DEPARTMENT OF CHEMICAL ENGINEERING

FACULTY OF ENGINEERING & ARCHITECTURE

JAI NARAIN VYAS UNIVERSITY, JODHPUR

SYLLABUS

BACHELOR OF ENGINEERING

CHEMICAL ENGINEERING

(SEMESTER SCHEME)

FOUR YEAR INTEGRATED COURSE

B. E. II Year Examination, 2018 (Session 2017-18)

BE II Year (Chemical Engineering Department), 2017-18

SEMESTER III EXAMINATION SCHEME

Branch Code	Subject Code		Subject	Lectures	Tutorials	Practicals	Contact H.	Credits	Examination H.	Marks		
										Theory	Practicals and Sessionals	Total
A: Written Papers												
Ma	201	A	Mathematics-I (ChE)	2	-	-	2	2.0	3	100	-	100
ChE	202	A	Computer Oriented Numerical Analysis (ChE)	2	1	-	3	3.0	3	100	-	100
ChE	203	A	Fluid Flow Operation (ChE)	4	1	-	5	5.0	3	100	-	100
ChE	204	A	Chemical Engineering Thermodynamics (ChE)	3	1	-	4	4.0	3	100	-	100
ChE	205	A	Heat Transfer Operation-I (ChE)	4	1	-	5	5.0	3	100	-	100
Total (A)				**15**	**4**	**-**	**19**	**19.0**	**-**	**500**	**-**	**500**
B: Practicals and Sessionals												
ChE	221	B	Computer Oriented Numerical Analysis Lab (ChE)	-	-	3	3	1.5	3	-	100	100
ChE	222	B	Fluid Flow Operation Lab.(ChE)	-	-	3	3	1.5	3	-	100	100
ChE	223	B	Heat Transfer Operation-I Lab. (ChE)	-	-	3	3	1.5	3	-	100	100
ChE	224	B	Chemical Process Calculations Lab. (ChE)	-	-	3	3	1.5	3	-	100	100
Total (B)				**-**	**-**	**12**	**12**	**6.0**	**-**	**-**	**400**	**400**
Grand Total (A+B)				**15**	**4**	**12**	**31**	**25.0**	**-**	**500**	**400**	**900**

BE II Year (Chemical Engineering Department), 2017-18

SEMESTER IV EXAMINATION SCHEME

Branch Code	Subject Code		Subject	Lectures	Tutorials	Practicals	Contact H.	Credits	Examination H.	Marks		
										Theory	Practicals and Sessionals	Total
A: Written Papers												
Ma	251	A	Mathematics-II (ChE)	2	-	-	2	2.0	3	100	-	100
ChE	252	A	Chemical Equipment Design (ChE)	3	1	-	4	4.0	3	100	-	100
ChE	253	A	Chemical Technology - I	2	-	-	2	2.0	3	100	-	100
ChE	254	A	Heat Transfer Operation-II (ChE)	3	2	-	5	5.0	3	100	-	100
ChE	255	A	Process Instrumentation and Control (ChE)	2	1	-	3	3.0	3	100	-	100
			Open Elective – I*	3	-	-	3	3.0	3	100	-	100
			Total (A)	**15**	**4**	**-**	**19**	**19.0**	**-**	**600**	**-**	**600**
B: Practicals and Sessionals												
ChE	271	B	Chemical Analysis Lab. (ChE)	-	-	3	3	1.5	3	-	100	100
ChE	272	B	Chemical Equipment Design Lab.	-	-	3	3	1.5	3	-	100	100
ChE	273	B	Heat Transfer Operation-II Lab (ChE)	-	-	3	3	1.5	3	-	100	100
ChE	274	B	Process Instrumentation Control Lab (ChE)	-	-	3	3	1.5	3	-	100	100
			Total (B)	**-**	**-**	**12**	**12**	**6.0**	**-**	**-**	**400**	**400**
			Grand Total (A+B)	**15**	**4**	**12**	**31**	**25.0**	**-**	**600**	**400**	**1000**
ChE	200	E	**Co-curricular Activities	-	1	1	2	-	-	-	100	100

