

STATE BOARD OF TECHNICAL EDUCATION, BIHAR

Scheme of Teaching and Examinations for IVth SEMESTER DIPLOMA IN CHEMICAL ENGINEERING (Effective from Session 2020-21 Batch)

THEORY

| Sr. No. | SUBJECT | SUBJECT CODE | TEACHING SCHEME | EXAMINATION-SCHEM | | | | | | | |
|-----------------|-------------------------------------|--------------|-----------------|-------------------|----------------|----------------------------------|------------------------|----------------------------------|---------------------|----------------|---------------------------|
| | | | | Periods per Week | Hours of Exam. | Teacher's Assessment (TA) MarksA | Class Test (CT) MarksB | End Semester Exam. (ESE) Marks C | Total Marks (A+B+C) | Pass Marks ESE | Pass Marks in the Subject |
| 1. | Process Heat Transfer | 2014401 | 04 | 03 | 10 | 20 | 70 | 100 | 28 | 40 | 03 |
| 2. | Chemical Engineering thermodynamics | 2014402 | 04 | 03 | 10 | 20 | 70 | 100 | 28 | 40 | 03 |
| 3. | Mass Transfer – I | 2014403 | 03 | 03 | 10 | 20 | 70 | 100 | 28 | 40 | 03 |
| 4. | Chemical Technology | 2014404 | 03 | 03 | 10 | 20 | 70 | 100 | 28 | 40 | 03 |
| 5. | Plant Utilities | 2014405 | 03 | 03 | 10 | 20 | 70 | 100 | 28 | 40 | 03 |
| Total: - | | | 17 | | | | 350 | 500 | | | 15 |

PRACTICAL

| Sr. No. | SUBJECT | SUBJECT CODE | TEACHING SCHEME | EXAMINATION-SCHEME | | | | | | |
|-----------------|------------------------------|--------------|-----------------------------------|--------------------|----------------|-----------------|-------------|-------------------|---------------------------|---------|
| | | | | Periods per Week | Hours of Exam. | Practical (ESE) | | Total Marks (A+B) | Pass Marks in the Subject | Credits |
| | | | | | | Internal(A) | External(B) | | | |
| 6. | Heat Transfer Lab | 2014406 | 04 50% Physical 50% Virtual | 03 | 15 | 35 | 50 | 20 | 02 | |
| 7. | Chemical Engineering Drawing | 2014407 | 04 50% Physical 50% Virtual | 03 | 15 | 35 | 50 | 20 | 02 | |
| Total: - | | | 08 | | | | 100 | | 04 | |

TERM WORK

| Sr. No. | SUBJECT | SUBJECT CODE | TEACHING SCHEME | EXAMINATION-SCHEME | | | | | |
|---|---|--------------|-----------------|--------------------|--------------------------------|--------------------------------|-------------------|---------------------------|-----------|
| | | | | Periods per Week | Marks of Internal Examiner (X) | Marks of External Examiner (Y) | Total Marks (X+Y) | Pass Marks in the Subject | Credits |
| 8. | Course Under Moocs / Swayam/Others (TW) | 2014408 | 04 | 15 | 35 | 50 | 20 | 02 | |
| 9. | Minor Project (T.W) | 2014409 | 04 | 15 | 35 | 50 | 20 | 01 | |
| 10. | Summer Internship – II (4 weeks) (T.W) | 2014410 | - | 15 | 35 | 50 | 20 | 02 | |
| Total: - | | | 08 | | | 150 | | 05 | |
| Total Periods per week Each of duration One Hour | | | | 33 | Total Marks = | | | 750 | 24 |

PROCESS HEAT TRANSFER

| Subject Code 2014401 | Theory | | | | | | Credits |
|-------------------------|-------------------------|---|-----|------------|----|-----|---------|
| | No. of Periods Per Week | | | Full Marks | : | 100 | 03 |
| | L | T | P/S | ESE | : | 70 | |
| | 04 | — | — | TA | : | 10 | |
| — | — | — | CT | : | 20 | | |

COURSE CONTENT:

| | |
|-----------------|--|
| UNIT-I | Basic modes of heat transfer and the laws governing them. Steady state conduction through plane and composite walls general heat conduction equation, concepts of thermal diffusivity and equivalent thermal conductivity. |
| UNIT-II | Convection – Dimensional analysis and empirical correlations, Critical insulation thickness for cylindrical and spherical surfaces, Physical significance of the dimensionless groups. |
| UNIT-III | Thermal Radiation laws, spectrum of electromagnetic radiation, Black and Gray bodies and configuration factor – typical examples. Boiling and condensation. |
| UNIT-IV | Heat Exchangers – classification, overall and individual film coefficients, mean temperature difference, LMTD correction factor for multiple pass exchanger. |
| UNIT-V | Evaporation, single and multiple effect operation, material and Energy balance in evaporators, boiling point elevation, Duhring’s rule, effect of liquid head. |

