GUJARAT TECHNOLOGICAL UNIVERSITY

CYBER SECURITY
SUBJECT CODE: 2150002
B.E. 5th SEMESTER

Type of course: NA

Prerequisite: Basic fundamental knowledge of computers, Internet and network

Rationale: NA.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
0	1	2	3	0	0	0	50	30	20	100

Content:

Sr. No.	Topics	Weightage %
1	**Systems Vulnerability Scanning** Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools. Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping Kismet	25
2	**Network Defense tools** Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System	25
3	**Web Application Tools** Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra	25
4	**Introduction to Cyber Crime and law** Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.	10
5	**Introduction to Cyber Crime Investigation** Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks	15

Reference Books:

1. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication Wiley

Course Outcome:

After learning the course the students should be able to: student should understand cyber-attack, types of cybercrimes, cyber laws and also how to protect them self and ultimately society from such attacks

List of Experiments:

1. TCP scanning using NMAP
2. Port scanning using NMAP
3. TCP / UDP connectivity using Netcat
4. Network vulnerability using OpenVAS
5. Web application testing using DVWA
6. Manual SQL injection using DVWA
7. XSS using DVWA
8. Automated SQL injection with SqlMap

Design based Problems (DP)/Open Ended Problem:

GUJARAT TECHNOLOGICAL UNIVERSITY

DISASTER MANAGEMENT
SUBJECT CODE: 2150003
B.E. 5th SEMESTER

Type of course: Applied Mechanics

Prerequisite: NA

Rationale: This subject is conceptual applications of principles of management to mitigate various disasters.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	0	3	70	20	10	0	0	0	100

ESE-End Semester Exam, PA-Progressive Assessment, E-External, M-Mid semester, V-Viva (External) , I-Internal

Sr. No.	Topics	Teaching Hrs.	Weightage %
1	**Understanding Disasters** Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management	4	10
2	**Types, Trends, Causes, Consequences and Control of Disasters** Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves); Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Man-made Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters); Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters	8	20
3	**Disaster Management Cycle and Framework** Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action	8	20
4	**Disaster Management in India** Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter-Governmental Agencies	10	20
5	**Applications of Science and Technology for Disaster Management & Mitigation** Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination)	12	30

	Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**50**	**30**	**10**	**0**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1 Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
4. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
5. Encyclopedia of disaster management, Vol I, II and IIIL Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006
6. Encyclopedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2,Angus M. Gunn, Greenwood Press, 2008
7 Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur
8. Management of Natural Disasters in developing countries, H.N. Srivastava & G.D. Gupta, Daya Publishers, Delhi, 2006, 201 pages
9. Natural Disasters, David Alexander, Kluwer Academic London, 1999, 632 pages
10 Disaster Management Act 2005, Publisher by Govt. of India
11 Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
12 NIDM Publications
13 High Power Committee Report, 2001, J.C. Pant
14 Disaster Mitigation in Asia & Pacific, Asian Development Bank
15 National Disaster Management Policy, 2009, GoI
16 Disaster Preparedness Kit, American Red Cross
17 Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
18 Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.
19 Sahni, Pardeep et.al. (eds.) 2002, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.
20 Roy, P.S. (2000): Space Technology for Disaster management: A Remote Sensing & GIS Perspective, Indian Institute of Remote Sensing (NRSA) Dehradun.
21 Sharma, R.K. & Sharma, G. (2005) (ed) Natural Disaster, APH Publishing Corporation, New Delhi.
22 Kasperson, J.X., R.E. Kasperson, and B.L. Turner III (Eds.), 1995, Regions at Risk: Comparisons of Threatened Environments, United Nations University Press, Tokyo
23 Singh Satendra (2003): Disaster Management in the Hills, Concept Publishing Company, New Delhi.
24 Taori, K (2005) Disaster Management through Panchayati Raj, Concept Publishing Company, New Delhi.