*List of Open Elective-I available for Chemical Engineering Department students for IV Semester (See Annexure I)

**Joint Award for BE III & IV Semester (Marks not counted for award of Division/ Degree)

MA 201 A: MATHEMATICS-I

(L-T-C : 2-0-2) **Max. Marks 100**

Section A

Differential equations : Simultaneous differential equations, Total differential equations, Partial differential equations of first order, Charpit's method, Linear partial differential equations with constant coefficient, Second order partial differential equations, Monge's method for the equation of type Rr + Ss + Tt = V.

Section B

Complex Analysis : Analytic function, Construction of an Analytic function, Cauchy – Riemann equations in Cartesian and Polar form. Complex integration, Cauchy's integral theorem, Cauchy's integral formula, Derivative of Cauchy's integral formula.

Taylor's and Laurent's series expansion of complex functions.

Cauchy's residue theorem and its applications for evaluation of the contour integrals of type $\int_0^{2\pi} f(\sin\emptyset,\ \cos\emptyset) \quad and \quad \int_{-\infty}^{\infty} f(x)dx.$

Section C

Probability and Statistics : Theorems of probability and their application, Binomial, Poisson and Normal probability distribution. Correlation and Regression analysis of two parameters.

ChE 202 A: COMPUTER ORIENTED NUMERICAL ANALYSIS

(L-T-C : 2-1-3) **Max. Marks 100**

Numerical solution of Linear Equations: Roots of Equations, Newton-Raphson method, False Position method, Bisection method, and Secant method.

System of Linear Equations: Solutions of simultaneous equations by Gaussian-elimination, Gauss-Jordan and Gauss-Seidal method.

Interpolation: Lagrange's interpolation, Newton's Forward and Backward interpolation, Difference tables.

Curve Fitting: Least square method (Polynomial, Trigonometric & Exponential).

Numerical Integration: Simpson's 1/3 rule, Trapezoidal method, Gauss Quadrature method.

Numerical Differentiation

Ordinary Differential Equation: Eulers, Runge Kutta second and fourth order, Predictor–corrector method, Finite-difference method.

Classification of Partial Differential Equations: Elliptical equation, 2D Laplace's equation for steady state problems (Only general Introduction).

Characteristic Equations: Estimation of Eigen values and Eigen Vectors of matrices (Only general Introduction). Programming approach (C++ programming)

ChE 203 A: FLUID FLOW OPERATIONS

(L-T-C : 4-1-5) **Max. Marks 100**

Basic principles: Units and dimensions, Properties of fluid, Classification of fluids – (Newtonian and Non-Newtonian fluid, Compressible and Incompressible fluids).

Fluid static: Fluid pressure & its measurement, Piezometers, Forces acting on immersed surfaces (Plane & Curved), Pressure diagrams.

Fluid dynamics: Laminar and turbulent flows, Conservation of mass, Continuity equation, Conservation of momentum and energy, Navier–stokes equation and its applications, Mechanical energy balance and Bernoulli's equation and its applications, Orifice meter and Venturi meter, impulse momentum equation and its application.

Dimensional analysis: Pi theorem, Dimensionless numbers and their physical significance, Similitude criterion. Introduction to boundary layer theory: Velocity distribution, Boundary layer calculations, and Boundary layer thickness.

Flow through orifices and mouthpieces: Classification of orifices and mouthpieces, Determination of the coefficient for an orifices, Energy and head losses of flowing liquid due to sudden changes in velocity.
Pipe Network: Specifications of standard pipes and tubes; Economic pipe diameter, Pipe fitting and valves, flow through pipes, Pressure drop, Friction factor, Darcy-Weishbach equation, Hydraulic Gradient Line (HGL) and Total Energy Line (TEL), Pressure drop in pipe network system, Hardy-Cross method.
Flow of compressible fluids: Isentropic expansion, Adiabatic, and Isothermal frictional flow.
Pumps, Blowers, and Compressors: Their types and basic working characteristics, their selection criteria, Cavitations, Net Positive Suction Head (NPSH).

