SYLLABI FOR MASTER OF SCIENCE INDUSTRIAL CHEMISTRY)
EXAMINATIONS 2023-202

SCHEME OF TEACHING AND EXAMINATION

Paper   **Subject**   **Teaching**

SCHEME OF TEACHING AND EXAMINATION

Paper	Subject	Teaching Hrs. per Week				End Term	Mid Term	Total Marks
SECOND SEMESTER		L	T	P	C			
ICH 2.1	Chemical Engineering-II (Heat & Mass Transfer)	3	1	-	4	50	50	100
ICH 2.2	Industrial Pollution Control	3	-	-	3	50	50	100
ICH 2.3	Pharmaceutical Chemistry	3	-	-	3	50	50	100
ICH 2.4	Physical Chemistry	4	-	-	4	50	50	100
ICH 2.5	Thermodynamic and Reaction Engineering	3	1	-	4	50	50	100
Practicals								
ICH 2.6	Heat & Mass Transfer Lab	-	-	2	1	-	50	50
ICH 2.7	Physical Chemistry Lab.	-	-	2	1	-	50	50
	Total	**1**	**2**		**20**	**2 0**	**3 0**	**00**

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SCHEME OF TEACHING AND EXAMINATION

Paper	Subject	Teaching Hrs. per Week			End Term	Mid Term	Total Marks
FOURTH SEMESTER		L	P	C			
ICH 4.1	Thesis	-	30	12	-	-	-
Total		**-**	**30**	**12**	**-**	**-**	**-**

NOTE

The student is required to make seminar presentation(s) of the results achieved before the submission of the thesis.

1. No marks are assigned to Thesis evaluation work. On successful completion and presentation of Research Seminars, the candidate will be awarded 'S' grade i.e. satisfactory or else 'X' grade i.e. unsatisfactory.

2. The thesis will be evaluated by Post Graduate Student Research Committee (PGRC) of the Institute. The constitution of the committee is as under:
   a. Chairperson of the institute
   b. Senior professor of the institute
   c. Supervisor(s)
   d. External examiner

3. The PGRC will evaluate the final thesis based on an open house presentation by the student, which will be attended by the faculty members, PG students and other research scholars of the institute.

4. Requirement for the award of M.Sc.(Industrial Chemistry) is 70 credits with a minimum of CGPA of 6.0 and successful completion of thesis work.

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SYLLABUS FOR
MASTER OF SCIENCE INDUSTRIAL CHEMISTRY)

FIRST SEMESTER

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UNIT-I CO1)

Importance of Instrumentation in Industry. Elements of instruments.

Static and Dynamic Characteristics of Instruments¸ Desirable and undesirable

Temperature measurement¸ Expansion thermometers– bimetallic thermometers, pressure spring thermometers. Thermocouples, resistance thermometers, optical and radiation pyrometers.

UNIT-II CO2)

Liquid level measurement¸ Direct measurement of liquid level, level measurement in open vessels: Bubbler system, diaphragm box system, air trap system, level measurement in pressure vessels: Differential pressure manometer, use of liquid seals with a manometer,

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Title	Organic Synthesis (Theory)		Credits	04
Paper Code	ICH 1.	Semester .-1st	L TP	4 --
Max.Marks	End term- 0	Mid term- 0	Elective	N
Pre requisites			Contact Hours	60

THEORY	
Note for the Examiner	**Question No. 1, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of the Questions 2 to) will be divided into FOUR Units having TWO questions each and candidate is required to attempt at least ONE question from each Unit. The duration of End Term exam will be 3 hrs.**
Course Objectives	1.To learn organic reagents in organic synthesis. 2..Learn and understand mechanism and stereochemistry of aliphatic nucleophilic substitution reactions. 3. To learn the detail mechanism of aromatic electrophilic and nucleophilic substitution reactions and different name reactions. 4. To know about the concept of pericyclic reactions .
Course outcomes	On completion of this course, students will be able to: CO1. Learn the applications of reagents for organic synthesis. CO2. Learn different mechanisms and stereochemistry of aliphatic nucleophilic substitution reactions. CO3.Understand the mechanism of aromatic substitution reactions (electrophilic and nucleophilic) and different name reactions CO4. Understand the basic concept of different peri

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Aliphatic Nucleophilic Substitution

The SN2, SN1, mixed SN1 and SN2 and SET mechanisms. The neighbouring group mechanism, neighbouring

group participation by   and

g

Unit 1

: Complexes-formationconstants; chelates– EDTA,Chelon

Effect, EDTA equilibria, effect of pH on EDTA equilibria, EDTA titration curves, Importance of complexometric titrations.(6)

: Introduction , principle and classification of techniques.
Thin layer and Paper chromatography – principle and application.ColumnChromatography–
Factorsaffectingcolumnefficiencyandapplications.Gas–liquidchromatography–theory,instrumentationandapplications .HPLC–
theory instrumentation,columnefficiency and applications.(6)

Unit 2

:Principle,classificationofmethods.