Course Outcome:

After learning the course the students should be able to:

(a) Understand disasters, disaster preparedness and mitigation measures

(b) Understand role of IT, remote sensing, GIS and GPS in risk reduction

(c) Understand disaster management acts and guidelines along with role of various stack-holders during disasters

List of Open Source Software/learning website:
www.GIS. Development.net
www.iirs.nrsa.org
http://quake.usgs.gov
www.nidmindia.nic.in

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (05)
MASS TRANSFER OPERATION-I
SUBJECT CODE:2150501
B.E. 5th SEMESTER

Type of course: Chemical Engineering

Prerequisite: None

Rationale:
The objective of this course is to study the principles of mass transfer and their application to separation and purification processes. The course integrates fluid dynamics and thermodynamics and proceeds to develop rate expressions for mass transfer in gases, liquids and solids

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	3	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction:** Classification of mass transfer operation, choice of separation method, Methods of conducting mass transfer operations, Design principles	04	07
2	**Molecular Diffusion in Fluids:** Definition of molecular and eddy diffusion, Ficks first law, Concept of N & J Flux, Steady state molecular diffusion in fluids at rest and in laminar flow, concept of effective diffusivity. Diffusivity of gases, Diffusivity of liquids.	10	18
3	**Mass Transfer Coefficients:** Mass transfer in laminar and turbulent regions, F and k type mass transfer coefficients, Film, Penetration and surface renewal theories.	04	08
4	**Inter Phase Mass Transfer:** Concept of equilibrium, diffusion between phases, Two resistance theory, Local overall mass transfer coefficient, controlling mass transfer resistances.	04	08
5	**Gas Absorption:** Equilibrium Solubility of gases in liquids, Ideal and non-ideal solution, Choice of solvent for absorption, Material balance and liquid-gas ratio for absorption and stripping, Counter current multi stage operation (isothermal), Absorption factor, Continuous contact equipments, Overall coefficient and Transfer units, Concept of HETP and HTU, NTU and j_H factor, Industrial absorbers. Dilute solutions, Absorption with chemical reaction	08	15

6	**Equipments for Gas Liquid Operations:** Gas Dispersed: Sparged vessels, Mechanically agitated vessels, Gas-Liquid contact, Tray Tower, Tray tower internals, Different types of trays, Weirs, Downcomers and criteria of their selection, Flooding, Loading, Coning, Weeping & dumping in tray tower; Liquid Dispersed: Ventury scrubber, Wetted wall towers, spray towers, Packed Towers, Packed tower internals, Different types of packings and their selection criteria, mass transfer coefficient for packed towers, Co-current flow of gas & liquid, End effects and axial mixing, Tray tower vs. Packed tower.	08	15
7	**Liquid-Liquid Extraction:** Ternary liquid- liquid equilibrium and tie line data, system of three liquids-one pair partially soluble, system of two partially soluble liquids-one solid, multi-component system, stage wise contact, Single stage & multistage extraction, Co-current and cross current extraction, Continuous counter current multistage extraction with and without reflux, Theory & performance of continuous contact equipments, Single stage & multistage equipments, Applications of liquid-liquid extraction.	07	13
8	**Leaching:** Steady state and unsteady state leaching operations, Single stage leaching, Multistage cross current and counter current leaching, Rate of leaching, Recovery of solvent vapors, Application of leaching, Leaching equipments	04	08
9	**Crystallization:** Saturation, Nucleation, Principle of crystallization, Crystallization rate, Equilibria and yields, Nucleation, Crystal growth, Caking of crystals, Application of crystallization, Crystallization equipments, Crystallization from melts	05	08

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**25**	**15**	**10**	**05**	**--**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. "Masstransferoperation" byR.E.Treybal,Mc-GrawHillinternational, 3rd edition
2. "MassTransfer"bySherwood, Pigford&Wilke,Mc-GrawHillinternational.
3. "ChemicalEngineering",Volume-2,byCoulson&Richardson, 4th edition
4. Perry'sChemicalEngineers handbook,byPerry&Green,Mc-Graw.Hill international, 7th edition
5. UnitOperationsofChemicalEngg.ByW.L.McCabe,J.C.Smith&Harriott,Mc-GrawHillinternational, 6th edition

Course Outcome:

After learning the course the students should be able to:

1. To build a basic knowledge of mass transfer operations and separation processes carried out in chemical industries.
2. To understand the designing of mass transfer equipments used in the chemical industries.
3. To utilizethe technological methods in problem solving of mass transfer operations in industries.
4. To reviewthe practical importance and relevanceof mass transfer in chemical industry.
5. To understand the applications of different mass transfer processes.
6. To recognize the selection criteria for mass transfer process and equipments required by the industries.

