IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Scheme & Syllabus Based on AICTE Flexible Curricula **(B. Tech)**

Chemical Engineering Department

Semester III (Second Year)

S. No.	Course Code	Course Title	Hrs./ week			Credits
			L	T	P	
1	PCC-CH301	Chemical Engineering Thermodynamics-I	3	1	0	4
2	PCC-CH302	Fluid Mechanics	3	1	2	4
3	PCC-CH303	Chemical Process Calculation	3	1	0	4
4	PCC-CH304	Fluid Particle Mechanics	3	1	2	4
5	HSMC-CH301	Industrial Psychology & Human Resource Management	3	0	0	3
6	ESC-CH301	Computer Programming	0	0	4	2
7	MC-CH301	Energy & Environmental Engineering	2	0	0	0
Total			**17**	**04**	**08**	**21**
Total Academic Engagement and Credits			**29**			**21**

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PCC-CH301	**III**	**Chemical Engineering Thermodynamics-I**	**3L: 1T: 0P (04hrs)**	**Credits:04**

Course objective-The objective of this course is to understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe, compression and expansion of fluids.

Course content-

MODULE 1: **(06 hrs)**

Basic concepts of work & heat system, properties and state of systems; first law of thermodynamics; application, batch flow processes; steady & unsteady state flow.

MODULE 2: **(12 hrs)**

Critical properties corresponding state compressibility, PVT behavior of pure fluids viral equation, cubic equation, generalized correlation & eccentric factor, behavior of liquid, second law of T.D, & its application. Adiabatic reactions, Equilibrium in homogeneous and heterogeneous reactions.

MODULE 3: **(08 hrs)**

Carnot cycle, Carnot theorem, thermodynamics temperature scales, concept of entropy, calculation of entropy for various systems, entropy for real system.

MODULE 4: **(05 hrs)**

Effect of pressure on specific heat, Joule Thompson effect, third law of thermodynamics & its applications.

MODULE 5: **(08 hrs)**

Compression & Expansion of fluids; single stage, multiple stage requirements & efficiency along with effect & engineering along with effects clearance, compression of real gas.

Course outcome-

1: Ability to understand basic concepts of thermodynamics and first law.
2: Capability to estimate PVT behaviors and critical properties of fluids.
3: To provide knowledge & application of second law of thermodynamics.
4: To provide knowledge & application of third law of thermodynamics.
5: To analyze effect of pressure on specific heat, compression & expansion of fluids.

Text/Reference Book-

1. K.V Narayanan (2010). A Textbook of Chemical Engineering Thermodynamics. (1st Edition). PHI learning private limited, New Delhi
2. J. M. Smith, H.C. Ness, M. Abbott (2009). Introduction to Chemical Engineering Thermodynamics. (7th Edition). McGraw Hill Education.
3. Daubert, T. E. (Thomas E.), 1937- Chemical Engineering Thermodynamics. (1st Edition McGraw-Hill) New York.

4. Stanley I. Sandler, Thermodynamics, 5th Edition, John Wiley & Sons 2017.

PCC-CH302	**III**	**Fluid Mechanics**	**3L: 1T: 2P (06hrs)**	**Credits:04**

Prerequisite(s): Engineering Mechanics

Course objective-The objective of this course is to understand basic concepts of fluid flow and its application to chemical process industries including pipe flow and fluid machinery.

Course content-

MODULE 1: **(09 hrs)**
Properties and classification of fluids; fluid statics: pressure at a point, pressure variation in static fluid absolute and gauge pressure, manometers, dimensional analysis and dynamic similitude dimensional homogeneity, use of Buckingham pi-theorem, calculation of dimensionless numbers.

MODULE 2: **(08 hrs)**
Fluid flow phenomena, introduction to non-Newtonian fluid; introduction to compressible flow. velocity field; stream function; rotational and Irrotational flow, integral and differentialanalysisforfluidmotion,streamtubes,continuityequation,boundarylayertheory, flow in boundary layer, flow past immersed bodies, packed bed, fluidized bed.

