**
Title Of Paper: Technology of oleo Chemicals & Surfactants	

Unit	Description in detail	Weightage (%)
1	Introduction to Oils, The constitution of vegetable oils and other components in vegetable oils, Constitution of fatty acids, Chemical properties of oils, Analysis of Oils, Refining of Oils Introduction to Oleochemicals, Overview of basic oleochemicals: Fatty acids, Fatty esters, Fatty alcohols, Fatty amines & Nitriles, Glycerol, Dibasic acid, Dimer acid	25
2	Chemistry of fatty acids, Technology of fat splitting & hydrolysis, Separation of fatty acids, Fatty acid distillation, Fractionation of fatty acids, Fatty Alcohols, Fatty acid methyl esters, Fatty amines	25
3	Applications of Oleochemicals as: Bio fuels , Agrochemicals and lubricants	25
4	Introduction to Surfactants, Classification, Physicochemical properties of surfactants, practical importance of surfactants in various fields, manufacturing technology of various industrial surfactants.	25

References:

1. Treatise on Fats, Fatty acids &Oleochemicals (vol.1 & 2), Edited by O. P. Narulla, Published by: Industrial Consultants(India), New Delhi.
2. Oleochemical manufacture and Applications, Edited by Frank D. Gunstone& Richard J. Hamilton, Published by: Sheffield Academic Press, England.
3. Handbook of Surfactants by Porter, Mc graw Hill Publishers
4. Chemistry and Technology of Surfactants, Edited by, Richard J. Farn, Blackwell Publishing.
5. Surface coatings: Raw materials and their usage(Vol1), Chapman and Hall publishers, London
6. Manufacture of Soaps, detergents and glycerine, Edgar, Norwood Pub.
7. Soaps and Detergents, By K S Parsuram, Tata McGraw Hill Pub.
8. Soaps their chemistry and Technology, J G Kane, Indian Central Oil seeds Co., Hyderabad.

CVM UNIVERSITY

Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: I

Syllabus with Effect from: June 2020

Paper Code: 101310108	**Total Credit: 4**
Title Of Paper: Water Pollution Control Technology	

Unit	Description in detail	Weightage (%)
1	Water quantity: water and its properties, necessity of water, water demand, factors affecting water demand, population forecast by different methods.Water quality: sampling, sample preservation, physical characteristics, chemical characteristics and biological characteristics, drinking water standards, pathogens and disease, nuisance organisms	25
2	Supply of water: sources of water and their characteristics: water from precipitation, surface water, ground water & saline intrusion. Sewerage collection and distribution system (types of sewer, types of traps, types of sewerage system etc.)	25
3	Water treatment: Basic of unit operations: Aeration, limitation of aeration, types of aerators, chemical handling and feeding, coagulation and flocculation, rapid mixing, slow mixing, filtration slow sand, rapid sand pressure. Disinfection: criteria for good disinfection, factors affecting efficiency of disinfection. Chlorination: chlorine chemistry, chlorination practices in India. Introduction to advanced water treatments: Ion exchange, water softening, membrane technology, control of colour, odour, taste	25
4	Waste water minimization by different methods: Recycle, reuse, process modification, product/raw material substitutions, technology change etc. Water conversion by pinch technology	25

References :

1. Water supply and sanitary engineering ,G. S. Birdie & J. S. BirdieDhanpatrypub.Co. Ltd.
2. Ground water assessment and management,K. R. Karanath,Tata Mc Graw hill
3.Advance in waste water treatment tech.vol – 2,R. K. Trivedy& N. S. Roman Globalscience
4. Sewage disposal and air pollution engineering volume – 2 ,Garg S. K.
5. Water supply engineering volume – 1 ,Garg S. K.
6. Environmental Engineering, Howard Peavy

CVM UNIVERSITY

Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 2

Syllabus with Effect from: June 2020

Paper Code: 101310201	**Total Credit: 4**
Title Of Paper: Industrial Analysis - II	

Unit	**Description in Detail**	**Weightage (%)**
	Details of practicals to be worked out by department	100

CVM UNIVERSITY

Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 2

Syllabus with Effect from: June 2020

Paper Code: 101310202	**Total Credit: 4**
Title Of Paper: Chem.Engg. Practicals - II	

Unit	**Description in Detail**	**Weightage (%)**
	Practicals based on Heat transfer Operations and Chemical Reaction Engineering. Details of practicals to be worked out by department	100