List of Experiments:

Minimum**5**practicalstobeperformedandremaining time should be allotted to open-endedprojects/study reports/latest outcomes in technologystudy**:-**

1. Inthebeginning oftheacademicterm,facultieswillhavetoallottheirstudentsatleastone Open-ended Project / StudyReport /Latest outcome in technology.
2. Literaturesurveyincludingpatents and research papers offundamental process

- Design based smallproject**or**
- Studyreport based on latest scientificdevelopment**or**
- Technologystudyreport/modeling/ simulation/collection report**or**
- Computerbasedsimulation/webbasedapplication/analysispresentationsofbasic conceptfieldwhich mayhelp them in chemical engineering.

3. Thesecan bedoneinagroup containingmaximum**three** students in each.
4. Facultiesshouldcultivateproblembasedprojecttoenhancethebasicmentalandtechnical level of students.
5. Evaluation should be done on **approach of the student on his/her efforts** (not on completion) to studythedesign moduleofgiven task.
6. Inthesemesterstudentshouldperform **minimum** 5 setofexperimentsandcomplete **<u>one smallopenendeddedicatedproject</u>**basedonengineeringapplications.Thisprojectalong with anyperformedexperiment should be **<u>EVALUATED BY EXTERNAL EXAMINER.</u>**

<u>PRACTICALS (ANYFIVE):</u>

1.	To determine the percentage extraction for the benzoic acid from dilute aqueous solution using toluene as solvent.
2.	To determine the diffusion co-efficient of CCl_4 in air & variation with temperature.
3	Determine mass transfer co-efficient of liquid (water) evaporation to atmospheric air at elevated temperature.
4.	To determine the efficiency of single stage leaching operation for leaching of NaOH aqueous solution & $CaCO_3$.
5.	To find out the liquid side mass transfer coefficient K_{La} for the absorption of CO_2 in NaOH in the packed column.
6.	To prepare the ternary diagram for a system of three liquid one pair partially soluble i.e. acetic acid, benzene and water system.

7.	To study the (cross current) liquid-liquid extraction for extracting acetic acid from benzene using water as solvent.
8.	To determine the mass transfer coefficient in a stirred cell.
9.	To carry out crystallization with & without seeding
10.	To determine the stage efficiency and the overall recovery of NaOH for multistage cross current leaching operation for leaching NaOH from mixture of NaOH and $CaCO_3$ using water as a solvent.

Design based Problems (DP)/Open Ended Problem:

Students are free to select any area of science and technology based on chemical engineering applications to define Projects.

Some suggested projectsarelisted below:

- Absorption of two compounds by using packed column
- To carry out crystallization by using crystallizer
- Separation of compounds using Liquid-liquid extraction and leaching.

Major Equipment:

Packed column, Stirred cell, crystallizer, Diffusion apparatus.

List of Open Source Software/learning website:

1) Literature available in any laboratory manual of Mass Transfer Operation-I.
2) Mass Transfer Operations for the Practicing Engineer by Louis Theodore, Francesco Ricci, Wiley Publishers
3) NPTEL
4) Website: academia.edu for Laboratory view based e-learning portal for virtual mass transfer operations laboratory

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (05)
MECHANICAL OPERATION
SUBJECT CODE: 2150502
B.E. 5th SEMESTER

Type of course: Chemical Engineering.

Prerequisite: Heat, Mass and Momentum transfer

Rationale: The main objective of this subject is to study the basic mechanical operation (crushing, grinding, screening, filtration, etc.) takes place during the process in chemical industry. It also provides platform to study and analyze various properties associated with the solid when it is in flow condition. This subject provides the fundamental knowledge regarding to particle size reduction and enlargement by various methods and also deals with the detail construction & working of equipment's used for mechanical operations.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	3	7	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Solids and Its Flow Properties:** Characterization of solid particles, Mixed particles sizes and analysis, Screen analysis, properties of particulate masses, Mixing of solids, Mixer for cohesive solids, Mixer for free flowing solids.	08	15
2	**Size Reduction, Enlargement, Screening:** Principles of comminution, Rittinger's and kick's laws, Bond's crushing law and work index, Size reduction equipments, crushers, grinders, Ultra fine grinders, Cutting machines, Open circuit and closed circuit operation, Screening equipment, Comparison of ideal and actual screens, Screen effectiveness.	12	22
3	**Fluidization and Conveying:** Conditions for Fluidization, Types of fluidization, Applications of fluidization, Slurry and pneumatic transport, Conveyers.	10	19
4	**Filtration and Sedimentation :** Introduction, Cake filters, Filter press, Shell and leaf filters, Discontinuous vacuum filters, Continuous vacuum filters, Centrifugal filters, Filter media, Filter aids, Principles of cake filtration, Clarifying filters, Gravity classifiers, Sink and float method, Differential settling methods, Clarifiers and thickeners, Batch sedimentation, Rate of sedimentation, Thickeners, sedimentation zones in continuous thickeners, Cyclones, Hydrocyclones, Cenrifuges.	15	28

