MASTER OF SCIENCE (INDUSTRIAL CHEMISTRY)
EXAMINATION 2020-2022

SCHEME OF TEACHING AND EXAMINATION

Paper	Subject	Teaching Hrs. per Week				End Term	Mid Term	Total Marks
FIRST SEMESTER		L	T	P	C			
ICH 1.1	Chemical Process Calculation	3	-	-	3	40	35	75
ICH 1.2								

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SYLLABUS FOR

MASTER OF SCIENCE (INDUSTRIAL CHEMISTRY)

FIRST SEMESTER(2020-2022)

Paper Title: Chemical Process Calculation (Theory)
Paper Code: ICH 1.1 Max. Marks 40 Credits: 3 Time: 3 hours
Course Duration: 35 Lectures of one hour each.
Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION-A

Review: Stoichiometric and composition relationship gas laws; Gaseous mixtures, vapor pressure, humidity, etc.

Material Balances for Non-reaction systems including balances involving recycle and by-pass streams.

SECTION-B

Material Balances for Reacting systems including balances involving recycle and purge streams.

Combustion Calculations.

Energy balances on nonreactive and reactive systems.

***Books Recommended*:**

1. Bhatt, V. I. & Vora, S. M. : Stiochiometry, 3rd Edition, Tata McGraw Hill, 1984.
2. Himmelbleau, D. M. : Basic Principles and Calculations in Chemical Engineering, 6th Edition, Prentice Hall, 1977.
3. Felder, R. M. & Rousseau R.W. : Elementary Principles of Chemical Processes, 3rd Edition, John Wiley and Sons, 1986.
4. Reklaithis, G. V. : Introduction of Material and Energy balances, John Wiley, 1983.
5. Lubyben, L.W. & Winzel, L. A. : Chemical Process Analysis, 2nd Edition, Prentice Hall, 1988.

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Paper Title: CHEMICAL ENGINEERING-I (Fluid Flow & Mechanical Operations) (Theory)
Paper Code: ICH 1.2 Max. Marks 40 Credits: 3 Time: 3 hours
Course Duration: 35 Lectures of one hour each.

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Paper Title: CHEMICAL TECHNOLOGY (Theory)
Paper Code: CHE 1.3 Max. Marks 40 Credits: 3 Time: 3 hours
Course Duration: 35 Lectures of one hour each.
Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.
SECTION-A

Oils & Fats: Introduction, Extraction of oils from vegetable oils, refining of oils and fats, hydrogenation of oils.

Soaps and Detergents: Introduction, Raw materials, Manufacture of soap, Classification of detergents, finishing of detergents.

divided

4. Pandey, G.N. : Chemical Technology, Volume-II, Lion Press, Kanpur.
5. Donnet J. B., Bansal R. C. : Carbon Fibres, Marcel Dekker Inc.
6. Donnet J. B., Bansal R. C., Wang M. J. : Carbon Black, Marcel Dekker Inc.
7. Bansal R. C., Donnet J. B., Stoeckli F. : Active Carbon, Marcel Dekker Inc.

MASTER OF SCIENCE (INDUSTRIAL CHEMISTRY)
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Paper Title: Organic Synthesis (Theory)
Paper Code: ICH 1.4 Max. Marks 50 Credits: 4 Time: 4 hours
Course Duration: 35 Lectures of one hour each.
Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION A

Reagents in Organic Synthesis:

Use of following reagents in Organic Synthesis and functional group transformations: Complex metal hydrides, Stereoselectivity in hydride reduction, Catalytic hydrogenation(Homogenous and Heterogeneous) and dissolving metal reductions, Lithium diisopropyl-amide (LDA), dicyclohexylcarbodiimide, Umpolung of reactivity (dipole inversions), trimethylsilyl iodide, trin-butyltin hydride, Oxidation of alcohols to carbonyl. Phenols to quinones, Osmium tetraoxide, selenium dioxide, phase transfer catalysis, Crown ethers, conversion of alkene to epoxides and diols, Oxidative bond cleavages.

