Teaching Scheme					Chemical Process Calculations (22PCM204T)					
					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

➢ Develop an ability to apply the knowledge of basic sciences and engineering to solve material and energy balance problems for unit operations and unit processes.
➢ Understand and correctly implement unit conversions in process calculations.
➢ Analyze and solve elementary material and energy balances in physical and chemical processes.

UNIT I: Stoichiometric relations and behaviour of ideal gases   12 Hr.

Basis of calculations: Conversion factors, mole concept, chemical calculations and use of molal quantities; Density, specific gravity and specific gravity scales; Composition of solids, liquids and gases; Methods for expressing compositions of mixtures and solutions; Ideal gases, Boyle's law, Charles law, Ideal gas equation, mixtures of ideal gases, Dalton's law, Amagat's law; Average molecular weight; Real gases, critical properties, equations of state and Van-der-Waals equation.

UNIT II: Material balance in unit operations and unit processes   10 Hr.

Basic material balance principles, tie substance and material balance calculations involving unit operations; Process involving recycle, bypass and purge calculations; Limiting and excess reactant, conversion, yield, selectivity and material balance calculations involving chemical reactions.

UNIT III: Vapour pressure and humidity calculations   10 Hr.

Vapour pressure and boiling point; Effect of temperature on vapour pressure, Clapeyron's equation, Clausius-Clapeyron's equation and Antoine equation; Vapour pressure plots; Ideal solutions, Raoult's law, non-ideal solutions and Henry's law; Saturation, humidity, dew point, wet bulb temperature, dry bulb temperature and humidity charts.

UNIT IV: Energy balance and combustion calculations   10 Hr.

Energy balances, heat capacity of gases, liquids and solids, Kopp's rule; Heat of fusion and vaporization, Trouton's rule, Kistyakowsky's equation; Thermochemistry: Heat effects accompanying chemical reactions, standard heat of reaction, combustion and formation; Hess's law of constant heat summation, calculations of theoretical and actual flame temperatures, fuels, calorific value of fuels, air requirements for fuels, Orsat's analysis, combustion calculations, incomplete combustion and thermal efficiency calculations.

Max. 42 Hr.

COURSE OUTCOMES
On completion of the course, student will be able to

CO1: Understand basics of stioichiometric calculations and make use of the different methods in expressing the composition of mixtures.
CO2: Apply the behaviour of ideal gas equations to bring the relation between temperature and pressure for pure components and solutions.
CO3: Analyze material balance, calculations for steady state unit operation and unit processes.
CO4: Estimate the vapour pressure and solve the heating and cooling problems using humidity concepts.
CO5: Acquaint and analyze energy balances over reactive and non- reactive equipment.
CO6: Apply material and energy balance concepts and perform combustion calculations.

TEXT/REFERENCE BOOKS

1. Hougen O.A., Watson K.M. and Ragatz. R.A., "Chemical Process Principles Part - I: Material and Energy Balance", 2nd Edition, CBS Publishers & Distributors, (2004).
2. Bhatt B.I. and Thakor, S., "Stoichiometry", 6th Edition, Tata McGraw Hill, New Delhi, (2017).
3. Himmelblau D.M. and Rigges J. B., "Basic Principles and Calculations in Chemical Engineering", 8th Edition, Prentice Hall of India, (2011).
4. Earnest J.H. and Harman B., "Chemical Engineering Calculations: Mass and Energy Balances", 1st Edition, McGraw Hill, New Delhi, (1959).
5. Richard M.F. and Ronald W.R., "Elementary Principles of Chemical Processes", 3rd Edition, John Wiley, (2004).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hr.**
Part A: 10 Questions each carrying 5 marks	50 Marks
Part B: 5 Questions each carrying 10 marks	50 Marks