5	**Mixing and Agitation:** Different types of agitators and their selection criteria, Calculation of power required for agitation, Scale up of agitated vessel, Static mixers.	**09**	**16**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**20**	**10**	**10**	**--**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Foust A. S. & associates, "Principles of Unit Operations" John Wiley and Sons (1980).
2. McCabe Smith, "Unit Operation in Chemical Engineering" 5th ed. McGraw Hill (1985).
3. Perry R.H. & Chilton C.H., "Chemical Engineers Hand Book", 7th ed. McGraw hill.
4. Badger and Bencharo, "Introduction to Chemical Engineering". Tata McGraw hill.
5. S. K. Gupta, "Momentum Transfer Operation". Tata McGraw Hill (1979)
6. Davidson J.F. &Harrison D."Fluidization" Academic press (1985)
7. Kunni & Levenspiel "Fluidization engineering "Wiley (1962) 8. Brown, G.G. and associates "Unit operations" Wiley, New York, (1950).
8. Coulson and Richardson: Chemical Engineering, Vol. 2.Butterworth Heinemann Pub
9. Welty, Wicks, Wilson & Rorrer, Fundamentals of Momentum, Heat and Mass Transfer, 4th ed. Wiley Narayanan C.M.& Bhattacharya B.C. "Mechanical Operations for Chemical engineers", Khanna Publishers. 3 rd Ed.1999

Course Outcome:

After learning the course the students should be able to:

1. To build basic knowledge of various mechanical operations.
2. To review the practical importance and relevance of unit operations used for crushing, grinding and size separation in chemical industry.
3. To utilize the technological methods related to unit operations in process plant.
4. To study a detailed overview of equipment used to perform various mechanical operations and problems associated during the implementation and applications.
5. To build a bridge between theoretical and practical concept used in industry

List of Experiments and Open Ended Projects:

Minimum **5** practicals to be performed and remaining time should be allotted to open-ended projects / study reports / latest outcomes in technology study:-

1. In the beginning of the academic term, faculties will have to allot their students at least one Open-ended Project / Study Report / Latest outcome in technology.

2. Literature survey including patents and research papers of fundamental process
- Design based small project **or**
- Study report based on latest scientific development **or**
- Technology study report/ modeling/ simulation/collection report **or**
- Computer based simulation/ web based application/ analysis presentations of basic concept field which may help them in chemical engineering.

3. These can be done in a group containing maximum **three** students in each.
4. Faculties should cultivate problem based project to enhance the basic mental and technical level of students.
5. Evaluation should be done on **approach of the student on his/her efforts** (not on completion) to study the design module of given task.
6. In the semester student should perform **minimum** 5 set of experiments and complete **one small open ended dedicated project** based on engineering applications. This project along with any performed experiment should be **EVALUATED BY EXTERNAL EXAMINER.**

PRACTICALS (ANY FIVE):

Sr. No.	List of experiments
1.	To carry out the batch sedimentation tests.
2.	To study the effect of forth flotation in the recovery of given sample from the solution.
3	To calculate the overall efficiency of the cyclone separator.
4.	To find mixing index.
5.	To determine Critical index, Work Index, Bond's Law, Rittinger's Law and Kick's Law for Ball mill.
6.	To determine the screen efficiency for the given sample.
7.	To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index.
8.	To determine nip angle, Reduction Ratio, Ribbon Factor, Rittinger's constant, Bond's constant, Kick's constant , Work Index as well as Theoretical & Actual Capacity.
9.	To Study how the power consumption of an agitator changes with Reynolds and Froude numbers.
10.	To study the Filter Press.