Aliphatic Nucleophilic Substitution

The SN2, SN1, mixed SN1 and SN2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, Classical and non-classical carbocations, norbornyl system. common carbocation rearrangements. The SNi mechanism. Nucleophilic substitution at an allylic, aliphatic, trigonal and a vinylic carbon.

Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis, ambident nucleophile, regioselectivity.

SECTION B

Aromatic Substitution Reaction (Electrophilic &Nucleophilic)

(i) Aromatic Electrophilic Substitution

The arenium ion mechanism, Evidences for arenium ion mechanism, role of π –σ complexes orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems.

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oligoolefin) metal complexes, alkyne metal complexes, allyl metal complexes and enyl metal complexes (dienyl and trienyl). (ii) Cyclic -bonded complexes: sandwich and half-sandwich compounds. synthesis, structure and properties of cyclopropenyl metal complexes, cyclobutadiene metal complexes, cyclopentadienyl metal complexes, arenecycloheptatrienyl metal complexes and cyclooctatetraene metal complexes

***Books Recommended*:**

1. Skoog, D. A. & West D. M. : Principles of Instrumental Analysis, 5th Edition, Saunders College Publishers, USA.
2. Skoog, D. A. & West D. M. : Fundamentals of Analytical Chemistry, 7th Edition, Saunders College Publishers, USA.
3. Willard, Meritt, Dean &Settle, : Industrial Methods of Analysis, 7th Edition.
4. Galen W. Ewing. : Industrial Methods of Chemical Analysis, 5th Edition.
5. Silverstein R. M. &Webster F.X.: Spectrometric identification of Organic Compounds, 6thEdition, John Wiley and Sons, Inc., USA.

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Paper Title: FLUID FLOW & MECHANICAL OPERATION LAB. (Practical)
Paper Code: ICH 1.6 Max. Marks 25 Credits: 1 Time: 2 hours

1. General study of pipe fittings, valves and other equipments in the Chemical Engineering Lab.
2. Pressure drop for flow through pipelines,Q322 643.06 Tm0 g0 G G92 reW* nBT/F2 12 Tf1 0 0 1 2794 0 6h53

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Paper Title: ANALYTICAL TECHNIQUES LAB (Practical)
Paper Code: ICH 1.8

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SYLLABUS FOR MASTER OF SCIENCE (INDUSTRIAL CHEMISTRY)

SECOND SEMESTER

Paper Title: CHEMICAL ENGINEERING-II (Heat & Mass Transfer) (Theory)

Paper Code: ICH 2.1

Max. Marks 40 **Credits: 3** **Time: 3 hours**

Course Duration: 35 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION-A

Conduction: Steady state conduction in one dimensional system, general conduction equation in Cartesian coordinates,conduction through a plain wall, composite wall, cylindrical wall, effect of variable thermal conductivity,

Convection: Free and forced convection, concept of heat transfer co-efficient, dimensionless numbers in free and forced convection, Dimensional analysis methods and simple problems.

Condensation and Boiling: Condensation heat transfer phenomenon, film condensation on vertical plates, turbulent film condensation, convective coefficient for film condensation on tubes, boiling, boiling regimes, bubble growth and nucleate boiling

Evaporation: Types of Evaporators, single and multiple effects, single effect calculations, methods of feeding.

Heat Exchangers: Construction and application of double pipe heat exchanger, 1,1 and 1,2 shell and tube heat exchangers

SECTION-B

Mass transfer: Introduction to mass transfer and diffusion, molecular diffusion in gases and liquids, diffusion coefficients for gases and liquids

Mass transfer coefficients: Concept and types of mass transfer coefficients, , theories of mass transfer.

Interphase mass transfer, concept of overall mass transfer coefficient.

