CONCEPTS OF HEAT TRANSFER

	L	T	P
CODE CH 201			
PL 201	2	--	2

RATIONALE

This subject is very important for chemical engineering students because every chemical industry use heat transfer equipments like heat exchangers, condensers, evaporators etc., so knowledge of this subject helps them a lot.

CONTENTS

1. Introduction:

1.1 Definition
1.2 Analogy between flow of heat and electricity
1.3 Modes of heat transfer.

2. Conduction:

2.1 The thermal conductivity
2.2 Fourier's law of heat conduction
2.3 Unsteady state equation
2.4 Steady state equation
2.5 Heat flow equation for composite walls
2.6 Composite cylinders
2.7 Spheres
2.8 Optimum insulation thickness

3. Dimensional Analysis:

3.1 Criteria of Similitude
3.2 Buckingham π theorem
3.3 Advantages and limitations of dimensional analysis
3.4 Dimensionless number for heat transfer and their physical significance

4. Temperature:

4.1 True temperature difference
4.2 Log mean temperature difference
4.3 Difference between normal temperature difference and Log mean temperature difference

5. Convection:

5.1 Natural and forced convection
5.2 Energy transfer mechanism through the boundary layer
5.3 Thermal and hydrodynamic boundary layer

6. Double Pipe Heat Exchanger:

6.1 Constructional detail and working
6.2 Overall and surface heat transfer coefficient
6.3 Process instrumentation drawing

7. Shell and Tube Heat Exchanger:

7.1 Construction detail and working
7.2 Temperature profiles of 1-1 cocurrent and counter current.
7.3 1-2 parallel and counter flow exchanger
7.4 Process instrumentation drawing

8. Plate Type Heat Exchanger:

8.1 Construction detail and working
8.2 Uses and application

PRACTICALS

1. To study the heat transfer between hot and cold fluids in a double pipe heat exchanger.
2. To determine individual and overall heat transfer coefficient of a double pipe heat exchanger.
3. To study heat transfer through lagged pipe.
4. To study heat transfer through composite wall
5. To study heat transfer through composite sphere l
6. To study heat transfer through forced convection apparatus.
7. To study shell and tube heat exchanger
8. To verify the temperature profiles of 1-1 co-current and counter-current heat exchanger
9. To study plate type heat exchanger

REFERENCE BOOKS :

1. Heat Transfer — Kern. D.Q.
2. Unit Operation in Chemical Engg. — Mc cabe & Smith.
3. Introduction to Chemical Engg. — Badger & Banchero

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MASS TRANSFER

CODE CH 202 L T P
PL 202 2 -- 2

RATIONALE

This subject intends to equip the students with the concept and principles of mass transfer operation, which are of prime importance in any chemical industry. Mass transfer equipments are an integral part of any chemical plant. This subject will help the students to operate and design various mass transfer equipments.

CONTENTS

1. Introduction :

1.1 Analogy between momentum, heat and mass transfer
1.2 Fick's law of diffusion
1.3 Diffusion of A through non-diffusing B
1.4 Equimolar counter diffusion

2. vapour liquid equilibrium

2.1 Introduction
2.2 Importance of distillation
2.3 Vapour liquid equilibrium diagram
2.4 Partial pressure
2.5 Dalton's, law
2.6 Henry's law
2.7 Raoult's law
2.8 Partial vaporization and partial condensation
2.9 Relative volatility

3. Distillation

3.1 Methods of distillation
3.1.1 Differential Distillation

3.1.2 Flash Distillation
3.1.3 Continuous rectification

3.2 Reflux ratio and it's significance
3.3 Optimum reflux ratio
3.4 Methods of calculating number of plates by Mc Cabe Thiele method
3.5 Equation of Q-line and its importance

4. Distillation equipments,

4.1 Construction and utility
4.2 Bubble cap column
4.3 Sieve plate
4.4 Packed column

5. Batch Distillation:

5.1 Azeotropic distillation
5.2 Extractive distillation
5.3 Steam distillation
5.4 Meaning and importance of height equivalence to theoretical plate (HETP).