MODULE 3: **(08 hrs)**
Navier-Stokes equation, Euler's equation of motion along with a streamline and derivation of Bernoulli's equation, application of Bernoulli's equation, energy correction factor, linear momentum equation for steady flow, momentum correction factor.

MODULE 4: **(07 hrs)**
Introduction to laminar and turbulent flow, concept of Reynolds number and friction factor; friction factor for rough and smooth pipe, losses of head due to friction in pipes and fittings.

MODULE 5: **(08 hrs)**
Fluid Measurements and Machines, velocity measurement (Pitot tube, Prandtl tube, current meters etc.) flow measurement (orifices, nozzles, mouth pieces, orifice meter, nozzle meter, venturi-meter, weirs and notches). Pumps, Blower, power & head requirement for pumps, energy losses in piping system, valves and fittings.

Course Outcomes:

After completion of this course, the students are able to:

1: Basic concept of fluid static, viscosity, pressure & vapor pressure and dimensional analysis

2: Different types of flow, streamlines & continuity equation

3: Euler's equation of motion, Bernoulli's equation, linear momentum equation, momentum correction factor.

4: Laminar & turbulent flow, concept of Reynolds number & friction factor.

5: Fluid Measurements and velocity measurement, working of pump, fan blowers and valves and fittings.

Text/Reference Book-

1. McCabe W.L., Smith J.C. and Harriott P. (2017) Unit Operations of Chemical Engineering", 7th Ed., McGraw Hill.
2. Nevers N.D. (2005) Fluid Mechanics for Chemical Engineers, 3rd Ed., McGraw Hill Education.
3. Darby R. (2001) Chemical Engineering Fluid Mechanics, 2nd Ed., Marcel Dekker Inc. New York.
4. Denn. M. (1979) Process Fluid Mechanics, Prentice Hall.

List of experiments-

1. Determine the local point pressure with the help of pitot tube.
2. Calculate the terminal velocity of a spherical body in water.
3. Calibration of venturi meter.
4. Determination of C_C, C_V,C_D of orifices.
5. Calibration of orifice meter.
6. Calibration of nozzle meter and mouth piece.
7. Reynolds experiment for demonstration of stream lines & turbulent flow.
8. Calculate the metacentric height.
9. Measure the friction factor of a pipe.
10. Study the characteristics of a centrifugal pump.
11. Verification of impulse momentum principle.

PCC-CH303	**III**	**Chemical Process Calculation**	**3L:1T:0P (04hrs)**	**Credits:04**

Course objective-The objective of this course to understand and apply the basics of calculations related to material and energy flow in the processes. In addition to make practical approach to solve industrial related material energy balance problems.

Course content-

MODULE 1: (9 hrs)

Mathematical and Engineering calculation- Units, different unit systems, conversion of unit from one system to other, dimensions, dimensional analysis, dimensional group, fundamental of mole concept, composition of solid, liquid and gases, Basic Stoichiometric Calculations.

MODULE 2: (10 hrs)

Ideal Gases & Vapor pressure- Introduction of ideal gas, behavior of ideal gases, real gas, Vander Waal equation, compressibility factor method to solve cubic equation, vapor pressure, Raoult's Law, Humidity, relative humidity, humid heat, humid volume, dew point, humidity chart and its use.

MODULE 3: (12 hrs)

Material balance without chemical reaction - Fundamental of conservation of mass, Introduction of component balance, solving material balance without simultaneous equation for different unit operations, solving material balance at steady state and unsteady state, recycle, by pass and purge calculations.

MODULE 4: (10 hrs)

Material balance with chemical reaction- Introduction of component balance, solving material balance with chemical reactions, recycles, by pass and purge calculation with chemical reactions, combustion calculations.

MODULE 5: (9 hrs)

Energy balance – Laws of thermo chemistry Heat capacity, calculation of enthalpy changes, Energy Balance for unit operations, calculation of standard heat of reaction, heats of formation, combustion, solution, mixing etc., effect of pressure and temperature on heat of reaction, energy balance with chemical reaction.