ChE 204 A: CHEMICAL ENGINEERING THERMODYNAMICS

(L-T-C : 3-1-4) Max. Marks 100

Basic concepts: Review of laws of thermodynamics and their application to engineering process, Closed and Open system, Thermodynamics analysis chemical process. Thermodynamic properties of fluids and their inter-relationships: PVT behavior of pure substance, Viral and Cubic equation, Equation of state, generalized correlations and acentric factor, PVT behavior of mixture, Entropy, Gibb's energy and its role as generating function, Helmoltz Energy, Residual properties, Properties of single and two-phase systems, Relationship among thermodynamic properties. Refrigeration cycles: Vapour absorption and Compression cycles, selection of refrigerants. Multicomponent systems: Partial molar properties, chemical potential, Gibb's-Duhem equation, Ideal – non-ideal solutions. Raoults's & Henery's laws, Fugacity and fugacity coefficient. Excess properties of mixtures, Activity and activity coefficients, Gaseous mixtures and fundamental property relation. Phase equilibrium and stability: General criteria for equilibrium, phase equilibrium, phase rule and its derivation, vapour – liquid equilibrium (VLE), Azeatropes, Liquid- Liquid equilibrium (LLE), and vapour- solid phase equilibrium and solid- liquid equilibrium (SLE)) (only general types, characteristics and qualitative behavior of these equilibrium systems). Chemical reaction equilibrium: Reaction coordinate, Evaluation of equilibrium constants and effect of temperature on them, Standard Gibb's free energy change, calculation of equilibrium conversion for single and multi-reaction systems, phase rule and Duhem equation for reacting systems.

ChE 205 A: HEAT- TRANSFER OPERATIONS- I

(L-T-C : 4-1-5) Max. Marks 100

Mechanism of heat transfer: Heat transfer rate, Flux, Coefficient and Resistance.
Thermal conductivity: Fourier's law, Conduction through flat and cylindrical walls, Spherical objects and finned surfaces, Composite walls, Heat losses and insulation. Application of energy equation one dimension and two dimensions (series solution) steady and unsteady state conduction, Solution of partial differential equation using numerical techniques.
Natural and forced convection: Film coefficient; Heat transfer between solid and fluids, Dimensionless analysis, laminar and turbulent flows through pipes.
Heat transfer with phase change: Film wise and Drop wise condensation- Film wise condensation on vertical and inclined plate, Equations for horizontal and vertical tubes, Calculations for condensers.
Radiant energy – Distribution, Emissive power, Planck's law, Wein's displacement law, Stephen-Boltzman law, Black body, Kirchoff's law, Gray body, Exchange of energy between two surfaces-Large plates, Infinites cylinders, Geometric factors, Gas radiation.
Heat transfer in reactive system- Endothermic reaction, Exothermic reaction, Heat transfer in catalytic bed reactor.

Ma 251 A: MATHEMATICS – II

(L-T-C : 2-0-2) **Max. Marks 100**

Section A

Laplace Transform, Inverse Laplace Transform, Application of Laplace Transform to solve different equation with constant coefficients.

Section B

Numerical Analysis : Newton – Gregory interpolation formulae, Lagrange's interpolation formula. Central difference interpolation formulae : Gauss' forward and backward formulae, Stirling's and Bessel's interpolation formulae. Numerical integration : Trapezoidal rule, Simpson's 1/3 and 3/8 rule. Numerical solution of algebraic and transcendental equations : Bisection, regula falsi and Newton – Raphson methods. Numerical solution of linear simultaneous equations : Gauss' elimination, Gauss – Jordan, Jacobi and Gauss – Siedal methods. Numerical solution of ordinary differential equations : Euler's Runge – Kutta Fourth order and Milne's methods.