6. Humidification:

6.1 Definition
6.1.1 Saturated gas
6.1.2 Relative humidity
6.1.3 Percentage humidity
6.1.4 Humid heat
6.1.5 Humid volume
6.1.6 Dew point
6.1.7 Total enthalpy
6.1.8 Adiabatic saturation temperature
6.1.9 Wet bulb temperature

6.2 Measurement of humidity from humidity chart
6.3 Constructional details and working

6.3.1 Humidifier's
6.3.2 Dehumidifier's

7. Adsorption:

7.1 Introduction
7.2 Types
7.3 Equipment and methods

PRACTICALS

1. Study of distillation in bubble cap column.
2. To study flash equilibrium distillation
3. To draw instrumentation scheme of distillation column
4. Study of cooling water and steam consumption in bubble cap column
5. Operation of cooling tower
6. To study Reyleigh equation for batch distillation
7. To study packed distillation column.
8. To study adsorption column
9. To study working of dehumidifier

REFERENCE BOOKS :

1. Mass Transfer Operation — Treybel
2. Chemical Engineering Vol. II — Richardson & Coluson
3. Unit Operation of Chemical Engg. — Mc Cabe & Smith
4. Introduction to Chemical Engg. — Badger & Bancheoro

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CHEMICAL PROCESS CALCULATIONS

CODE CH 203

L T P
2 2/2 --

RATIONALE

This subject is backbone of Chemical Engineering. The knowledge of this subject is to develop the ability to calculate the pre- data information regarding Chemical Engineering.

CONTENTS

1. Introduction

1.1 Dimensions and units.
1.2 Tables and conversion factors
1.3 Chemical formula
1.4 Chemical Analysis
1.5 Chemical process industries
1.6 Unit process and unit operations
1.5 Simple numerical problems

2. Chemical and Physical Principles :

2.1 Stoichiometric relations
2.2 Methods of expressing composition.
2.3 Ideal gas law and applications
2.4 Partial pressure and vapour pressure.
2.5 Simple numerical problems.

3. Material Balances without Chemical Reactions:

3.1 Key components
3.2 Basis of calculations
3.3 Total and component balance
3.4 Steady state and unsteady state
3.5 By-pass and Recycle.
3.6 Simple numerical problems.

4. Material Balances without Chemical Reactions:

4.1 Introduction
4.2 Preperation of material balances
4.3 Electrochemical reactions
4.4 By-pass and Recycle

5. Energy Balance :

5.1 First law of Thermodynamics
5.2 Types of heat effects
5.3 Heat capacity and specific heat.
5.4 Thermochemistry of solution.
5.5 Heat of wetting.
5.6 Heat of absorption.

6. Energy Balances with Chemical Reaction :

6.1 Heat of reaction
6.2 Adiabatic flame temperature calculations

7. Unit Operations :

7.1 Applications of stoichiometric calculations to humidification, evaporation, distillation, crystallization and drying.
7.2 Simple numerical problems.

8. Unit Processes :

8.1 Combustion
8.2 Oxidation of sulfur compounds
8.3 Simple numerical problems.

REFERENCE BOOKS :

1. Stoichiometry — Bhatt & Vohra
2. Process Principles — Haugen & Watson
3. Solved Examples in Chemical Engineering — G.K. Roy

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TRANSPORT PHENOMENA

CODE CH 204

L T P
2 2/2 --

RATIONALE

Transport phenomena deals with mechanism of mass transfer, heat transfer and momentum transfer. The knowledge of the subject is important because this is of common use in chemical Engineering.

CONTENTS

1. Introduction :

1.1 Definition of Transport phenomena
1.2 Analogy between mass, heat and momentum transfer
1.3 Definition of viscosity, diffusivity and conductivity

2. Transport in Laminar Flow :

2.1 Shell balances for momentum, energy and mass transfer,
2.2 Unidimensional velocity, temperature and concentration profiles.