Course Outcomes:

After completion of this course, the students are able to:

1: Unit conversion, concept of stoichiometry, mole and composition.

2: Behavior of liquids as well as gases and concept of humidity.

3: Material balance across equipment's used in process industries.

4: Material balance for chemical reactions involves in chemical process industries.
5: Energy balance including and excluding chemical reaction.

Text/Reference Book-

1. Hougen O.A.; Watson K.M.; Ragatz R.A. Chemical Process Principles Part I, CBS pub. 2004.
2. Himmelblau D.M. Basic Principles and Calculations in Chemical Engineering, PHI. 2012
3. Bhatt B.I.; Vora S.M.; Stoichiometry, 4th Edition McGraw Hill Education. 2004
4. Narayanan, K.V.; Lakshmikutty B. Stoichiometry and Process Calculations, PHI. 2016.

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PCC-CH304	**III**	**Fluid Particle Mechanics**	**3L:1T:2P (06hrs)**	**Credits:04**

Prerequisite(s): Engineering Mechanics

Course objective-The objective of this course is to understand basic principles of various mechanical operations, construction and working of the equipment's.

Course content-

MODULE 1: **(08 hrs)**

Solids, Characteristics of Solid particles, Particle size, Average particle size, Specific surface area of mixture, Screen analysis, Standard screens, Standard screens, Capacity and effectiveness of screen, Ideal and actual screens, Screening Equipment–Grizzly screens, Gyrating screens, Trommels, Shaking screens, Oscillating screens.

MODULE 2: **(08 hrs)**

Size reduction, Mechanism of Size reduction, Crushing Efficiency, Energy and power requirement, Rittinger's, Law, Kick's and Bond's Law, Work index, Size reduction equipments-crushers, grinders, ultrafine grinders and cutting machines.

MODULE 3: **(08 hrs)**

Mixing- Mixing of liquids with liquids, liquids with solids and solids with solids, power requirements. Mixing equipment-Kneaders, dispersers and masticators, Banbury Mixer, Muller Mixer, Pug mills, Ribbon Blenders, Tumbling Mixers.

MODULE 4: **(12 hrs)**

Classification of solid particles, Magnetic Separation, Electrostatic Separator, Floatation, Sedimentation, Thickeners, Cyclone Separator, Filtration, Filter Media, Filter Aid, Equipments for filtration-Pressure filters, Leaf filters, Continuous rotary filters.

MODULE 5: **(10 hrs)**

Transportation, handling and fluidization: Selection of conveying devices for solids: Conveyers-Belt conveyors, Screw conveyor, Chain and Flight conveyors, Bucket Elevators, Pneumatic conveyors, storage bins & silos. Fluidization: Particulate & aggregative fluidization characteristic of fluidized bed, pressure drop through a fluidized bed.

Course Outcomes:

After completion of this course, the students are able to:

1: Evaluate size, surface and population of particles, & screen analysis of solids.

2: Principle of size reduction, crushing, grinding, pulverizing and ultra-fining.

3: Mixing equipment and calculate power requirements

4: Principle of separation techniques for system involving solids, liquids and gases, sedimentation and filtration.

5: Transportation of materials, particulate and aggregative fluidization, pressure drop through fluidized bed.

Text/Reference Book-

1. Perry RH & Don WG; (2008) Perry's Chemical Engineering Hand Book (8th Edition); New York Chicago; Mc Graw Hill.
2. Banchero & Badger; (1998) Introduction to Chemical Engineering (6th Reprint); the University of California, Mc Graw Hill.
3. McCabe W.L., Smith J.C. and Harriott P. (2017) Unit Operations of Chemical Engineering", 7th Ed., McGraw Hill.
4. Narayan CM & Bhattacharya BC; (2014); Mechanical Operations for Chemical Engineers (3rd Edition); Khanna Publishers, New Delhi.

