

SCHEME OF STUDIES
DIPLOMA IN CHEMICAL ENGINEERING (C-20)

CURRICULUM STRUCTURE

V Semester Scheme of Studies - Diploma in Chemical Engineering [C-20]

Pathway	Course Category / Teaching Department	Course Code	Pathway Title	Hours per Semester			Total contact hrs /Semester	Credits	CIE Marks		SEE-1 Marks (Theory)		SEE-2 Mark (Practical)		Total Marks	Min Marks for Passing (including CIE marks)	Assigned Grade	Grade Point	SGPA and CGPA
				L	T	P			Max	Min	Max	Min	Max	Min					
Programme Specialization Pathway																			
1	ES/CH Specialization pathways in emerging areas Student may select any one specialization	20CH51I	1. Petroleum technology and Petrochemicals.	104	52	312	468	24	240	96	60	24	100	40	400	160			Both SGPA & CGPA
		20CH52I	2. Instrumentation and process control	104	52	312	468	24	240	96	60	24	100	40	400	160			
		20CH53I	3. Food technology and	104	52	312	468	24	240	96	60	24	100	40	400	160			
		20CH54I	4. Process plant technology	104	52	312	468	24	240	96	60	24	100	40	400	160			
Science and Research Pathway				L	T	P	Total	Credit	CIE Marks		SEE Marks								
									Max	Min	Max	Min							
2	BS/SC/CH Specialization pathway in Science and Research (Student need to take all four papers in this pathway)	20SC51T	Paper 1-Applied Mathematics	52	26	0	78	6	50	20	50	20	100	40					Both SGPA & CGPA
		20SC52T	Paper 2 - Applied Science	52	0	52	104	6	50	20	50	20	100	40					
		20RM53T	Paper 3 - Research Methodology	52	0	52	104	6	50	20	50	20	100	40					
		20TW54P	Paper 4 - Technical Writing	39	13	52	104	6	60	24	40	16	100	40					
			Total	195	39	156	390	24	210	84	190	76	400	160					
Entrepreneurship Pathway																			
3	ES/CH	20ET51I	Entrepreneurship and Start up	104	52	312	468	24	240	96	160	64	400	160					

L:- Lecture T:- Tutorial P:- Practical BS- Basic Science:: ES-Engineering Science:: SC: Science , I: Integrated

Note: In 5th Semester student need to select any one of the pathways consisting of 24 credits

Students can continue their higher education irrespective of the pathways selected

CURRICULUM STRUCTURE

VI Semester Scheme of Studies - Diploma in Chemical Engineering [C-20]

Pathway	Course Category / Teaching Department	Course Code	Pathway	Course		Total contact	Credits	CIE Marks		SEE Marks		Total Marks	Min Marks for Passing	Assigned Grade	Grade	SGPA and CGPA
								Max	Min	Max	Min					
Internship	CH	20CH61S	Specialisation pathway	Internship/ project	40 Hours / week Total 16 Weeks	640	16	240	96	160	64	400	160			
		20CH61R	Science and Research Pathway	Research project	40 Hours / week Total 16 Weeks	640	16	240	96	160	64	400	160			
		20CH61E	Entrepreneurship and Start up pathway	Minimum Viable Product - MVP/ Incubation/ Startup proposal	40 Hours / week Total 16 Weeks	640	16	240	96	160	64	400	160			

Note: Student shall undergo Internship/Project/research project/MVP/Incubation/Startup proposal in the same area as opted

in 5th semester pathway

Petroleum and Petrochemical Technology



Government of Karnataka

DEPARTMENT OF COLLEGIATE and TECHNICAL EDUCATION

Program	Diploma in chemical Engineering	Semester	V
Course Code	20CH51I	Type of Course	L:T:P (104: 52: 312)
Specialization	Petroleum and Petrochemical Technology	Credits	24
CIE Marks	240	SEE Marks	160

Introduction:

Welcome to the curriculum for the Specialisation Pathway – Petroleum and petrochemical technology is specialisation course taught in Boot camp mode. Boot camps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur. You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn how to develop process flowsheets and demonstrate Petroleum refineries and petrochemical industrial processes that are needed for today's job skills of a chemical technologist aspiring to secure a job role in a refinery or petrochemical industry.