REFERENCE BOOKS:

1. DC. Sirdar, “Process Heat Transfer and Chemical Equipment Design”, Revised Ed., Khanna Publishing House
2. W. L. McCabe and J. C. Smith, “Unit Operations in Chemical Engineering”, 7th Ed., McGraw Hill Publishing Co.
3. Binay K. Dutta, “Heat Transfer Principles and applications” Prentice Hall of India Pvt. Ltd.
4. C. M. Narayanan & B. C Bhattacharya, ‘Unit operations and Processes’ Vol-I, CBS Publishers & Distributors, 2006

CHEMICAL ENGINEERING THERMODYNAMICS

| | | | | | | |
|---------------------------------------|--------------------------------|----------|------------|-------------------|----------|------------|
| Subject Code 2014402 | Theory | | | Credits | | |
| | No. of Periods Per Week | | | Full Marks | : | 100 |
| | L | T | P/S | ESE | : | 70 |
| | 04 | — | — | TA | : | 10 |
| | — | — | — | CT | : | 20 |
| | | | | | | 03 |

COURSE CONTENT:

| | |
|-----------------|---|
| UNIT-I | Introduction to Basic laws and Terminologies in Thermodynamics- Statement of First law, P-V-T behavior of pure fluids - Heat effects accompanying chemical Reactions - Statements of second law- Clausius Inequality-Mathematical Statement of Second law-Third Law of Thermodynamics. |
| UNIT-II | Applications to Laws of Thermodynamics - Flow processes: Flow in pipes, Flow through nozzles, Compression- Refrigeration |
| UNIT-III | Thermodynamic Properties of Pure Fluids- Classification of Thermodynamic properties – Work function and Gibb’s Free Energy-Fundamental Property relations-Maxwell’s equations Clapeyron equation- -Differential equations of Entropy Relationship between Cp and Cv-Effect of pressure and volume on Cp and Cv- Gibb’s Helmholtz Equation. |
| UNIT-IV | Thermodynamic Properties of Solutions - Introduction to fugacity and activity, Activity Coefficients-Partial molar properties- Lewis Randall rule-Roult’s and Henry’s law-Gibbs Duhem Equation. |
| UNIT-V | Phase Equilibria and Chemical Reaction Equilibria - Criteria for phase equilibrium, Criterion of stability, Phase equilibria in single and multiple component systems, Duhem’s theorem, VLE for Ideal solutions, Reaction Stoichiometry-Equilibrium constant- Feasibility of reaction- Effect of temperature, pressure, volume and other factors. |

REFERENCE BOOKS:

1. J.M. Smith, Hendrick Van Ness, Michael M. Abbott, Introduction to Engineering Thermodynamics, McGraw Hill, New York.
2. K.V. Narayanan, A Textbook of Chemical Engineering Thermodynamics, PHI Learning, New Delhi.
3. S. Sundaram, Chemical Engineering Thermodynamics, Ahuja Publishers, New Delhi.

MASS TRANSFER – I

| | | | | | | | |
|---------------------------------------|-------------------------|---|-----|------------|---|-----|---------|
| Subject Code 2014403 | Theory | | | | | | Credits |
| | No. of Periods Per Week | | | Full Marks | : | 100 | 03 |
| | L | T | P/S | ESE | : | 70 | |
| | 03 | — | — | TA | : | 10 | |
| | — | — | — | CT | : | 20 | |
| | | | | | | | |

COURSE CONTENT:

| | |
|-----------------|--|
| UNIT-I | Definition- Fick's law, Molecular and eddy diffusion, Diffusion in gaseous mixtures, liquid mixtures and solids, measurement and calculation of diffusivities. Mass transfer coefficients - Individual and overall, with relations, Theories of mass transfer, Analogies between momentum, heat and mass transfer to predict mass transfer coefficients. |
| UNIT-II | Absorption – Solubility, theory of gas absorption, Concept of Equilibrium and operating lines. Mass Transfer Equipment's Batch and continuous, Stage wise contactors and Differential contactors, Concept of HTU and NTU, Tower packings and packing characteristics. |
| UNIT-III | Humidification Theory, Psychometric Chart, Adiabatic Saturator, Wet Bulb Theory, Methods of Humidification and dehumidification, Cooling towers. |
| UNIT-IV | Drying Theory and Mechanism, Drying Characteristics, Estimation of Drying time, drying rate curve, Classification of Driers, Description and Application of Driers, Continuous driers. |
| UNIT-V | Crystallization, Solubility curve, Types of crystals, Principles of Crystallization, Supersaturation Theory, Factors governing nucleation and crystal growth. Theory of crystallization, Classification of crystallizers and their applications. |