Distillation: differential distillation for binary systems, Fractionation of binary mixtures using McCabe – Thiele method,

Books Recommended:

1. McCabe, W.L., Smith, J.C. and Harriot H.P. : Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill,2005.

2. Holman, J.P. : Heat Transfer, McGraw Hill Publication Co.Ltd., New Delhi, 9th Edition, 2008

3. Chapman, A.J. : Heat Transfer, McMillan Publishing Co., 4th Edition, 1984

4. Kern, D.Q. : Process heat Transfer, Tata McGraw Hill Publishing Co., New Delhi, Edition 1997, 2006

5. Kreith, F. : Principles of Heat Transfer, Harper & Row Pub., London.

6. Geankoplis, C.J. : Transport Processes and Unit Operations, Prentice Hall of India Pvt. Ltd., 3rd Edition, 1999.

7. Treybal, Robert E. : Mass Transfer Operations, 3rd Edition, McGraw-Hill, 1981.

MASTER OF SCIENCE (INDUSTRIAL CHEMISTRY)
EXAMINATION 2020-2022

Paper Title: INDUSTRIAL POLUTION CONTROL (Theory)

Paper Code: ICH 2.2

Max. Marks 40 **Credits: 3** **Time: 3 hours**

Course Duration: 35 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION-A

Water pollution

Types of waste water, and sources of pollutants.

Basic concept of Industrial Wastewater Treatment:

- Primary treatment: Sedimentation, Flotation
- Secondary treatment: Activated Sludge process, Trickling Filters, Oxidation pond, Rotating Biological Cyclone (RBC) and Anaerobic digester
- Tertiary treatment

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EXAMINATION 2020-2022

Paper Title: PHARMACEUTICAL CHEMISTRY (Theory)

Paper Code: ICH 2.3

Max. Marks 40 **Credits: 3** **Time: 3 hours**

Course Duration: 35 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

Section A

The design and dosage forms Preformulation

Design of Dosages Forms: Principles of Dosage from designs, biopharmaceuticals consideration in dosage form designs, roots of drug administration, drugs factors in dosage from design, therepautices consideration in dosage form design.

Preformulation: Concept of preformulations, Uxorious aspects of preformulation, spectroscopy, solubility, melting point, powder flow properties, assay development.

Some common Drugs
Antipyretic drugs: Classification , pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Paracetamol , acetanilide and aspirin.
Analgesic drugs: Classification , pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Morphene Sulphate, codeine and levorphanontartarate.
Non Steroidalanti inflammatory(tic)5(d)-3(r)4(3(e)4(Iho12 0 612 792 reW* nBTF2 12 Tf1 0 0 1 144.74 358.4

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Paper Title: THERMODYNAMICS AND CHEMICAL REACTION ENGINEERING – III (Theory)

Paper Code : ICH 2.5 **Max. Marks 40** **Time: 3 hours**

Course Duration: 35 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION-A

Thermodynamics ·

The First law of thermodynamics and other basic concepts-

- Joule experiment, internal energy, the first law of thermodynamics, energy balance for closed system, thermodynamics state and state function equilibrium, phase rule, the reversible process, constant volume and constant pressure process, enthalpy, heat capacity, mass and energy balance for open system.
- Volumetric properties of pure fluids-PVT behavior of pure substance, Equations of states. · Heat effects. ·
- The Second law of thermodynamics.

SECTION-B

Thermodynamic properties of fluids-properties relation for homogenous phases, residual properties, residual properties by equation of states.

Reaction Kinetics:

Kinetics of homogenous reactions, analysis of reversible , irreversible, series, parallel reaction schemes, Introduction to different types of reactors.

Books Recommended:

1. Smith, J.M. and Van Ness, H.C. : Introduction to Chemical Engg. Thermodynamics, McGraw Hill Book Co., London.

2. Stiener, L.E. : Introduction to Chemical Thermodynamics, McGraw Hill Book Co.

3. Levenspial, D. : Chemical Reaction Engineering, John Wiley.

4. Narayanan, K.V. : A Textbook of Chemical Engineering Thermodynamics, PHI Learning Pvt. Ltd., 2004.

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1. Drago R.S., Physical Methods for Chemistry, Pubs: Saunders College Publishing. NewYear (1992). 2. Ebsworth E.A.V., Rankin D.W.H. and Cradock S., Structural Method in Inorganic Chemistry, Pubs: Blackwell Scientific Publications (1987).