Leading to the successful completion of this boot camp, you shall be equipped to either do an internship in a petroleum refinery and petrochemical industry or do project in the related field. After the completion of your diploma, you shall be ready to take up roles like production operator, Supervisor and can rise up to the level of production Manager, also can become Entrepreneur in the related field and more.

This course will teach you about Petroleum and petrochemical processes, develop a flowsheet, identify engineering problems in an operation or a process and troubleshoot and analyse a process from a point of view of environmental concerns to identify pollution problems and suggest suitable remedies.

Pre-requisite:

Before the start of this specialisation course, you will have prerequisite knowledge gained in the first two years on the following subjects:

1st year -Engineering Mathematics, Communication Skills, Computer Aided Engineering Graphics, Statistics & Analysis, Basic IT Skills, Fundamentals of Electrical and Electronics Engineering, Project Management skills, Particulate technology and particulate technology lab.

2nd year- Inorganic chemistry, physical and organic chemistry, Momentum transfer, heat transfer, chemical process calculations, Mass transfer, Plant maintenance and pollution control, Thermodynamics and reaction kinetics.

Instruction to course coordinator

1. Each Pathway is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. Single faculty shall be the Cohort Owner.
3. This course shall be delivered in boot camp mode

4. The industry session shall be addressed by industry subject experts (in contact mode/online / recorded video mode) in the discipline only.
5. The cohort owner shall identify experts from the relevant field and organize industry session as per schedule.
6. Cohort owner shall plan and accompany the cohort for industrial visits.
7. Cohort owner shall maintain and document the industrial assignments and weekly assessments, practices and mini project.
8. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table
9. The cohort owner along with classroom can augment or use for supplementally teaching on line courses available although reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademic, SWAYAM, etc.
10. Cohort owner shall guide the cohort for the execution of mini project

Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Identify the origin and occurrence, exploration of crude petroleum, different distillation methods of crude petroleum and heating of crude, dehydration and desalting of crude and explain environmental concerns and energy consumption reduction methods.
CO-02	Identify the treatment methods of petroleum products, the cracking, catalytic cracking, fluidized bed cracking and coking methods and energy consumption reduction pertaining to environmental concerns.
CO-03	Identify the cracking, catalytic cracking, fluidized bed cracking and coking methods and energy consumption reduction pertaining to environmental concerns.
CO-04	Identify the various unit operations and processes involved in the purification and manufacture of petrochemicals, various reactions involved & methods of production of petrochemicals and their applications and production of various C3 and C4 and higher hydrocarbons and identify their applications.
CO-05	Build a flowsheet of Natural Rubber production, structure collection, properties, compounding, masticating mixing, vulcanization, Bio- diesel – Raw materials, methods of production.

Detailed course plan

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
1	1	1,2,4,5,7	1	Present an overview of Petroleum refinery operations and petrochemical processes.	4			Present an over view of Petroleum refineries and petrochemical industries in Indian scenario.			3
			2	Origin and formation of petroleum - Occurrence of petroleum- Theories of origin -Indian resources	1		3	Virtual demonstration and documentation on Origin and formation of petroleum - Occurrence of petroleum- Theories of origin -Indian resources			3
			3	Composition of crude petroleum --Primary methodologies to find hydrocarbons - Exploration methods and production-Drilling mechanism of petroleum.	1		3	Storage - different types of tanks, conditions required, instruments used - Transportation. Virtual demonstration of exploration methods.			3
			4	Environmental concerns & innovative methods to reduce energy consumption, for recovery & reuse of valuable materials in petroleum and petrochemical industries.			4	Virtual tour/ demonstration and documentation on pollution problems and treatment methods generally adopted in petroleum and petrochemical industries.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
2	1	1,2,4,5,7	1	PEER Discussion on Industry Assignment		2	2	Make a presentation on different exploration methods			3
			2	Properties of petroleum products - Specific gravity, Viscosity. Various instruments used to measure viscosity - Redwood viscometer - Ostwald viscometer etc.	4			Experiment to determine viscosity of petroleum products using viscometers. Virtual demonstration on automatic viscometers -capillary tube method .			3
			3	Distillation range - flash and fire point - pour point and cloud point - smoke point and char point - carbon residue - Sulphur and moisture content, Aniline point.			4	Experiment to determine flash point and fire point of petroleum products. Experiment to determine aniline point.			3