CVM UNIVERSITY

Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 2

Syllabus with Effect from: June 2020

Paper Code: 101310203	**Total Credit: 4**
Title Of Paper: Unit Processes	

Unit	Description in detail	Weightage (%)
1	Introduction, definition, agent, technologies and applications of Nitration.	25
2	Introduction, definition, agent, technologies and applications of Esterification, Hydrolysis, hydration.	25
3	Introduction, definition, agent, technologies and applications of Alkylation.	25
4	Introduction, definition, agent, technologies and applications of Oxidation, Synthesis Based on Carbon Monoxide and Hydrogen.	25

References:

1. Unit processes in organic synthesis, P. H. Groggins, Tata Mcgraw Hill pub. 5th edition
2. Chemistry of petrochemical processes, Sami Mater,Lewis Hatch, Gulf Professional pub. 2nd edition
3. Industrial Organic Chemistry, K.Weissermal, H.J.Arpe,Wiley VCH. 4th edition
4. Chemistry and technology of basic organic and petrochemical synthesis, N.N. Lebedev, Mir pub.

CVM UNIVERSITY

Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 2

Syllabus with Effect from: June 2020

Paper Code: 101310204	**Total Credit: 4**
Title Of Paper: Heat Transfer Operations and Stoichiometry	

Unit	Description in detail	Weightage (%)
1	Introduction to Fourier's law, Newton's law and Stefan Boltzman law. Three dimensional heat conduction equation in rectangular and cylindrical co-ordinates, Effect of variables such as thermal conductivity, Heat transfer from extended surfaces. Calculations for conduction, free and forced convection, Radiations and Kirchhoff's law, Absorption, Transmission, Reflection and Emission of radiation, Heat transfer coefficients, Effect of scale formation, Fouling factors.	25
2	Design of Heat transfer equipments- Shell& tube, double pipe and plate heat exchangers, multi-pass heat exchangers, LMTD correction factors, Effectiveness and number of transfer units for heat exchangers, principle and working of multi effect evaporators- forward feed, mixed feed and backward feed evaporators.	25
3	Mass balance calculation for processes with and without chemical reactions, recycle & purge operations.	25
4	Energy balance calculation for processes with and without chemical reactions.	25

References:

1. Unit Operations of Chemical Engineering, W. McCabe,J. Smith, McGraw Hill Co 7^{th} edition
2. Chemical Engineering, Vol 1 to VI, Coulson &Richardson,Pergamon Press. 4^{th} edition
3. Engineering Heat Transfer,C.P.Gupta, R.Prakash, Nomchand& Bros.,Roorkee. 7^{th} edition.
4. Process Heat Transfer, D.Q.Kern, Mc.Graw Hill Co.
5. Fundamentals of Engg. Heat & Mass Transfer, R. C. Sachieve, Wiley Ltd.

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 2

Syllabus with Effect from: June 2020

Paper Code: 101310205	**Total Credit: 4**
Title Of Paper: Petrochemical Technology	

Unit	Description in detail	Weightage (%)
1	Primary raw materials for petrochemicals: Crude oil, Natural Gas, Coal, Oil shells, Tar sand & Gas hydrates. Crude oil Exploration Techniques and Crude oil analysis	25
2	Processing Operations in Petroleum Refinery: Physical separation processes (Unit Operations), Chemical Conversion Processes (Unit Processes), Production of Hydrocarbon Intermediates	25
3	Petrochemicals based on synthesis gas, Alkanes (Methane, Ethane, & Propane), Alkenes (Ethylene & Propylene)	25
4	Petrochemicals based on C4 Olefins & Diolefins, BTX. Lubricating Oil and Grease Test Methods for petroleum products	25

References:

1. Chemistry of Petrochemical Process, Sami Matar, Lewis F. Hatch, Gulf Professional Publishing. Boston.
2. Fundamental of Petroleum Chemical Technology, P. Belov, Mir Publications, Moscow.
3. Advanced Petroleum Refining, G. N. Sarkar, Khanna Publishers, Delhi
4. Petrochemicals, Peter Wisheman, John Wiley & Sons, New York
5. Fundamentals of Petroleum and petrochemical Engineering, UttamRaiChaudhari,CRC Press,Taylor & Francis group
6. Organic chemistry, warren, oxford university press

CVM UNIVERSITY

Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 2

Syllabus with Effect from: June 2020

Paper Code: 101310207	**Total Credit: 4**
Title Of Paper: Technology of Paint Manufacturing, Printing Inks & Heavy Duty Protective Coatings	