TGA – Principle,Instrumentationandapplications

: Principle, Theory: molecular vibrations ,vibrational frequency, selection rules, factors affecting vibrational frequency ,finger print region, identificationoforganic compounds on the basis of infrared spectra.(6)

: Introduction, laws of absorption, origin of spectra, types of transitions,transition probability, factors affecting absorption,identification oforganic compounds based on Woodward-Fieser rules .(6)

Paper Code ICH 1.8   **Max. Marks 0 Credits 1**   **Time 2 hours**

1) Quantitative analysis and function group detection of unknown organic compounds containing multiple functional groups (nitrobenzaldehyde, nitroaniline, aminobenzoic acid)

2) Organic preparations:

(i)

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.

Paper Title¸ INDUSTRIAL POLUTION CONTROL Theory)

Note for the Paper setter¸ Question No. 1, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of the Questions 2 to) will be divided into FOUR Units having TWO questions each and candidate is required to attempt at least ONE question from each Unit. The duration of End Term exam will be 3 hrs.
COs:
CO1: Classify water pollutants, their sources and effects and Types of waste water treatment methods; primary to tertiary.
CO2: Analysis of methods/equipment utilized for waste water treatment and the design of physical/ chemical/ biological treatment methods for municipal sewage and industrial waste water treatment.

CO3: Describe principal air pollutants, their sources and effects and describe atmospheric dispersion of air pollutants

CO4: Demonstrate the construction, working and theory of equipment used for the control of air pollution. Classify solid wastes, their sources, effects and methods of disposal of solid wastes.

Syllabus

UNIT-I

Water pollution- Types of waste water, and sources of water pollutants. Calculation of water quality parameters (physical, chemical and biological) e.g. BOD, COD, DO,TDS, TSS, color, odor, turbidity, hardness, alkalinity, microbial activity. DO level in water bodies and its calculation. Calculation of Ultimate BOD, rate constant, critical DO level and BOD 5 days. Oxygen sag curve and nitrogenous BOD. Application of Thomas model. Wastewater sampling and its analysis. Water quality standards. Water prevention and control of pollution act, 1974, River water pollution and its impacts on aquatic like, lakes restoration and oxygen nano-bubbling. Anaerobic & aerobic biology, Desalination technology and membrane treatment.

UNIT-II

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 systems: Brief review about Coagulation and Filtration, Adsorption on Activatedcarbon, Ion exchange, Reverse osmosis, Electrodialysis, Nitrogen and Phosphorous removal.

Unit-III

 Air Pollution Classification and properties of major air pollutants, Effects of air pollution on human, plants and materials. Basic concept of Air pollution, Control methods for Particulate emission control, types of particulate matter, stability of atmosphere, types of inversions, types of plumes, Point, line and area sources, Gaussian plume model and its numerical applications. Buoyant and non-buoyant plumes,

Unit-IV

Particulate control equipments and their design, Gravitational settling chambers, Cyclone separators, Fabric filters, Electrostatic precipitators, Wet scrubbers.Solid Waste Management Types of solid wastes and sources. Methods of solid waste management: Sanitary landfill, Incineration and Concept of Recycling.

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EXAMINATIONS 2023-202

Ionic Interaction: Non-ideal behavior of electrolyt

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Note for the Paper setter, Question No. 1, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of the Questions 2 to) will be divided into FOUR Units having TWO questions each and candidate is required to attempt at least ONE question from each Unit. The duration of End Term exam will be 3 hrs.

Unit I

- Demonstrate an understanding of the first law of thermodynamics and its application to closed systems.
- Explain the concepts of internal energy, energy balance, thermodynamic state, and equilibrium.
- Apply the phase rule and analyze reversible and irreversible processes.
- Calculate enthalpy and understand heat capacity.

Unit II

- Describe the PVT behavior of pure substances.

- Analyze heat effects and their impact on thermodynamic processes.
- Apply thermodynamic principles to analyze volumetric properties of pure fluids.

- Analyze the thermodynamic properties of fluids using relations for homogeneous phases.
- Calculate and io pmee leuiqupc ptoerties bosedtin equatou

Paper Code ICH 2.
Max. Marks 0   **Credits 1**   **Time 2 hours**

General study of heat and mass transfer equipment in the Chemical Engineering Lab.
Determination of heat transfer co-efficient for different types of heat transfer equipment. Wilsonplots.
Correlation of instantaneous heat transfer coefficients with time, study of deposition of scale on a heating surface.
Heat losses for insulated pipes
Duhring's plot for solutions involving nonvolatile solutes.
Mass transfer coefficients for naphthalene-air system.
Drying rate curves for different wet materials.
Verification of Rayleigh's equation for differential distillation. Flooding velocities in packed
columns. Determination of HETP for packed distillation columns.