3. Parish R.V., NMR, IR., NQR., ESR & Mossbauer Spectroscopy in Inorganic Chemistry, Pubs: Ellis Horwood, New York (1990).

4. Silverstein R.M. and Bassler G.S., Spectroscopy Identification of Organic Compounds, 5th Edition, Pubs: John Wiley (1991).

5. Willard R.M. Merrit I. and Dear J. A., Instrumental Methods of Analysis, 7th Edition, Pubs: Van Nostrand-Reinhold (1988).

6. Kemp W., Organic Spectroscopy, 2nd Edition, Pubs: E.I.B.S (1987).

7. Akitt J.W., NMR and Chemistry, Pubs: Chapman and Hall New York (1983).

8. Williams D. and Fleming I., Spectroscopic Methods in Organic Chemistry, Pubs: TMH (1988).

9. Atta-U-Rahman, Nuclear Magnetic Resonance, Pubs: Springer-Verlag, New York (1986).

10. Narrow C.M., Molecular Spectroscopy, Pubs: McGraw-Hill (1964).

11. Drago R.S., Physical Methods in Chemistry, Pubs: Van Nostrand-Reinhold (1977).

12. Banwall C.N., Fundamental of Molecular Spectroscopy, Pubs: Tata McGraw-Hill (1983).

MASTER OF SCIENCE (INDUSTRIAL CHEMISTRY)
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Paper Title: Polymer Science and Technology
Paper Code: ICH 3.2
Max. Marks 40 **Credits: 3** **Time: 3 hours**
Course Duration: 35 Lectures of one hour each

SECTION-A

Polymers, Functionality and Degree of Polymerization, Mechanism of Polymerization, Molecular Weights of Polymers, Methods of polymerization, Functional Polymers, Industrial applications of Polymers Polymerization reaction kinetics for polycondensation, addition polymerization, copolymerization, ziegler-Natta Polymerization, emulsion polymerization reactions, most probable molecular weights and distributions. Control of molecular weight and distributions, gelation phenomena, techniques of polymerization, and design of reactors for polymerization reactions, viscosity build up and heat and mass transfer effects in polymer reactors.

SECTION-B

Basic principles, description of different processing techniques such as extrusion, blow molding, wire coating, calendering including equipment, detailed discussions of parameters affecting the processing, problems and troubleshooting during processing, compounding and mixing of polymers and additives.

***Books Recommended*:**

1. Odian, G.: Principles of Polymerization, McGraw Hill Book Co., 1970.
2. Throne, J.L.: Plastics Process Engineering, Marcel Dekker Inc., New York, 1979
3. Reichert, K., and Geiseler, W.: Polymer Reaction Engineering, Huthing&Wepf. Basel, 1986
4. Bernhardt, E.C.: Processing of Thermoplastic Materials, Reinhold Pub., New York.
5. Middleman, S.: Fundamentals of Polymer Processing, McGraw Hill Book Co., 1977.

3. Nanotchnology

Section A

Overview of Nanostructures and Nanomaterials: classification . Crystalline nanomaterials and defects therein. Hybrid nanomaterials.

Multiscale hierarchical structures built out of nanosized building blocks (nano to macro).Nanomaterials in Nature: Nacre, Gecko,Teeth.

Nanostructures: Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magnetoresistance, etc. Cells response to Nanostructures.

4. RENEWABLE ENERGY

SECTION A

Renewable energy resources

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

Wind energy

Power in the Wind – Types of Wind Power Plants (WPPs) – Components of WPPs-Working of WPPs- Sitng of WPPs-Grid integration issues of WPPs.