Design based Problems (DP)/Open Ended Problem:

Students are free to select any area of science and technology based on chemical engineering applications to define Projects.

Some suggested projects are listed below:

- Preparation of working / non working models of filtration equipments, mixing / agitation tanks, grinding / crushing unit and its industrial importance.
- Practical importance of various and various analogies associated with it.

Major Equipment:

Jaw crusher, Gyratory crusher, Roll crusher, Ball mill, Cyclone separator, Plate & Frame filter, Filter press, Sieve shaker apparatus etc.

List of Open Source Software/learning website:

1) Literature available in any laboratory manual of Mechanical Operation.
2) NPTEL
3) MIT Open course lecture available on Internet etc…

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (05)
CHEMICAL ENGINEERING THERMODYNAMICS – II
SUBJECT CODE: 2150503
B.E. 5th SEMESTER

Type of course: Chemical Engineering

Prerequisite: Chemical Engineering Thermodynamics- I

Rationale: This course introduces the basic thermodynamics concepts of multiphase equilibrium in pure and multi-component systems. Starting with ideal gas mixtures and ideal solutions, the concepts of bubble and dew points are introduced to enable flash calculations and design of process components. Subsequently, various levels of non-ideality and complexity are introduced: 1) activity coefficient models for non-ideal liquid mixtures, 2) fugacity calculations of gas and liquid phases from equations-of-state, 3) systems with chemical reactions. The course provides fundamental insight into the underlying thermodynamic principles, as well as practice with advanced computational techniques to solve complex problems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2	0	5	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Vapour/Liquid Equilibrium (VLE): Introduction The Nature of Equilibrium, the Phase Rule, Duhem's Theorem, VLE-Qualitative Behaviour, Azeotropic Mixtures, Maximum Boiling Azeotrope, Minimum Boiling Azeotrope, Simple Models for Vapour/Liquid Equilibrium ,Raoult's Law, Dewpoint and Bubblepoint Calucations with Raoult's Law ,VLE by Modified Raoult's Law,VLE from K,Value Correlations, Flash Calculations	12	22
2	Solution Thermodynamics: Theory Fundamental Property Relation, The Chemical Potential as a Criterion for Phase Equilibria, Partial Properties, Equations Relating Molar and Partial Molar Properties , The Partial Molar Gibbs Energy and the Generalized Gibbs-Duhem Equation, Partial Properties in Binary Solutions, Relations among Partial Properties, The Ideal Gas Mixture , The Partial Molar Gibbs Energy and Fugacity, Fugacity and Fugacity Coefficient: Pure Species, Fugacity and Fugacity Coefficient: Species in Solution ,The Ideal Solution Model , The Lewis/Randall Rule , Excess Properties , The Excess Gibbs Energy and the Activity Coefficient, Nature of Excess Property	12	22
3	Solution Thermodynamics: Applications Liquid-Phase Properties from VLE Data ,Composition Dependence of Liquid- Phase Fugacities for Species in a Binary Solution, Excess Gibbs	12	22

	Energy, Data Reduction, Thermodynamic Consistency, Integral or Area Test Method , Models for the Excess Gibbs Energy, Margules Equations, VanLaar Equations, Calculations with Margules and VanLaar Equations, Local Composition Models, NRTL Equation, UNIQUAC Equation, UNIFAC Method, Enthalpy/ Concentration Diagrams		
4	Chemical Reaction Equilibria: The reaction coordinates, Application of the criteria for equilibrium to chemical reactions, the standard Gibbs free energy change and the equilibrium constant, effect temperature on equilibrium constant, evaluation of the equilibrium constant, Relation of equilibrium constant to composition, calculation of equilibrium conversion for single reaction, The phase rule and Duhem's theorem for reacting systems, multireaction Equilibria	12	22
5	Phase Equilibria: The Gamma / Phi Formulation of VLE, Equilibrium and stability, liquid-liquid equilibrium, solid- liquid equilibrium, osmotic equilibrium and osmotic pressure	6	12