List of experiments-

1. Analyze the given sample by differential, cumulative methods using standard screen.
2. Determination of size and surface area of irregular particles using a measuring gauge.
3. Calculate the crushing efficiency and to determine the Rittinger's and Bond's constant of the given solid in a jaw crusher.
4. Determine the efficiency of a ball mill for grinding a material of known.
5. Calculate the power consumption of the hammer mill.
6. Find out the specific cake resistance for the given slurry by leaf filter.
7. Calculate the efficiency of a given cyclone separator.
8. Evaluate the efficiency of fluidized characteristic bed.
9. Perform the analysis of the dorr type of thickener.
10. Study the plate & frame filter press.

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HSMC-CH301	**III**	**Industrial Psychology and Human Recourse Management**	**3L:0T:0P(03hrs)**	**Credits:03**

Course objective-This course equips students with human resource management skills to be able to function effectively in their professional career.

Course content-

MODULE 1: **(10 hrs)**

Introduction and overview of the course, changes/challenges in HRM, management theories, research methodology andstatistical tools, management of change

MODULE 2: **(10 hrs)**

Organizational culture & climate, knowledge productivity, new leadership motivation theories

MODULE 3: **(10 hrs)**

Talent management, training & development, performance management

MODULE 4: **(10 hrs)**

Selection and recruitment, compensation, unions, entrepreneurship

Course Outcomes:

After completion of this course, the students are able to:

1: Knowledge about HR challenges and their management. Ability to know about research methodology and statistical tools towards improvement to HRM skill.

2: Learn about the important segment of organizations including organizational culture & climate, productivity and leadership motivation for the improvement in HRM.

3: Knowledge about the management of talent, training anddevelopment and performance along with their implementation for organizational improvement.

4: Knowledge about selection and recruitment process. Ability to handle problem related to compensation and union challenges.

Text/Reference Book-

1. Argyris, C. (1957). Personality and Organization: the Conflict between System and the Individual (1st edition). New York, Harper & Row.
2. Locke, E. A. (1999). The Essence of Leadership (1st edition), Lahman, Mariland, Lexington Books.
3. Robbins, S. P., Judge, T. A., N. Vohra (2016). Organizational Behavior (16th edition), London, Pearson.
4. Bach, S. (2005). Managing Human Resources (4th edition), Oxford, Blackwell publishing
5. Claydon, T., &Beardwell J. (2010) Human Resource Management: A Contemporary Approach (6th edition), Edinburgh, UK, Harlow: Financial Times Prentice Hall

ESC-CH301	**III**	**Computer Programming (Programming in Python)**	**0L:0T:4P (04 hrs)**	**Credits:02**

Course Objective:

The course is designed to provide Basic knowledge of Python. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language. Learning Outcomes: Problem solving and programming capability.

Course Outcomes:

After completion of this course, the students are able to:

1. Install Python and have knowledge of syntax ofPython.
2. Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries inPython.
3. Express different Decision Making statements andFunctions.
4. Develop code in Python using functions, loopsetc.
5. Design GUI Applications in Python and evaluate different databaseoperations.

MODULE I: **(08 hrs)**

Introduction, History,Features, Python –EnvironmentSetupLocal Environment Setup, Getting Python, Installation of Python, Use of IDE

MODULE II: **(08 hrs)**

Python –Basic SyntaxPythonIdentifiers, Reserved Words, Lines & Indentation, Multiline Statements, Quotation in Python, Comments & other useful constructs, Python –Variables Assigning Values to Variables, Multiple Assignment, Standard Data Types

MODULE III: **(08 hrs)**

Python –Variables, Assigning Values to Variables, Multiple Assignment, Standard Data Types; Python Numbers, Python Strings, Python Lists, Python Tuples, Dictionary, DataType Conversion

MODULE IV: **(08 hrs)**

Python –Basic Operators, Types of Operators, Arithmetic Operators, Comparison Operators, Assignment Operators, Bitwise Operators, Logical Operators, Operator Precedence, Python – Decision Making & Loops, Flowchart, If statement Syntax

MODULE V: **(08 hrs)**

Python-Functions, Syntax for defining a function, Calling a Function, Function Arguments, Anonymous Functions Python-Applications & Further Extensions.