3. Mechanism of Mass Transfer :

3.1 Diffusion in gas phase

3.1.1 Equimolecular counter diffusion
3.1.2 Diffusion through a stationary gas
3.1.3 Comparison of mass transfer rates in equimolecular counter diffusion and diffusion through a stationary gas.
3.1.4 Maxwell's law of diffusion
3.1.5 Diffusivities of various vapours

3.2 Diffusion in the liquid phase

3.2.1 Mass transfer by convection

3.2.2 Mass transfer in turbulent fluid
3.2.3 Mass transfer in bulk flow

3.3 Mass transfer across a phase boundry

3.3.1 Two film theory
3.3.2 Penetration theory
3.3.3 Mass transfer coefficients

4. Mechanism of Heat Transfer :

4.1 Heat transfer by conduction

4.1.1 Steady state heat transfer through- Single flat wall, Composite wall, Thick walled tube and Spherical shell
4.1.2 Unsteady state transfer of heat

4.2 Heat transfer by convection

4.2.1 Determination of film coefficient
4.2.2 Forced convection inside tubes
4.2.3 Forced convection outside tubes
4.2.4 Natural convection

5. Mechanism of Momentum Transport :

5.1 Law of viscosity
5.2 Equation of continuity
5.3 Newtonian and Non-Newtonian fluids
5.4 Boundary layers and pipe flow
5.5 The momentum equation

6. Transport Phenomena Anaogies :

6.1 Reynolds analogy
6.2 Chilton - Colburn analogy

REFERENCE BOOKS :

1. Transport Phenomena — Bird, Stewart & Light foot.
2. Unit operations of chemical Engg. — Mc Cabe & Smith
3. Chemical Engineering Vol. I,II & III — Coulson & Richardson.

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ORGANIC CHEMISTRY

CODE CH 205

L	T	P
2	--	2

RATIONALE

It is relevant to know the basic concepts of organic compounds and Polymers for the students of Diploma course in chemical Engineering.

CONTENTS

1. Structure of Organic Molecules:

1.1 Tetra valency of carbon
1.2 Bonding system
1.3 Structural formulae.

2. Introductory Study of Organic Compounds :

2.1 Classification
2.2 Nomenclature
2.3 Homologous series
2.4 Functional groups
2.5 Isomerism – Structural and Stereo in brief.

3. Introduction of Polymerisation :

3.1 Definitions and concepts
3.2 Polymerisation reactions
3.3 Polymer structure, functionality and degradation,
3.4 Characterisation of polymers.

4. Polymers :

4.1 Different types of polymers - natural and modified natural products,
4.2 Synthetic polymers,
4.3 Addition and condensation products and their preparations.

5. Methods of Polymerization :

5.1 Mass, solution, emulsion and suspension polymerisation processes,
5.2 Reactions and equipments used

6. Colour and Dyes :

6.1 Origin of colour
6.2 Theories of colour and dyes.
6.3 Classification of dyes
6.4 Chemical constitution

7. Alkaloids :

7.1 General properties and uses

8 Terpenes :

8.1 Definition
8.2 Classification
8.3 General properties and uses.

9. Colloids :

9.1 Crystalloids and colloids
9.2 Classification
9.3 Preparation
9.4 Lyophillic and Lyophobic
9.5 Cataphoresis
9.6 Electrophoresis
9.7 Peptization
9.8 Applications

PRACTICALS

1. Determination of melting and boiling points of organic compounds
2. Tests for functional groups
2.1 Carboxyl
2.2 Hydroxyl

2.3 Phenol
2.4 Alcohol
2.5 Carbohydrates
2.6 Carbonyl
2.7 Aldehydes and Ketones
2.8 Nitro
2.9 Amine

3. Identification of Compounds

3.1 Citric Acid
3.2 Tartaric Acid
3.3 Benzoic Acid
3.4 Oxalic Acid
3.5 Acetic Acid
3.6 Phenol
3.7 P-naphthol
3.8 Methyl Alcohol
3.9 Ethyl Alcohol
3.10 Acetone
3.11 Naphthalene
3.12 Benzene
3.13 Toluene
3.14 Urea
3.15 Chloroform

REFERENCE BOOKS :