			4	Calorific value, octane number, cetane number	2		2	Experiment to determine the calorific value of a fuel. Virtual demonstration on octane test engine.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
3	1	1,2,4,5,7	1	PEER Discussion on Industry Assignment		1	3	Demonstrate and document on the determination of any property of a petroleum product.			3
			2	Dehydration and desalting. Chemical treatment, gravity settling and electric desalting. Heating of crude – Pipe still heaters and furnaces and Distillation of petroleum methods	4			Virtual tour/ demonstration and documentation on various treatment techniques.			3
			3	Arrangements of towers – Vacuum distillation unit and stages wise distillation units - Production from distillation – Blending operation – integrated refineries.	2		2	Virtual tour/ demonstration and documentation petroleum distillation towers –VDU AND ADU.			3
			4	Virtual tour/ demonstration and documentation on Environmental problems and treatment methods in the above processes.			4	Treatment techniques – Production and treatment of LPG – absorption techniques – gas liquefaction – Amine treatment .			3
			5	CIE 1- Written and practice test				Assessment Review and corrective action.			3
			6	Industry Class +Industry assessments	2		2				
4	2		1	PEER Discussion on Industry Assignment		1	3	Demonstrate and document on- Pipe still heaters and furnaces.			3

		1,2,4,5,7	2	Gasoline Treatment –by different methods.	4			Virtual tour/ demonstration and documentation on gasoline treatment			3
			3	Treatment Kerosene – liquid sulphur dioxide extraction. Treatment of lube oils – Clay treatment method, solvent method.	2		2	Virtual tour/ demonstration and documentation on different treatment methods of kerosene. Virtual tour/ demonstration and documentation on different treatment methods of lube oils.			3
			4	Different solvent treatment methods of lube oils. Environmental problems and treatment methods in the above processes.	1		3	Virtual tour/ demonstration and documentation on pollution problems and treatment methods in the above processes			3
			5	Developmental Assessment		4		Assessment Review and corrective action.			3
			6	Industry Class +Industry assessments	2		2				
5	2,3	1,2,4,5,7	1	PEER Discussion on Industry Assignment		2	2	Presentation and document on properties of solvents used in gasoline, kerosene and lube oil treatment.			3
			2	Wax and purification – dewaxing process, Chilling and pressing, sweating and solvent dewaxing	4			Virtual tour/ demonstration and documentation on Ketone dewaxing. propane dewaxing			3
			3	Environmental concerns & innovative methods to reduce energy consumption, for recovery & reuse of valuable materials .	1		3	Virtual tour/ demonstration and documentation innovative methods to reduce energy consumption in dewaxing treatment.			3
			4	Cracking – Thermal cracking reactions ,dubbs two coil process.	2		2	Virtual tour/ demonstration and documentation on Cracked products and properties.			3
			5	CIE 2- Written and practice test				Assessment Review and corrective action			3
			6	Industry Class	2		2				