Unit	Description in detail	Weightage (%)
1	Principles of paint formulation, concept of pigment volume concentration, theory of pigment wetting & dispersion, dispersion technology	25
2	Coating manufacturing equipments-ball mill, sand mill, basket mill, attritor, High speed disperser	25
3	Different types of inks,manufacturing of inks ,different printing processes	25
4	Corrosion & Technology of heavy duty protective coatings,technology of marine coatings	25

References:

1. Surface coating technology, Vol 1 & 2,OCCA,Chapman & Hall, London & New York
2. Paints & surface coatings, theory & practice, 2nd edition,R.Lambourne& T.A.Stevens,William Andrew Publishers
3. Technology of printing inks,E.A.Apps
4. Protective Print coatings for metals, Fraun Hofer &Boxaln,Particullis Press,England Basics of Paint Technology, 1stedition, C.Malshe

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 2

Syllabus with Effect from: June 2020

Paper Code: 101310208	**Total Credit: 4**
Title Of Paper: Air Pollution Control Technology	

Unit	Description in detail	Weightage (%)
1	Definition, sources of air pollution- Natural and anthropogenic. Vehicular pollution and its control. Aeroallergens- sources, biology and health effects. Effects of pollution on humans, animals, plants and materials and services, ambient air quality standards and exhaust emission standards from vehicles. Principal atmosphere pollutants – particulate matter, CO2, CO, HCs, NOx, acid rain asbestos and metals	25
2	Environmental factors and air pollution – Heat, insulation, wind, precipitation, mixing height and topography, plume – behavior, Gaussian plum model and box model, sampling and measurement of air pollution – ambient air and stack. Indoor air pollution measurement and monitoring.	25
3	Prevention and control pollution – Technology for particulate and gaseous pollution abatement. Air pollution episodes – Bhopal, Chernobyl, Los Angeles and London smog, Indonesian forest fire. Recent case studies on air pollution. Clean development mechanisms: carbon sequestration, carbon foot print, carbon trading and carbon markets	25
4	Statistics – sampling, data presentation techniques, frequency distribution, mean median, mode, standard deviation, standard error, t – test, probability, correlation and regression, analysis of variance	25

References:

1. Air quality management, Stern A. C.
2. Air pollution, Perkin H. G., Mc grow hill
3. Air pollution, Sharma B. K. and Kaur H
4. Air pollution, Rao M. N. and Rao H. V. N.
5. Biostatistics, K. S. Negi, AITBS publishers
6. Biostatistics, P. N. Malhan, Himalayan publication house
7. Sewage and air pollution engineering, Garg S. K.

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 3

Syllabus with Effect from: June 2020

Paper Code: 101310301	**Total Credit: 4**
Title Of Paper: Synthesis Planning 1	

Unit	**Description in Detail**	**Weightage (%)**
	Details of practicals to be worked out by department	100

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 3

Syllabus with Effect from: June 2020

Paper Code: 101310302	**Total Credit: 4**
Title Of Paper: Synthesis Planning - II	

Unit	**Description in Detail**	**Weightage (%)**
	Details of practical to be worked out by department.	100

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 3

Syllabus with Effect from: June 2020

Paper Code: 101310303	**Total Credit: 4**
Title Of Paper: Spectroscopy & Instrumental Techniques	

Unit	Description in detail	Weightage (%)
1	Absorption Spectroscopy: Introduction, Theory and Instrumentation of ^{1}HNMR and Introduction to ^{13}C NMR.	25
2	Theory and instrumentation of FTIR and Mass Spectrometry.	25
3	Theory of Chromatography and Instrumentation and applications of HPLC.	25
4	Introduction, instrumentation and Application of TGA, DSC & XRD.	25

References:

1. Organic Spectroscopy, William Kemp, ILBS 3rd edition
2. Spectrometric identification of organic compounds, Silver stein,John willey pub. 6th edition.
3. Applications of absorption spectroscopy of organic compounds, J.R.Dyer. 10th reprint.
4. Instrumental methods of chemical analysis, B.K. Sharma, Goel pub., 26th edition.
5. Instrumental Methods of analysis, Willard and Dean, CBS, 7th edition.
6. Spectroscopy of organic compounds, P.S.Kalsi. Willey eastern ltd.
7. HPTLC, D.Sethi, CBS 2nd edition

CVM UNIVERSITY

Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 3

Syllabus with Effect from: June 2020

Paper Code: 101310304	**Total Credit: 4**
Title of Paper: Process Safety Management & Transportation of Fluids	