1. Organic Chemistry — Bahel and Tuli
2. Organic Chemistry — Kumar and Mahenot
3. Organic Chemistry — Shivharae and Lawania
4. Organic Chemistry — Panchanan Dey
5. Text Book of Polymer Science — Fred.W.Billmeyer, John Wiley and sons, 1980.
6. Polymer Science — V.R. Gowarikar, New Age International, Second Edition, 2006.
7. Polymer Science and Engineering — David J. Williams, Prentice Hall, 1971.
8. Fundamentals of Polymer Processing — Stanley Middleman, McGraw Hill, 1977.
9. Introduction to Polymer Science &Technology — Herman S. Kaufman & Joseph J Falcetta, JohnWiley & sons, 1977.
10. Fundamentals of Polymers — Rakesh K. Gupta and Anil Kumar, International edition, 1998

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CHEMICAL REACTION ENGINEERING

CODE CH 206 L T P
2 2/2 --

RATIONALE

Study of chemical reaction engineering helps a chemical engineer in determining the rate of reaction, understanding reaction mechanism, safety parameters, designing of reactors and other chemical equipments in any chemical industry.

CONTENTS

1. Introduction :

1.1 Rate of reaction
1.2 Variables affecting rate of reaction
1.3 Molecularity and order of reaction
1.4 Rate constant.

2. Types of Reaction :

2.1 Single - multiple reactions
2.2 Reversible - Irreversible reactions
2.3 Elementary - Non elementary reaction
2.4 Homogeneous - Heterogeneous reactions
2.5 Temperature dependency according to Arhenious theory, collision theory and transition state theory,
2.6 Simple numerical problems

3. Constant Volume Batch Reactor :

3.1 Integral method of analysis of data
3.2 Differential method of analysis of data
3.3 Rate expressions for zero, first, second and third order reactions.
3.4 Simple numerical problems

4. Reactor Design :

4.1 Design equation for batch reactor
4.2 Semi batch reactor
4.3 Continuous reactor (C.S.T.R.)
4.4 Plug flow reactor
4.5 Space time
4.6 Holding time
4.7 Space velocity
4.8 Simple numerical problems

5. Comparison of Reactors :

5.1 Size Comparison For Single Reactors
5.2 Batch Reactor With Plug Flow Reactor
5.3 Comparison Of Mixed Flow And Plug Flow Reactor
5.4 Comparison Of CSTR With Plug Flow Reactor For First Order Reactions

6. Basic concepts of non ideal flow

6.1 Deviation From Ideal Flow
6.2 Residence Time Distribution (RTD) Function
6.3 Pulse Input
6.4 C Curve
6.5 E Curve
6.6 F Curve

REFERENCE BOOKS :

1. Chemical Engg. Kinetics — J. M. Smith.
2. Chemical Reaction Engg. — Octave Levenspal.
3. Reaction Engg. — Walas.
4. Chemical Reaction Engg-I&II — Gawhane

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HYDRAULICS

CODE CH 207

L	T	P
2	--	2

RATIONALE

This subject involves the knowledge of fluid properties, flow of fluids, and transportation of fluids etc. So it is necessary for Chemical Engineering diploma students.

CONTENTS

1. Hydrostatics :

1.1 Pressure at a point in a liquid at rest
1.2 Pressure, unit of pressure, type of pressures,
1.3 Pascal's law
1.4 Transmission of fluid pressure
1.5 Simple applications like Bramah press

2. Manometers :

2.1 Piezometer tube
2.2 Simple U-tube manometer
2.3 Differential manometers
2.4 Inverted U-tube manometers
2.5 Inclined manometers
2.6 Micro manometers

3. Flow of Fluids :

3.1 Types of flow
3.2 Reynolds number
3.3 Bernoulli's theorem
3.4 Applications of Bernoulli's theorem in measuring flow rate by orificemeter, venturimeter, Pitot tube Rotameters

4. Viscosity :

4.1 Concept and importance of viscosity
4.2 Types of viscosity and their units
4.3 Newton's law of viscosity
4.4 Newtonian and non-Newtonian fluids

5. Flow through Pipes :

5.1 Haugen-Poiseuille equation
5.2 Loss of head due to friction
5.3 Darcy's formula
5.4 Head loss in pipe fittings
5.5 Water hammer

6. Transmission of Fluids :

6.1 Transportation of fluids
6.2 Pipes and tubes
6.3 Different types of valves like gate valve, glow valve, ball valve, cock valve, butterfly valve, needle valve
6.4 Different types of pumps like centrifugal, reciprocating, gear pumps, vacuum pumps jet ejector.
6.5 Cavitation, Priming, NPSH, Suction lift.
6.6 Characteristics curves for centrifugal pumps
6.7 Calculation of head and power of centrifugal pumps

Note : Simple numerical problems may be given in exam.