Title	**PHYSICAL CHEMISTRY PRACTICAL**		Credits	
Code	**ICH 2.**		1	
Max.Marks	50			
Pre requisites	-			

Objectives

The students shall
- Understand physical properties of various solvents
- Learn to perform conductometric and titrations
- Learn to perform potentiometric titrations
- Learn to use a Colorimeter
- Learn basic concept of polarography
    1. Surface tension method used to find volume percentage of ethanol in its solution in benzene using Stalagmometer

    2. Determination of cell constant

    3. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid like acetic acid by conductivity measurements.

    4. To verify Debye-Huckel Onsager equation
    5. To study the effect of ionic strength on mean ionic

Khosla, B. D.; Garg, V. C. & Gulati, A. (2011).   R. Chand & Co.: New Delhi

Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *E*   *E*   McGraw- Hill: New York (2003).

Halpern, A. M. & McBane, G. C. *E*   *E*   W.H. Freeman & Co.: New York (2003).

SEMESTER THIRD   Paper Title˛ ORGANIC SPECTROSCOPY
Paper Code˛ ICH 3.1   Max. Marks   0
Credits˛   Time˛ 3 hours

Note for the Paper setter˛ Question No. 1, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of the Questions 2 to) will be divided into FOUR Units having TWO questions each

systems, Chemical shift reagents, Chiral resolving agents, NMR imaging, Chemically induced dynamic polarisation (C.I.D.N.P)

UNIT-IV

Mass Spectrometry, Theory of mass spectrometry, Instrumentation, Electron and chemical Ionization (EI and CI), Metastable peaks, Isotope peaks, Index of hydrogen deficiency, Nitrogen Rule. Fragmentation patterns of some functional group in organic molecules: alkanes, alkenes, alcohols, ketones, carboxylic acids, amides, aromatic hydrocarbons, phenols, Mclafferty rearrangement. Introduction of modern techniques used in Mass Spectrometry: Principle and application: Fast atom bombardment Ionization (FAB-MS), Liquid in Secondary ion mass spectrometry (LSIMS), Matrix assisted laser desorption/ ionization (MALDI), Electron Spray Ionization (ESI-MS). Application of mass spectrometry in solving structural problems of simple organic molecules.

Suggested Books MASTER OF SCIENCE   INDUSTRIAL CHEMISTRY) EXAMINATION 2020-2022

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

Paper Title ̦ Chemical Technology
Paper Code ̦ ICH 3.2
Max. Marks 0   **Credits ̦ 3**   **Time ̦ 3 hours**
Course Duration ̦ 3   Lectures of one hour each

Note for the Examiner ̦ Question No. 1, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of the Questions 2 to) will be divided into FOUR Units having TWO questions each and candidate is required to attempt at least ONE question from each Unit. The duration of End Term exam will be 3 hrs.

Unit-I

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

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

Unit-II

Introduction, Raw Materials, types of pulp, Manufacture of paper.

: Introduction; Sugar extraction, defacation, sulphitation, carbonation, concentration, crystallization, drying, refining; Uses of molasses and bagasse.

Unit-III

: Introduction, Manufacture of sulphuric acid by Chamber and Contact process, Material of construction, Storage and handling.

: Cement-Types of cement, Constituents of cement, Manufacture of Portland cement. Glass-Introduction, Types of glass, Raw materials, Manufacture of glass.

Unit-IV

Introduction, Properties of ceramics, Classification of refractories, Important steps involved in the manufacture of refractories.

: Nitrogeneous fertilizers- Manufacture of Ammonia, Nitric acid, Urea, CAN, Ammonium Sulphate. Phosphatic fertilizers- superphosphate and triple superphosphate.Potassic fertilizers- Potassium Chloride and Potassium Sulphate, Safety aspects.

Course Outcomes

Upon completion of this course, the students will be able to

1. To understand extraction, refining, and hydrogenation of oil and fats, and soap anddetergent manufacturing.
2. To understand the production of pulp and paper, and sugar manufacturing.
3. To understand the production of sulphuric acid, cement and glass,
4. To understand the manufacturing of ceramics, and fertilizers.

Books Recommended

1. Shreev, R.N. & Brink, J.A.   : Chemical Process Industries, 5th Edition,McGraw Hill, 1987.

2. Austine, G.T.   : Shreeves Chemicals Process Industries, 5th

Focus on: Brunauer-Emmett-Teller (BET) technique, Transmission Electron Microscopic techniques, Auger Electron Spectroscopy, Xray Photoelectron Spectroscopy. Electron Energy Loss Spectroscopy.