Unit	Description in detail	Weightage (%)
1	Introduction to Industrial hygiene, Process safety management objectives, Lethal dose, IDHL, Flash point, Auto ignition point, Fire triangle, Fire Extinguishing systems, Pressure Relief valves & rupture discs, Colour Codes, OSHA & WISHA rules & regulations, Various types of Hazards, handling and Storage of flammable & combustible Chemicals, 5S of housekeeping, Safety in unit operations and chemical reactors.	25
2	Process Safety Information, Process Hazard Analysis, Process Risk Management, Training & Performance, Contractors, Process & Equipment Integrity, Management of Change, Incident Investigation, Compliance Audits, Trade Secrets, Employee Participation, Pre-startup Safety Review, Emergency Planning and Response, Audits & Corrective actions	25
3	Boundary layer concept, Reciprocating and Centrifugal pumps, Use of air vessels in pumps, Vapour locking and NPSH. Design of flow meters, Hagen Poiseulle equation & its applications.	25
4	Motion of particles through fluids: Types of settling, Terminal settling velocity of particles settling under Stokes, Intermediate and Newton's range in free & hindered settling, Mechanism of fluidization, Design of fluidized bed columns.	25

References:

1. "Plant Guidelines for Technical Management of Chemical Process Safety", by the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers.

2. “Chemical Process Safety, Fundamentals with Applications”, Second Edition by Daniel A. Crowl& Joseph F. Louvar ,Published by Prentice Hall, Inc. ISBN 0-13-018176
3. Safety and accident prevention in chemical operation, 2nd edition, Howard H.,
4. Handbook of occupational safety and health,Lawrence S
5. Practical Process Management,
6. Process Systems Analysis and Control, Coughanowr, Donald R., 3rd edition, McGraw Hill.
7. Process Control, Peter Harriot, McGraw Hill

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 3

Syllabus with Effect from: June 2020

Paper Code: 101310305	**Total Credit: 4**
Title Of Paper: Pharmaceutical Technology	

Unit	Description in detail	Weightage (%)
1	Drugs, Drug Targets, Pharmacokinetics, Pharmacodynamics, Preclinical testing & Clinical Trials	25
2	Solid dosage forms, Semi-solid dosage forms Preformulations and its role in development of solid dosage forms. Tablets: Types of tablets and tablet design and production Capsules: Hard & Soft shell capsules, Production of capsules QC of tablets and capsules	25
3	Advanced drug delivery systems: Sustained & Controlled release drug delivery system, Target oriented Drug delivery system, parenteral products	25
4	Regulatory Affairs and QA:GMP, GLP & Validation	25

References:

1. Handbook of pharmaceutical manufacturing, Edited by Shayne Cox Gad, Willey interscience, USA
2. Remington: The science and practice of pharmacy, 19th edition, A.R. Gennaro, Mack pub. Co.
3. Modern pharmaceutics, G.S.Banker, Informa healthcare.
4. Ansel's Pharmaceutical dosage forms and drug delivery systems, 8th edition, H.C.Ansel,Lippincott Williams and wilkins publisher

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 3

Syllabus with Effect from: June 2020

Paper Code: 101310307	**Total Credit: 4**
Title of Paper: Processing of Oils & Fats To Utility Products	

Unit	Description in detail	Weightage (%)
1	Processes and plants employed for hydrogenation of oils,chemistry of hydrogenation of oils, catalyst for hydrogenation of oils, hydrogen production for hydrogenation of oils	25
2	Raw materials and technology of pea nut butter and edible oil blends	25
3	Raw materials for soap industries, plant & process employed in soap manufacturing	25
4	Raw materials for detergents, plants & processes employed for detergents detergent additives	25

References:

1. Continuous processing of fats ,M.K. Schwitzer, Chem Pub Comp., New York
2. Baileys Industrial Oils & fats products, Vol 1-5,John Wiley & Sons
3. Manufacture of soaps, detergents & glycerine, edgar, Norwwod Limited
4. Treaties on fats,fatty acids & oleo chemicals,O P. Narulla, Indl Consultants India ltd., New Delhi
5. Soaps & Detergents, Parsuram K. S., Tata McGraw hill Pub, New Delhi
6. Soaps, their chemistry & technology, J G.Kane, Indian central oil seeds comp, Hyderabad