Recommended Books:

1. Python Crash Course: A Hands-On, Project-Based Introduction to Programming, by Eric Matthes, No StarchPress.
2. LearnPythonthe HardWay'byZedA.Shaw (3rdEdition),AddisonWesley.
3. Head-First Python, by Paul Barry,O'Reilly.
4. 'Python Programming' by John Zelle, Franklin, Beedle& AssociatesInc;

List of Experiments:

1. To write a Python program to find GCD of two numbers.
2. To write a Python Program to find the square root of a number by Newton's Method.
3. To write a Python program to find the exponentiation of a number.
4. To write a Python Program to find the maximum from a list of numbers.
5. To write a Python Program to perform Linear Search
6. To write a Python Program to perform binary search.
7. To write a Python Program to perform selection sort.
8. To write a Python Program to perform insertion sort.
9. To write a Python Program to perform Merge sort.
10. To write a Python program to find first n prime numbers.
11. To write a Python program to multiply matrices.
12. To write a Python program for command line arguments.
13. To write a Python program to find the most frequent words in a text read from a file.
14. To write a Python program to simulate elliptical orbits in Pygame.
15. To write a Python program to bouncing ball in Pygame.

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MC-CH301	**III**	**Energy & Environmental Engineering**	**2L:0T:0P (02 hrs)**	**Credit:00**

Course objective-To provide an introduction to energy resources and an emphasis on alternative energy sources and their application. To study the interrelationship between the living organism and environment. To understand the transformation and degradation of organic pollutants in the environment

Course content-

MODULE 1: (06 hrs)

Energy:Introduction, conventional and non-conventional energy resources - coal, oil, gas, solar energy, wind energy,geothermal energy, Hydropower, Bio-energy, Nuclear energy. Energy survey in India. Current and futureenergy requirements in India and across the world including associated environmental problems.

MODULE 2: (08 hrs)

Ecosystem and Biodiversity: Introductionof an ecosystem,Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, rivers, oceans),Biodiversity at global, national and local levels. Threats to biodiversity,Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic andoption values; Endangered and endemic species of India. Conservation of biodiversity: In-Situ and Ex-Situ.

MODULE 3: (08 hrs)

Air pollution and Water Pollution:Definition, Cause, effects and control measures of Air pollution;Mobile and stationary sources of air pollutants,effective stack height concept, CO, CO_2, H_2S, SO_x, NO_x emissions, and its control. Definition, Classification, Cause, effects and control measures of water pollution, Measurement of levels of pollution such as DO, BOD, COD.

MODULE 4: (06 hrs)

E-Waste:Definition, Classification, Cause, effects and control measures of e-waste, global trade issues of e-waste, Recycling method of e-waste & its benefit.

MODULE 5: (08 hrs)

Environment Impact & Protection ActEnvironment: Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness. Environmental Impact Assessment. Measuring environmental impacts and policies for the regulation of environmental impacts.

Course Outcomes:

After completion of this course, the students are able to:

1: Ability to understand basic concepts conventional and non-conventional energy resources.

2: Ability to understand Ecosystem& Biodiversity.

3: To provide knowledgeabout Air pollution & Water Pollution.

4: To provide knowledge & reuse of E-Waste.
5: Ability to understand basic concepts of Environment Impact & Protection Act.

Text/Reference Book-

1. H. Peavy, D. Rowe & G. Tchobanoglous. Environmental Engineering, McGraw Hill Education. 2017.
2. A. K. De, Environmental Chemistry, 1st Edition New Age Publisher Int. Pvt. Ltd. 2016.
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai.
4. C.R. Brunner, Hazardous Waste Incineration, McGraw Hill Inc. 1993.
5. R.K. Trivedi, Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards', Vol I and II, B.S. Publications, 2010.

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