REFERENCE BOOKS:

1. Binay. K.Dutta “ Principles of Mass Transfer and Separation Processes”., PHI Learning
2. R.E. Treybal, “Mass Transfer Operations”, McGraw Hill Book Co., New York.
3. N. Anantharaman and K.M.Meera Sheriffa Begum, “Mass Transfer Theory and Practice”, Prentice Hall of India Pvt. Ltd., New Delhi.
4. J. M. Coulson and J. F. Richardson, “Chemical Engineering”, Vol. II, Butterworth Heinemann, New York.
5. W.L. McCabe, J.C. Smith and P. Harriot, “Unit Operations of Chemical Engineering”, McGraw Hill Book Co., New York.

CHEMICAL TECHNOLOGY

| | | | | | | | | |
|---------------------------------------|--------------------------------|----------|------------|-------------------|----------|------------|----------------|-----------|
| Subject Code 2014404 | Theory | | | | | | Credits | |
| | No. of Periods Per Week | | | Full Marks | : | 100 | | 03 |
| | L | T | P/S | ESE | : | 70 | | |
| | 03 | — | — | TA | : | 10 | | |
| | — | — | — | CT | : | 20 | | |

COURSE CONTENT:

| | |
|-----------------|--|
| UNIT-I | Natural Products Processing: Production of pulp, paper and rayon, Manufacture of sugar, starch and starch derivatives, Gasification of coal and chemicals from coal. |
| UNIT-II | Industrial Microbial Processes and Edible Oils: Fermentation processes for the production of ethyl alcohol, citric acid and antibiotics, Refining of edible oils and fats, fatty acids, Soaps and detergents. |
| UNIT-III | Alkalies and Acids: Chlor - alkali Industries: Manufacture of Soda ash, Manufacture of caustic soda and chlorine - common salt. Sulphur and Sulphuric acid: Mining of Sulphur and manufacture of Sulphuric acid. Manufacture of hydrochloric acid. |
| UNIT-IV | Cement Gases, Water and Paints: Types and Manufacture of Portland cement, Glass: Industrial gases: Carbon dioxide, Nitrogen, Hydrogen, Oxygen and Acetylene - Manufacture of paints – Pigments. |
| UNIT-V | Fertilizers: Nitrogen Fertilizers; Synthetic ammonia, nitric acid, Urea, Phosphorous Fertilizers: Phosphate rock, phosphoric acid, super phosphate and Triple Super phosphate. |

REFERENCE BOOKS:

1. R. Gopal and M. Sittig, "Dryden's Outlines of Chemical Technology: For The 21st Century" Third Edition, Affiliated East-West Publishers.
2. G.T. Austin, "Shreve's Chemical Process Industries", McGraw Hill, New York.
3. O.P. Gupta, "Chemical Process Technology", Khanna Publishing House
4. W.V.Mark, S.C. Bhatia "Chemical Process Industries volume I and II" CBS Publishers & Distributors
5. S. D. Shukla and G. N. Pandey, "Text book of Chemical Technology" Vol 2, Vikash

PLANT UTILITIES

| Subject Code 2014405 | Theory | | | Credits | | |
|--------------------------------|-------------------------|---|-----|------------|---|-----|
| | No. of Periods Per Week | | | Full Marks | : | 100 |
| | L | T | P/S | ESE | : | 70 |
| | 03 | — | — | TA | : | 10 |
| | — | — | — | CT | : | 20 |

COURSE CONTENT:

| | |
|-----------------|---|
| UNIT-I | IMPORTANT OF UTILITIES: Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water. |
| UNIT-II | STEAM AND STEAM GENERATION: Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories. |
| UNIT-III | REFRIGERATION: Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluoro Methane, Chlorofluoro Carbons and Brins. Refrigerating Effects and Liquefaction Processes. |
| UNIT-IV | COMPRESSED AIR: Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Velocity Diagram for Centrifugal Compressor, Silp Factor, Impeller Blade Shape. Properties of Air –Water Vapors and use of Humidity Chart. Equipment’s used for Humidification, Dehumidification and Cooling Towers. |
| UNIT-V | FUEL AND WASTE DISPOSAL: Types of Fuel used in Chemical Process Industries for Power Generation such as Natural Gas, Liquid Petroleum Fuels, Coal and Coke. Internal Combustion Engine, Petrol and Diesel Engine. Waste Disposal. |

REFERENCE BOOKS:

1. P. L. Ballaney, “Thermal Engineering”, Khanna Publisher New Delhi.
2. Perry R. H. Green D. W. “Perry’s chemical Engineer’s Handbook”, McGraw Hill, New York,.
3. D B DHONE, “Plant utilities” Nirali Prakashan.
4. P. N. Anantha narayan, “Basic Refrigeration & Air-Conditioning”, Tata McGraw Hill, New Delhi.
5. Sadhu Singh, Refrigeration & Air-Conditioning, Khanna Publishing House. New Delhi