6	3	1,2,4,5,7	1	PEER Discussion on Industry Assignment		2	2	Presentation and documentation on field of applications of wax and its properties, perform tests on wax properties			3
			2	Catalytic cracking – Reactions– Fixed bed (Houdry process) , Moving bed by air lift method and Houdry flow process.	1		3	Types of Catalysts, properties, Advantages of Catalytic cracking. video demonstration on Catalytic cracking.			3
			3	Fluidized bed processes: Fluid Catalytic cracking process – Catalytic reforming. Hydro cracking - HG processes – Moving bed hydro crackers. –	4			Coking , delayed and fluid coking			3
			4	Hydro fining operation, visbreaking operation	1		3	Environmental concerns & innovative methods to reduce energy consumption, for recovery & reuse of valuable materials like catalysts, solvents, by-products of coking, gaseous products in the above processes.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class + Industry assessments	2		2				
7	4	1,2,4,5,7	1	PEER Discussion on Industry Assignment		2	2	Presentation and documentation on Flexi and Ortho flow Catalytic cracking and different methods of hydrofining operations.			3
			2	Development of Petrochemical industries – Status in India – Feed stocks for petrochemicals – Purification of gases – Separation of gases into individual constituents by separation techniques	4			Manufacture of petrochemicals – Chemicals from methane – oxidation of methane – Production of Methanol			3
			3	Formaldehyde, Flouro- Chloro methane, Methyl amines	1		3	Occurrence of Ethane – Ethylene production by thermal cracking			3
			4	Vinyl chloride by oxychlorination, Acetaldehyde production from acetylene.	2		2	Virtual demonstration and documentation on chemicals from methane and ethane			3
			5	CIE 3- Written and practice test				Assessment Review and corrective action			
			6	Industry Class + Industry assessments	2		2				

8	4	1,2,4,5,7	1	PEER Discussion on Industry Assignment		2	2	Make a presentation on ethylene derivatives and its production by naphtha cracking.			3
			2	Chemicals from C3 & C4 & higher hydrocarbons – isopropanol production by sulphuric acid dehydration.	4			Discussion and documentation on acetone.			3
			3	Production of Acrylonitrile – phenol from cumene	1		3	Dehydrogenation of Butene , Production of Butanol			3
			4	Maleic anhydride , Separation of paraffin's-wax products	2		2	Presentation and documentation on above discussed process			3
			5	Developmental Assessment		4		Assessment Review and corrective action			
			6	Industry Class + Industry assessments	2		2				
9	4	.1,2,4,5,7	1	PEER Discussion on Industry Assignment		2	2	Presentation and documentation on schemes for separation of C4 streams			3
			2	Steam Reforming of Hydrocarbons – Natural gas steam reforming	4			Discussion and documentation on Natural gas, its chemical properties, uses and advantages.			3
			3	Polymers, methods of polymerization, poly propylene and its production.	1		3	Presentation and documentation on physical and chemical properties of poly propylene.			3
			4	Plastics, classification, Phenol formaldehyde resin production	2		2	Presentation and documentation on properties applications of Phenol formaldehyde			3
			5	CIE 4- Written and practice test				Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
10	5	1,2,4,5,7	1	PEER Discussion on Industry Assignment			2	Presentation and documentation on PVC.			3
			2	Natural Rubber, structure collection, properties, compounding, masticating mixing, vulcanization.	4			Presentation and documentation on Industrial applications of natural Rubber and synthetic rubber			3
			3	Synthetic rubber- Butadiene from alcohol.	1		3	Production of SBR. Comparison of natural and synthetic rubber.			3

			4	Importance of rubber in industries, rubber products.	2		2	Presentation and documentation on innovations in Rubber industries			3
			5	Developmental Assessment		4		Assessment Review and corrective action			
			6	Industry Class +Industry assessments	2		2				
11	5	1,2,4,5,7	1	Industry Class +Industry assessments		2	2	Presentation and documentation on Pollution problems and treatment methods in the rubber processes.			3
			2	Introduction to biofuels, Raw materials, techniques used for production	4			Virtual demonstration and documentation on production of biofuels.			3
			3	Bio- diesel – Raw materials, methods of production.	1		3	Properties of bio diesel, ISO standards, European standards			3
			4	Bio - ethanol- raw materials, methods of production. Properties of bio ethanol, ISO standards, European standards.	2		2	Presentation and documentation on different types and benefits of Biofuel , comparison of Biofuels with fossil fuels.			3
			5	CIE 5- Written and practice test				Assessment Review and corrective action			
			6	Industry Class +Industry assessments	2		2				
12			1	PEER Discussion on Industry Assignment		2	2	Mini project			3
			2	Mini project	4			Mini project			3
			3	Mini project	1		3	Mini project			3
			4	Mini project	2		2	Mini project			3
			5	Developmental Assessment		4		Assessment Review and corrective action			
			6	Industry Class +Industry assessments	2		2				
13			1	PEER Discussion on Industry Assignment		4		Mini project-presentation and demonstration			3
			2	Mini project-presentation and demonstration			4	Mini project-presentation and demonstration			3
			3	Mini project-presentation and demonstration			4	Mini project-presentation and demonstration			3
			4	Mini project-presentation and demonstration			4	Mini project-presentation and demonstration			3