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	**28**	**21**	**7**	**7**	**-**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Smith J.M, Van Ness H.C., Abbott M. M, "Introduction to Chemical Engineering Thermodynamics", the McGraw Hill Companies, Inc., USA, 7th Ed., 2005.
2. Elliot J. R. and Lira C.T., "Introductory Chemical Engineering Thermodynamics", Prentice Hall, 1999.
3. Hougen O.A., Watson K.M., and Ragatz R.A., "Chemical Process Principles Part,II" Thermodynamics, John Wiley 1970.
4. Perry's chemical engineers handbook, 7th edition, McGraw,Hill, USA, 2000.
5. K.V.Narayanan "A Text book of chemical Engineering thermodynamics", Prentice Hall of India
6. Stanley I. Sandler, "Chemical, Biochemical and Engineering Thermodynamics", Wiley India Pvt. Ltd., 4th ed., 2007.
7. B.G. Kyle,"Chemical Process Thermodynamics", 2nd Edn., Prentice Hall of India Pvt.Ltd., New Delhi, 2000.
8. J.M.Prausnitz, R.N. Litchtenthaler, Molecular thermodynamics of fluid phase Equilibria, 3rd Edition,Prentice Hall.
9. Stanley M. Walas, Phase-Equilibria in Chemical Engineering,Wiley India Private Limited

Course Outcome:

After learning the course the students should be able to:

1. Solution thermodynamics fundamentals. Application of Raoult's law and its variation to obtain VLE for binary systems.
2. Understand partial molar properties of components in a particular phase, and apply to calculations of heat of mixing, volume, and entropy changes on processing of ideal and real mixtures.
3. Azeotrope and its importance.
4. Estimating thermodynamic properties like fugacity, activity from the network of equations.
5. Solution Thermodynamics calculating the thermodynamic properties from experimental data. Different Activity coefficient models.
6. Data reduction to get constants of different activity coefficient models.
7. Predict the equilibrium products and their concentration in equilibrium when dealing with systems involving chemical reactions. The topic will include Homogeneous and Heterogeneous reaction. You will also get an introductory knowledge of multi reaction equilibrium.

List of Open Source Software/learning website:

1. Students can refer to video lectures available on the websites including NPTEL lecture series.
2. Students can refer to the CDs available with some reference books for the solution of problems using software/spreadsheets. Students can develop their own programs/spreadsheets for the solution of problems.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (05)
INSTRUMENTATION & PROCESS CONTROL
SUBJECT CODE: 2150504
B.E. 5th SEMESTER

Type of course: BE

Prerequisite: Basics of differential equations, material and energy balance.

Rationale: This course introduces dynamic processes and the engineering tasks of process operations and control. Subject covers modeling the static and dynamic behavior of processes; control strategies; design of feedback, feed forward, and other control structures; and applications to process equipment.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	3	7	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction of Process Control:** Steady state system, Process control, Feedback control, Transient response, Proportional control, Integral control, Block diagram, Parts of control system.	1	2
2	**Laplace Transforms:** Definition, Transforms of simple functions, Ramp functions, Sine functions, Solutions of differential equations. Inversions of transform function by partial fractions, qualitative nature of solutions, Final value and initial value theorems, Translation of transforms, Transforms of unit impulse functions, Transforms of integral.	5	9
3	**Response of First Order Systems:** Mercury thermometer, Transient response of step functions, Sinusoidal input, Impulse functions. Physical Examples of First Order Systems: Liquid level, Mixing process, RC circuit, linearization. First Order System in Series: Non-interacting system of liquid level, Generalization of several non-interacting systems in series, Interacting systems.	6	11
4	**Second Order Systems:** Development of transfer functions, Damped vibrator, Liquid manometer, Thermometer in thermo pocket, Step response & impulse response for $\zeta<1$, $\zeta>1$& $\zeta=1$, Overshoot, Decay ratio,	4	8