Deformation behaviour of nanomaterials. Fracture and creep. Nanomechanics and nanotribology. Electrical, Magnetic and Optical properties.

Books Recommended

1. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.
2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
3. Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.
4. Additional Reading: Encyclopedia of Nanoscience and Nanotechnology, Ed.:Hari Singh Nalwa, American Scientific Publishers, 2004.

RENEWABLE ENERGY

Note for the Paper setter¸ Question No. 1, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of the Questions 2 to) will be divided into FOUR Units having TWO questions each and candidate is required to attempt at least ONE question from each Unit. The duration of End Term exam will be 3 hrs.

Unit I

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.

Unit II

Solar Photo voltaic and thermal systems

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds.-Thermal Energy storage system with Phase Change Mat

Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

Unit IV

Other energy sources
Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell :Principle of working- various types – construction and applications. Energy Storage System- Hybrid Energy Systems.

Books Recommended

1. Rai G.D. , Non-Conventional Energy Sources, Khanna Publishers, 2011
2. Twidell and Wier, Renewable Energy Resources, CRC Press (Taylor and Francis), 2011

NUMERICAL ANALYSIS
Note for the Paper setter, Question No. 1, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of the Questions 2 to) will be divided into FOUR Units having TWO questions each and candidate is required to attempt at least ONE question from each Unit. The duration of End Term ex- .3 0 1 c) 3 a)- .0 0 .-3.0120 e)TJ 22ϴϵ 0 Td x- .3 0 1 c) 20 ,)-

Unit I
Solution of Algebraic and Transcendental Equations Bisection Method, Method of False Position, Iteration Method / Fixed Point Iteration Method, Newton-Raphson Method.**0 hrs**. **Finite Differences**: Forward, Backward and Central Differences**,** Differences of a Polynomial, Factorial Notation.   **0 hrs.**

Unit II
Interpolation. Newton's Formulae for Forward and Backward Interpolation, Central Difference Interpolation Formulae: Stirling's Formula, Bessel's Formula, Interpolation with unevenly Spaced Points:Lagrange's Interpolation Formula, Divided Differences, Newton's Divided Difference Formula. 0 **hrs.** **Inverse Interpolation.** Lagrange's Method, Iterative Method. **03hrs.**

Unit III

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INDUSTRIAL SAFETY & HAZARDS

Adsorption - Removal of dissolved inorganics – Combined treatment of industrial and municipal wastes – Residue management – Dewatering - Disposal

Unit IV
HAZARDOUS WASTE MANAGEMENT
Hazardous wastes - Physico chemical treatment – solidification – incineration – Secured land fills

Books Recommended:

Moister, pH, total nitrogen, phosphorous, silica, lime, Magnesia, Manganese, sulfur and alkali salts. Fuel analysis: Solid, liquid and Gas , ultimate and proximate analysis heating values , grading of cool , liquid fuels , flasks points , aniline point , octane number and carbon residue , gaseous fuels – producer gas and water gas – calorific value.

Unit II

Clinical Chemistry. Composition of blood collection, andpreparation of samples, clinical analysis – serum electrolytes, blood glucose, bloodurea nitrogen, uric acid, albumin, globulin, barbiturates, acidic and alkaline phosphates,Immunoassay , principals of radiimmunoassy and applications. The blood- gas analysis –trace elements in the body.

Unit III

Drug analysis: Narcotics and dangerous drugs, classification of drugs, screening by gas m thin layer chromatography and spectrophotometric analysis. Introduction to Fluorescence, instrumentation and its application in Biological, Medical and Drug Development.

Unit IV

Food analysis . Moister, ash, crude protein, fat, crud fiber, carbohydrate, calcium,potassium, sodium, and phosphates, food adulteration – common adulteration in food,contamination of food stuffs, microscopic examination of foods for adulterants,Pesticide analysis in food products, Extraction and purification of sample, HPLC, gas chromatography for organo – phosphates, thin layer chromatography for identification ofchlorinated pesticides in food products

Books Recommended.

1. Fundamentals of analytical chemistry by D. A. Skoog , D. M. West and F. J. Honer, W. B. Saunders.
2. Chromic phenomenon , The Technological application of color chemistry Peter,Bamfield

Paper Code. ICH 3.   Max. Marks 0 Credits. 1   Time. 2 hour

   Paper Title: CHEML23(m)18.9636(i)0.89126–A89126(E)-3Li Tl

5. Cement: Loss of ignition, silica, insolubles, estimation of Mg, Ca, Fe.