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 3

Syllabus with Effect from: June 2020

Paper Code: 101310308	**Total Credit: 4**
Title of Paper: Industrial Polymers	

Unit	Description in detail	Weightage (%)
1	Thermoplastics materials: Synthesis of monomers, Polymerization, Structure related properties, general properties and applications of various thermoplastics materials like PVC, Poly(vinyl acetate) and its derivatives, Acrylic plastics	25
2	Engineering thermoplastics: Intermediates, polymerization technology, structure, properties & applications of aliphatic polyamides, PET and poly carbonates	25
3	Thermoplastic elastomers: Introduction, structure, properties and applications of various thermoplastic elastomers like styrene based elastomers, olefinic elastomers	25
4	Introduction, Principle, working and applications of following polymer processing techniques: Injection moulding, extrusion, blow moulding, compression moulding, film casting ,thermoforming and vacuum forming	25

References:

1. Fundamental principles of polymer materials practices for engineers, Plastics Materials, Stephen L. Rosen, Barnes & Noble, New York.
2. Plastics Materials, J. A. Brydson, Butterworths, London.
3. Polymer Technology, D.C. Miles & J. H. Briston, Chemical Publishing company, Inc, New York.
4. Plastics Materials and Processes, Seymour S. Schwartz S.H. Goodman, Van Nostrand Reinhold, New York.
5. Plastics Technology, R. V. Milbey, McGraw Hill, Book Company New York,
6. Polymer science and Technology of Plastics and Rubber, P. Ghosh, McGraw hill, New York.
7. Engineering Plastics, R.W. Dyson, Chapman & Hall, New York

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 4

Syllabus with Effect from: June 2020

Paper Code: 101310401	**Total Credit: 8**
Title of Paper: Project	

Unit	**Description in Detail**	**Weightage (%)**
	A project report based on literature survey and laboratory work conducted on topics related to chemical engineering and/or chemistry is to be submitted and presented as a seminar by each student	100

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 4

Syllabus with Effect from: June 2020

Paper Code: 101310402	**Total Credit: 4**
Title of Paper: Introduction to Reaction Engineering and Steam Generation	

Unit	Description in detail	Weightage (%)
1	Homogeneous reaction kinetics: Single and Multiple Reactions, Application of Arrhenius, transition and collision theories for reaction kinetics. Elementary and Non-elementary reactions, order of reactions, Kinetic models for non-elementary reactions Integral and Differential analysis for constant volume, variable volume reactors-irreversible and reversible.	25
2	Heterogeneous reactions kinetics: Global rate of reaction, Effect of transport processes on selectivity in series and parallel reactions, Rate equations for surface reactions, Various three phase reactors. Catalyst properties such as surface area, porosity, density and particle size of catalyst.	25
3	Introduction to ideal batch, Continuous stir tank reactor and plug flow reactors for constant volume, variable volume reactors, determination of the best system for a given conversion, space time, space velocity, residence time distribution.	25
4	Introduction and thermodynamics of steam generation, steam generators, Indian boiler act, Classification and selection of boilers, Calculations for boilers.	25

References:

1. Chemical Reaction Engineering, Octave Levenspiel, Wiley Eastern Ltd. 3rd edition.
2. Chemical Engineering Kinetics, J. M. Smith, McGraw Hill Book Co.3rd edition.
3. Chemical Kinetics, S. K. Jain, Vishal Publication, Jallander.
4. Fundamentals of Chemical reaction Engineering., Holland & Anthony
5. Chemical Reactor Theory, Lenbigh & Turner, University of Cambridge.
6. Reaction Engg. Through solved problems, G.M.Pande & S.M. Shrivastava

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 4

Syllabus with Effect from: June 2020

Paper Code: 101310403	**Total Credit: 4**
Title of Paper: Process Development In Chemical Industries	

Unit	Description in detail	Weightage (%)
1	Introduction to process research & development, Goals & Objectives of Process development, Stages in process development, Scope and Limitations of Project development, Exploratory (Investigative) approach in Process development, Survey of Some organic reactions in relation to process development	25
2	Strategies for simplification of organic reaction and processes, Choosing a reagent, Modifying reagents Solvents: choosing a solvent, impurities in solvent, effect of solvents in organic reactions, mixed solvents, aqueous mediums for organic reactions, liquid products as solvents, some new solvents, no solvent is the best solvent. Phase transfer catalysis: Nature of phase transfer catalysis reactions, Factors effecting, Choosing a phase transfer catalyst, Important phase transfer catalysts	25
3	Workup, Purity & Purification, Detection & Prevention of chemical accidents, Chemical process safety, Chemical reaction hazard	25
4	Selected Chemical processes and Products	25