	Rise time, Response time, Period of oscillation, Natural period of oscillation, Sinusoidal response, Transportation lag.		
5	**The Control Systems:** Block diagram, Negative and positive feedback, Servo problem v/s regulator problems, Development of block diagrams, Process measuring element, Controller, Final control element. Closed Loop Transfer Functions: Standard block diagram symbols, Overall transfer function for single loop system, Overall transfer function for change in load, Overall transfer function for multi loop control system.	**6**	**11**
6	**Controllers and Final Control Elements:** Actual v/s Ideal controller, Pneumatic controller mechanism of proportional control, Proportional integral (PI) control, Proportional derivative (PD) control, Proportional integral derivative (PID) control. Control valve, Control valve characteristics.	**2**	**4**
7	Transfer functions of P, On-off, PI, PD, and PID control, Motivation for addition of integral and derivative modes, Block diagram of chemical reactor control system.	**2**	**4**
8	**Transient Response of Simple Control Systems:** Proportional control for Set point change (Servo Problem), Proportional control for load change (Regulator Problem), Proportional integral control for load change, Proportional Integral control for set point change, Proportional control for system with measurement lag.	**3**	**5**
9	**Stability:** Concept of stability, Definition of stability (linear system), Stability criterion, Characteristic equation, Routh test for stability, Routh array, Method of Root Locus for stability analysis, Nyquist stability criterion.	**6**	**11**
10	**Frequency Response analysis:** Fortunate circumstances, Transportation lag, Bode diagrams, First order system, First order system in series, Graphical rules for Bode diagrams.	**4**	**8**
11	**P & I Diagrams (Piping & Instrumentation diagram):** Symbols, P&I Diagram of reactors, Distillation column, Shell & tube heat exchanger, etc.	**1**	**2**
12	**Introduction of Process Measurement:** Elements of instruments, Parts of instruments, Static and dynamic characteristics.	**1**	**2**
13	**Temperature Measurement:** Scales, Expansion thermometers like constant volume gas, Mercury in glass, Bimetallic, Filled system thermometer like pressure spring thermometer, Static accuracy of thermometer, Dip effect in thermometer, Errors in thermometer of liquid and gas filled type like cross ambient effect, Head effect, Methods of compensation, Thermoelectric temperature measurement: Thermo couples, Laws of thermo electricity, Pyrometers: Laws of radiation,	**4**	**8**

	Radiation pyrometer, Photo electric pyrometers, Optical pyrometers, Errors in optical pyrometers.		
14	**Pressure Measurement:** Liquid column manometer, Enlarged lag manometer, Inclined tube manometer, Ring manometer, Tilting U tube manometer, Bourdon gauge, Bellows, Bellows differential pressure gauge, Vacuum Measurement: Ionization gauge, Pirani vacuum gauge, Thermocouple vacuum gauge, McLeod gauge	**3**	**5**
15	**Liquid Level Measurement:** Direct measurement, Float and tap, Float and shaft, Hydraulic remote transmission, Bubbler system, Diaphragm & air trap system, Differential pressure manometer, Float and spring pneumatic balance, Displacement float, Magnetic float gauge.	**3**	**5**
16	**Flow Measurement:** Head flow meter, Orifice plate, Flow nozzle, Venturi tube, pitot tube, Differential pressure meter, Electric type head flow meter, Bellows type meter, Rotameter, Piston type area meter, Positive displacement meter.	**3**	**5**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**20**	**15**	**10**	**5**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. "Process System Analysis & Control", Coughanower and Kappel, Mc-Graw Hill Book Company.
2. "Process Control and Instrumentation", R. P. Vyas, Denett & Co.
3. "Chemical Process Control", George Stephanopoulos, Prentice-Hall India
4. "Industrial Instrumentation", Donald .P. Eckman, John Wiley & Sons Inc, New York.
5. "Industrial Instrumentation & Control", S. K. Singh, Tata McGraw-Hill Education.
6. "Process Instrumentation And Control", A. P. Kulkarni, Nirali Prakashan

Course Outcome:

After learning the course the students should be able to:

1. Understand concepts of process dynamics and various forms of mathematical models to express them, including differential equations, Laplace transfer functions, and frequency response plots.
2. Develop mathematical models of chemical and processes by writing unsteady-state mass and energy balances.

3. Analyze, design and tune feedback / feedforward controllers in the context of various control strategies used to control chemical and biological processes.
4. Recognize and fit various simple empirical models that are used for designing controllers.
5. Understand and design basic control strategies.

List of Experiments:

Experiments based on above topics.

Design based Problems (DP)/Open Ended Problem:

- Non working models of control systems for exemplary chemical processes
- Projects based on advanced control strategies
- Mathematical models of simple physical systems
- Studies related to modern hardware and instrumentation needed to implement process control

Major Equipment:

- Interacting and non interacting liquid level tanks
- Equipment for non linear process
- Temperature trainer
- Pneumatic control valve, etc

List of Open Source Software/learning website:

- NPTEL lecture series
- Literature available on Instrumentation & Process Control
- MIT Open course lecture on Instrumentation & Process Control

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