PRACTICALS

1. Study of constructional features and working of different types of manometers and pressure gauges
2. Verification of Bernoulli's theorem
3. Measurement of flow by orifice and venturimeter
4. Study of pitot tube and rotameters
5. To determine friction loss in flow through pipes
6. To study constructional features of centrifugal pumps
7. To study constructional features of reciprocating pumps
8. To study constructional features of gear pumps
9. To study Reynolds's apparatus to determine laminar, transition and turbulent flow
10. To study variation in head and capacity of centrifugal pumps

REFERENCE BOOKS:

1.	Hydraulics, Hydraulic machines and Fluid Mechanics	R.S. Khurmi
2.	Introduction to Chemical Engg.	Bedger and Benchero
3.	Unit operation in Chemical Engg.	McCabe Smith
4.	Solved examples in Chemical Engg.	G.K. Roy

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MECHANICAL OPERATIONS

CODE CH 208

L	T	P
2	--	2

RATIONALE

This subject involves the characteristics of various fluids and solids handle in process industries. It gives knowledge about various mechanical operations like size reduction, screening, Filtration, Mixing and transportation of fluids and solids. So it is important for Chemical Engg. diploma course.

CONTENTS

1. Particle Technology :

- 1.1 Characteristics of solid particles
- 1.2 Determination of specific surface and size of particles and number of particles in the mixture
- 1.3 Properties of particulate masses
- 1.4 Mohr stress circle
- 1.5 Janssen equation
- 1.6 Mixing of solids, mixing of Cohesive and non cohesive solids

2. Comminution :

- 2.1 Basic principles
- 2.2 Determination of power in communition energy by laws of comminution
- 2.3 Factors affecting comminution
- 2.4 Industrial communition equipments like jaw crushers, Gyratory crushers, double roll crushers, ball mill and fluid energy mill
- 2.5 Simple numerical problems

3. Screening :

- 3.1 Screening, mesh number, standard screens,
- 3.2 Differential and cumulative analysis,
- 3.3 Screen capacity and effectiveness.
- 3.4 Screening equipments

4 Filtration :

4.1 Filter medium,
4.2 Batch and continuous filtration,
4.3 Gravity and centrifugal filters.
4.4 Filtration equipments like sand filter, Rotary drum filter, bag filters, plate and frame filter press,

5. **Gas Cleaning :**

5.1 Cyclones
5.2 Electrostatic precipitators,
5.3 Sonic agglomeration

6. Storage and Transportation of Solids :

6.1 Storage of solids
6.1.1 Angle of repose

6.2 Conveyors like belt conveyor, screw conveyor, bucket elevators, pneumatic conveyors, apron conveyors, and hydraulic transport.

PRACTICALS

1. To perform the Sieve analysis of a given sample
2. To study Rittingers's law of comminution
3. To study Kick's law of comminution
4. To study Bond's law of comminution
5. To study the rate of filteration with the help of filter press
6. To study screen effectiveness
7. To study the rate of conveying of material and motor power required for pneumatic conveyors
8. To study the power of drive motor for given load/ capacity for Bucket elevator.

REFERENCE BOOKS :

1.	Unit Operations of Chemical Engg.	Mc Cabe & Smith
2.	Mechanical Operations for Chemical Engineers	CM Naryan & B.C. Bhattacharya Khanna Publication
3.	Chemical Engg. Vol II	Rechardson & Coulson

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GENERAL CHEMICAL TECHNOLOGY

CODE CH 209

L	T	P
2	2/2	--

RATIONALE

This subject feeds the important aspects of various processes industries, productions and is very significant to the chemical diploma student.