References:

1. The chemistry of process development in fine chemicals and pharmaceutical industry, 2nd edition, By C. Someshwara Rao, Asian books Pvt. Ltd. New Delhi.
2. Developing an Industrial chemical process, By Joseph Mizrahi, Taylor and Francis Pub.
3. Practical process research and development, N. G. Anderson, Science direct.
4. Designing and operating safe chemical reaction process, HSE publishers

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 4

Syllabus with Effect from: June 2020

Paper Code: 101310404	**Total Credit: 4**
Title of Paper: Technology of Chemical Process Industries	

Unit	Description in detail	Weightage (%)
Overview and study of following group of Chemical industries with respect to their classification, raw materials, chemistry and production technology		
1	Pigment Industry	25
2	Surface Coating Industry 1: Binders, oleo resinous media, alkyd resins, oil free saturated poly ester resins.	25
3	Surface Coating Industry 2: Urethane resins, epoxy resins. Solvents: classification, solvency ratings Additives for surface coating industry.	25
4	Fertilizers & Agrochemical Industries	25

References:

1. Hand book of Industrial Chemicals, Vol. 1 & 2, K.M.Shah, Multitech pub.
2. Encyclopaedia of Chemical Technology, By Kirk and Othmer
3. Handbook of Pigments, K. M. Shah, Multitech pub.
4. Surface Coatings, Vol. 1 & 2, Oil &Color chemist association (OCCA), Australian Champman & Hall Pub.
5. Chemical Process Industries, Edited By R N Shreve, McGraw Hill Pub.
6. Handbook of Fertilizer Technology, B.K.Jain, B.Swaminathan, The fertilizer association of India, New Delhi.

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 4

Syllabus with Effect from: June 2020

Paper Code: 101310406	**Total Credit: 4**
Title Of Paper: Advanced Analytical Chemistry	

Unit	Description in detail	Weightage (%)
1	Raman spectroscopy	25
2	Inductively coupled plasma (ICP)	25
3	TEM	25
4	Particle Size Analyser	25

References:

1. Analytical Chemistry – Dr.Alka Gupta, Pragati Prakashan.
2. Instrumental Methods of Chemical Analysis-Chatwal and Anand.
3. Instrumental Methods of Chemical Analysis-B. K. Sharma.
4. Instrumental Methods of Chemical Analysis-Skoog, west, Holler.
5. Instrumental Methods of Chemical Analysis- Willard Merriett and Dean.

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Programme & Subject: M.Sc. (Industrial Chemistry)

Semester: 4

Syllabus with Effect from: June 2020

Paper Code: 101310407	**Total Credit: 4**
Title Of Paper: Natural Products	

Unit	Description in detail	Weightage (%)
1	Introduction of natural products, General methods for the structure determination of natural products Vitamins: Structure & Synthesis of Vitamin A1,Vitamin B_1 (Thiamine),Vitamin B_6 (Pyridoxine) and Biotin (Vitamin H), Synthesis of Vitamin C	25
2	Alkaloids: Introduction of opium alkaloids, Structure and Synthesis of Morphine, rearrangement in opium alkaloids, structure and synthesis of Sceletium alkaloid A_4, structure and synthesis of Mahanimbine, synthesis of Reserpine and Tylophorine, biogenesis of Alkaloids	25
3	Terpenouids and Cartenoids: Structure nad Synthesis of cicyclic sesqiterpenoids eudesmol and cadinene, Structure and Synthesis of β -Carotene, synthesis of Caryophyllene and Khusimone, molecular rearrangement of Caryophyllene and Logifolene, biogenesis of Terpenoids and Carotenoids	25
4	Steroids: Structure nad Synthesis of Cholestrol, Synthesis of Cortisone, Androgens and Oestrogens, Chemistry of bile acids, Biogenesis of Steroids	25

References:

1. The Chemistry of Natural Products,K.W.Bentley,Vol. I-V, (Interscience)
2. Organic Chemistry,Vol. 2, I.L. Finar, 5th Edition(1994), ELBS Publications
3. Natural Products chemistry, Vol. I & II, Nakanishi et al., Academic press pub.(1974)
4. The molecules of Nature, J.B. Hendrickson, W.A. Benjamin Inc (1965)
5. Selected Organic Synthesis, Ian Fleming, John Wiley(1977)
6. Chemistry of Natural Products, N.R.Krishnaswamy, University Press Ltd(1999)