Heat Transfer Lab

| Subject Code 2014406 | Practical | | | Credits | | |
|-------------------------|-------------------------|---|-----|------------|---|----|
| | No. of Periods Per Week | | | Full Marks | : | 50 |
| | L | T | P/S | ESE | : | 50 |
| | — | — | 04 | Internal | : | 15 |
| | - | - | - | External | : | 35 |

COURSE CONTENT

| | |
|-----|---|
| 1. | Temperature distribution in a metal rod |
| 2. | Radiation |
| 3. | Forced convective heat transfer |
| 4. | Shell and Tube Heat exchanger |
| 5. | Condenser |
| 6. | Open pan evaporator |
| 7. | Thermal Conductivity of metal rod |
| 8. | Natural convective heat transfer |
| 9. | Double pipe heat exchanger |
| 10. | Plate Heat Exchanger |
| 11. | Heat Transfer in Jacketed Kettle |

REFERENCE BOOKS

1. Lab Manual
2. W. L. McCabe, J.C. Smith and P. Harriott, "Unit operations of Chemical Engineering", McGraw Hill, International Edn.,
3. G Chandrasekhar, Laboratory Experiments in Chemical and Allied Engineering: Penram International Publishing (India) Pvt. Ltd.,

Chemical Engineering Drawing

| Subject Code 2014407 | Practical | | | | | | Credits |
|--------------------------------|-------------------------|---|----------|------------|----|----|---------|
| | No. of Periods Per Week | | | Full Marks | : | 50 | 02 |
| | L | T | P/S | ESE | : | 50 | |
| | — | — | 04 | Internal | : | 15 | |
| - | - | - | External | : | 35 | | |

COURSE CONTENT:

| | |
|-----------------|--|
| UNIT-I | P & ID symbols – Line numbering – line scheduling – Typical P & ID diagrams, Different types of valves, Pumps, Gland & Stuffing box. |
| UNIT-II | Drawing of vessels & supports such as bracket, saddle, skirt. |
| UNIT-III | Storage Tanks, Cyclone separators centrifuges, thickeners and filtration equipment's. |
| UNIT-IV | Crystallizers, agitated vessel, jacketed and coil heated vessels. |
| UNIT-V | Double Pipe & Shell & Tube Heat Exchangers, Tray Columns & Packed Columns. |

REFERENCE BOOKS:

1. D.C. Sikdar, "Process Heat Transfer & Chemical Equipment Design", Revised Ed. Khanna Publishing House
2. V. V. Mahajani and S. B. Umarjii, "Joshi's Process Equipment Design", Mac Millan Publishers India Limited, New Delhi,
3. R. K. Sinnott, "Chemical Engineering Design", Coulson and Richardson's Chemical Engineering Series, Volume-6, Fourth Edition, Butterworth-Heinemann, Elsevier, New Delhi, 2005.
4. R. H. Perry, "Chemical Engineers' Handbook", 7th Edn., McGraw Hill, New York, 1998.
5. B.C. Bhattacharyya, "Introduction to Chemical Equipment Design Mechanical Aspects", CBS Publishers & Distributors, New Delhi.

TERM WORK

COURSE UNDER MOOCS /SWAYAM / OTHERS (TW)

| Subject Code | Term Work | | | Full Marks | | | Credits |
|--------------|-------------------------|---|-----|------------|---|----|---------|
| | No. of Periods Per Week | | | Internal | : | 50 | |
| 2014408 | L | T | P/S | Internal | : | 15 | 02 |
| | — | — | 04 | External | : | 35 | |
| | - | - | - | - | : | - | |
| | - | - | - | - | : | - | |

MINOR PROJECT (T.W)

| Subject Code | Term Work | | | Full Marks | | | Credits |
|--------------|-------------------------|---|-----|------------|---|----|---------|
| | No. of Periods Per Week | | | Internal | : | 50 | |
| 2014409 | L | T | P/S | Internal | : | 15 | 01 |
| | — | — | 04 | External | : | 35 | |
| | - | - | - | - | : | - | |
| | - | - | - | - | : | - | |

Summer Internship – II (4 weeks) (T.W)

| Subject Code 2014410 | Term Work | | | | | | Credits |
|--------------------------------|-------------------------|---|-----|------------|---|----|---------|
| | No. of Periods Per Week | | | Full Marks | : | 50 | 02 |
| | L | T | P/S | Internal | : | 15 | |
| | — | — | - | External | : | 35 | |
| - | - | - | — | : | — | | |