Section C

Special function : Series solution of Bessel and Legendre's differential equation. Generating function of Bessel and Legendre's Polynomials. Orthogonal Property of Bessel and Legendre's function. Rodrigue's formula

ChE 252 A: CHEMICAL EQUIPMENT DESIGN

(L-T-C : 3-1-4) **Max. Marks 100**

Theories of columns, Thermal stress, Membrane stresses in shells of revolutions, Stress concentration, Theories of failures.

General Design Consideration: Design code, Design pressure, Design temperature of cylindrical and spherical shells under internal and external pressures, Selection and design of flat plate, Spherical, Ellipsoidal conical closures.

Tall vertical vessels: Pressure, Dead weight, Wind, Earthquake and Eccentric loads and induced stresses, Combined stresses.

Vessel Supports: Design of skirt, lug and saddle supports. Design shell of supported vessel.

Liquid Storage Tanks: Classification, Storage tank codes, Design of shell, Bottom plates, Self-supported, and Column-supported roofs, Wind grinder, Nozzles.

High-pressure vessels: Stress analysis of thick walled cylindrical shell, Design of monoblock.

Flanges: Types of flanges and their selection, Gaskets.

Detailed process and mechanical design: Fixed and floating head shell and tube heat exchangers, Single and multiple effect evaporators, Plate and packed columns for distillation and absorption, Flash drum, Condenser cooling tower, Rotary drier, Fixed bed adsorption column, Cyclonic separator, Packed and fluidized bed reactors, Crystallizer, Setting tank, Piping network

ChE 253 A: CHEMICAL TECHNOLOGY-I

(L-T-C : 2-0-2) **Max. Marks 100**

Indian Chemical Industry: An Overview

High temperature processes: Manufacture of Cement, Glass.

Chlor alkali industries.

Oil, fats, and Waxes: Vegetable oils, Animal fats and oils, Waxes.

Soaps and Detergent.

Sugar and Starch.

Paper and Pulp Industries: Different pulping processes.

ChE 254 A: HEAT TRANSFER OPERATIONS – II

(L-T-C : 3-2-5) **Max. Marks 100**

Heat exchangers: Types of Heat Exchangers, Double-pipe Heat Exchanger- Parallel and counter-current flows, Shell and Tube Heat exchangers, LMTD, Equivalent diameter; NTU and Effectiveness, Fouling factors, Cross flow heat exchangers and it's application.

Design of Shell - Tube Heat Exchangers: Calculation of heat transfer coefficient and pressure drop.

Condensation of single vapors system and type of condenser.

Vaporizers, Evaporators and Reboilers: Forced and Natural circulation vaporizers (Kettle Reboiler), Reboilers arrangements, Heat flux and temperature difference, Single and multi-effect evaporators, BPR, Forward and Backward feeds, Calculations for chemical evaporators, Optimum numbers of effects. Batch and unsteady state heating arrangements in jacketed and agitated vessels.

ChE 255 A: PROCESS INSTRUMENTATION & CONTROL

(L-T-C : 2-1-3) **Max. Marks 100**

Introduction to process variables: Direct and Inferential measurement, On and off line measurement, Static and Dynamic characteristics of instruments and their general classification, Error, Accuracy, Repeatability, Drift, Threshold, Zero-stability etc., Interpretation of performance specification of transducers.

Working principle of instruments: Classification of sensors and transducers based on their principles of measurement, Building block of an instrument- Transducer, Amplifier, Signal conditioner, Signal transmitter, Data acquisition, I/O devices (general working principle only).

Instrumentation Systems: Working principle of transducers/instruments employed for the measurement of Flow, Level, Pressure, Temperature, Density, Viscosity, pH, Radiation, Composition, Humidity, Advantages and Disadvantages, Preparation of instrumentation diagrams, Instrumentation of important equipments like Distillation column, Heat exchanger, etc.

Construction and characteristics of final control elements: Introduction to Pneumatic, Hydraulic and Electronic controllers, Pneumatic control valves, Characteristics and sizing, motorized valve etc.

Signal transmission and Telemetry: Sampling, Multiplexing, Modulation and Demodulation, Basic principle of DAC and ADC, Pneumatic and Electronic Transmitter and their Advantages and Disadvantages.