Solar Photo voltaic and thermal systems

Solar Radiation, Radiation Measurement, Solar Thermal ETQq0.00000912 0 612of

Paper Title: OPEN ELECTIVES (Theory)
Paper Code : ICH 3.4
Max. Marks 40
Time: 3 hours
Course Duration: 35 Lectures of one hour each.
Note for the Paper setter: The question paper should be divided into Section A and Section B Total
of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students
will be required to attempt 5 questions selecting at least 2 from each section.

1. RESEARCH METHODOLOGY

SECTION-A

Introduction: Meaning, Features, Objectives/Motives & types of Research; Attributes of good Research, Research Methods and Research Methodology; Research Process, Significance of Research in Managerial decision making. Research Design: Meaning, Characteristics and various concepts relating to research design and classification of research design, Importance. Measurement and Scaling: Data Types Nominal, Ordinal and Ratio scale; scaling techniques. Formulation of Hypothesis: Meaning, Characteristics and concepts relating to testing of Hypothesis (Parameter and statistic, Standard error, Level of significance, type-I and Type-II errors, Critical region**,** one tail and two tail tests); Procedure of testing Hypothesis. Numerical problems based on chi-square test and Ftest (variance ratio test only).

SECTION-B

Data Collection: Sources of Data-Primary/Secondary Methods of collecting data; direct personal interview, indirect oral interview, information through local agencies, mailed questionnaire method, schedule sent through enumerators; questionnaire and its designing and characteristics of a good questionnaire. Sampling Design: Meaning and need of Sampling, Probability and non-probability sampling design, simple random sampling, systematic sampling, stratified sampling, cluster sampling and convenience, judgment and quota sampling (non-probability), determination of sample size. Data Analysis & Interpretation: Introduction to Multivariate analysis- Multiple and partial correlation, multiple regression analysis (with two independent variables), specification of regression models and estimation of parameters, interpretation of results. Analysis of Variance (ANOVA)-One way and Two way ANOVA. Introduction to discriminant analysis and Factor Analysis (Numerical not to be asked) Report writing: Style/format, contents and essential steps for report writing.

Books Recommended:

1. K.N. Krishna Swamy Appa Lyer Siva Kumar M. Mathirajan: Management Research Methodology,
Pearson Education,66 0 G[ )]TJETQ E2i0 G7ŸMCID 21ŽBDC q0. ucation,6 1t53( )]y Tf1 0 0 1 434.83 181.46 Tm

3. Donald R. CooperPamela S. Schindler: Business Research Methods, Tata McGraw Hill
4. Michael Riley et.al: Researching & Writing dissertation in Business & Management, Thomson Learning.
5. R. Pannerselvam: Research Methodology, Parentice Hall of India Limited.
6. R. Nandagopalet.al.:Research Methods in Business, ExcelBooks.
7. William G.Zikmund :Business Research Methods, Thomson South Western Publication
8. C.R. Kothari:Research Methodology-Methods &Techniques.
9. K.V. Rao:Research Methodoloty in Commerce &Management.

2. INDUSTRIAL SAFETY & HAZARDS

SECTION-A

Definitions, identifications, Classifications and assessment of various types of hazards in work-place environment. Protective and preventive measures in hazard control. Toxic chemicals: Maximum allowable concentrations and other standards. Biological threshold limit values.
Mechanical and electrical hazards, personal protective equipments.

SECTION-B

Explosive and inflammable substances. Radioactive hazards. Fire prevention. Good housing keeping in industrial environment. Standard safety procedures and disaster control. Indian legislation on safety and prevention of hazards and safety code. Case study of typical hazardous industry.

Books Recommended:

1. Wells, G.L : Safety in process

3. WASTE MANAGEMENT IN INDUSTRY

SECTION-A

INTRODUCTION

Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health – Environmental legislations related to prevention and control of industrial effluents and hazardous wastes

5. CHEMICAL

Paper Title: ORGANIC SPECTROSCOPY LAB (Practical)
Paper Code: ICH 3.5 Max. Marks 25 Credits: 1 Time: 2 hours

This laboratory work involves; Manual skills; studies on Organosilicon complexes, Schiffs bases and their complexes, Manual skill