CONTENTS

1. **Sulfur and Sulfuric Acid:**

1.1 Properties
1.2 Classification of production process
1.3 Description of economical process and uses of sulfur and sulfuric Acid

2. Fertilizers Industries :

2.1 Properties
2.2 Classification of manufacturing processes
2.3 Description of economical production process and uses of Ammonia, Nitric Acid, Urea, Ammonium Nitrate, Phosphoric acid, Calcium Phosphate and Ammonium Phosphate.

3. Chloralkali Industries :

3.1 Properties
3.2 Classification of manufacturing processes. Description of economical production process and uses of Soda Ash, Caustic and Chlorine.

4. Soap and Detergent:

4.1 Properties
4.2 Classification of manufacturing process
4.3 Description of economical process and uses of soaps and detergents

5. Carbohydrates and Fermentation Industries :

5.1 Properties
5.2 Classification of processes
5.3 Description of economical process and uses of Sucrose, Starch and Ethyl Alcohol

6. Pulp and Paper Industries :

6.1 Properties
6.2 Classification of processes
6.3 Description of economical process and uses of pulp, paper, cellulose and lignin products.

7. Man Made Fibres :

7.1 Properties
7.2 Classification of processes
7.3 Description of economical processes and uses of Rayon, Polyester, Acrylic, Nylon-6 and Nylon 6-6

8. Cement and Lime :

8.1 Cement: Types and Manufacture of Portland cement,
8.2 Lime Manufacturing

9. Natural Products :

9.1 Vegetable oil,
9.2 Soybean Oil by Solvent Extraction

REFERENCE BOOKS:

1. Out line of Chemical Technology — Dryden
2. Chemical Process Industries — Shreve

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'C' PROGRAMMING

CODE CH 210 L T P
Same in all branches except AR/CC/CE/CS/ EE /IT 2 -- 2

RATIONALE

'C' is computer programming language and also structured programming language. In 'C' programming language we consider various syntax used in programming. By having good knowledge of 'C', students can write modular application and system programs. 'C' can be used in the engineering applications. By acquiring a sound knowledge of 'C' students will be able to understand the concept of all the application areas. This course is specially designed for engineering students of all diploma streams.

CONTENTS

1. Introduction :

1.1 Scope of 'C' Language
1.2 Distinction and similarities with other HLLs
1.3 Special features and Application areas

2. Elements of 'C' :

2.1 Character set
2.2 Key words
2.3 Data types
2.4 Constants and Variables
2.5 Operators: unary, binary, ternary
2.6 Operator precedence

3. Console Input-Output :

3.1 Types of I-O
3.2 Console I-O
3.3 Unformatted console I-O: getchar(),putchar(), gets(), puts(), getch(),getche()
3.4 Formatted I-O : scanf(), printf()

4. Control Flow :

4.1 Statements and blocks
4.2 if
4.3 switch
4.4 Loops: for, while, do-while
4.5 goto and labels
4.6 break, continue, exit
4.7 Nesting control statements

5. Arrays :

5.1 Basic concepts
5.2 Memory representation
5.3 One dimensional array
5.4 Two dimensional array

6. Functions :

6.1 Basic concepts
6.2 Declaration and prototypes
6.3 Calling
6.4 Arguments
6.5 Scope rules

6.6 Recursion
6.7 Storage classes types
6.8 Library of functions: math, string, system

7. Pointers :

7.1 Basic concepts
7.2 &, * operator
7.3 Pointer expression: assignment, arithmetic, comparison
7.4 Dynamic memory allocation
7.5 Pointer v/s Arrays

8. Structure and Enumerated Data Types:

8.1 Basic concepts
8.2 Declaration and memory map
8.3 Elements of structures
8.4 Enumerated data types : typedef, enum
8.5 Union

PRACTICALS

1. Problems based on arithmetic expression, fixed mode arithmetic.
2. Problems based on conditional statements and control structures.
3. Problems based on arrays (1-D, 2-D), functions and pointers.
4. Problems based on engineering applications.

REFERENCE BOOKS :

1. 'C' Programming — Stephen Kochan
2. Programming with 'C' — Schaum's Series
3. 'C' Programming — V.Balguru Swami
4. 'C' Programming — Kernighan & Ritchie
5. Let us 'C' — Yashwant Kanetkar

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