			5	CIE 6- Comprehensive assessment based on mini project (Only practice)				CIE 6- Comprehensive assessment based on mini project (Only practice)			
			6	CIE 6- Comprehensive assessment based on mini project (Only practice)							

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE (1 to 5)

Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam - 4 hours

Programme	Chemical Engineering	Semester	V		
Course	Petroleum Technology and Petrochemicals	Max Marks	30		
Course Code	20CH51I	Duration	4 hours		
Name of the course coordinator					
Note: Answer one full question from each section.					
Qn.No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) - 10 marks					
1.a)	Construct a diagram and explain the occurrence of crude petroleum.	L3	1	1,2,4,5,7	05
b)	Make use of a neat sketch the petroleum drilling rig to show its working details.	L4	1	1,2,4,5,7	05
2.a)	Identify the composition of crude petroleum.	L3	1	1,2,4,5,7	3
b)	Analyze Dehydration and desalting method of treatment.	L4	1	1,2,4,5,7	3
c)	Conclude Treatment techniques for gasoline.			1,2,4,5,7	4
Section-2 (Practical) - 20 marks					
3)	Determination of any property of a petroleum product.	L4	1	1,2,4,5,7	20
4)	Determine viscosity of(specify the petroleum product) petroleum products using viscometer.	L4	1	1,2,4,5,7	20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme : Chemical Engineering		Semester : V		
Course : Petroleum Technology and Petrochemicals		Max Marks : 100		
Course Code : 20CH511		Duration : 3 Hrs		
Instruction to the Candidate: Answer one full question from each section.				
Q.No	Question	CL	CO	Marks
Section-1				
1.a)	Organize the transportation and storage of petroleum.	L3	1	10
b)	Classify properties of petroleum products	L4		10
2.a)	Apply primary methodologies to find hydrocarbons	L3		10
b)	Compare octane number and cetane number	L4		10
Section-2				
3.a)	Build gasoline Treatment by copper chloride process	L3	2	10
b)	Analyse wax and purification by dewaxing process	L4		10
4.a)	Construct treatment of lube oils clay treatment method	L3		10
b)	Survey environmental concerns & innovative methods to reduce energy consumption	L4		10
Section- 3				
5.a)	Develop Catalytic cracking reactions by Fixed bed (Houdry process)	L3	3	10
b)	Build the flowsheet for Formaldehyde production	L4		10
6.a)	Identify the catalysts properties	L3		10
b)	Develop a flowsheet of Vinyl chloride by oxychlorination	L4		10
Section-4				
7.a)	Construct Isopropanol production by sulphuric acid dehydration	L3	4	10
b)	Conclude Natural gas steam reforming	L4		10
8.a)	Make use of Hydrofining operation by visbreaking	L3		10
b)	Discover Acetaldehyde production from acetylene	L4		10
Section-5				
9.a)	Compare the types natural Rubber and its applications	L3		10

b)	Classify Properties of bio ethanol	L4	5	10
10.a)	Identify Pollution problems and treatment methods in the rubber processes	L3		10
b)	Compare the techniques used for production of Biofuel	L4		10

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
1	Case submission	20
2	Case presentation	20
3	Case innovation	20
4	Result	20
5	Viva voce	20
Total		100

Case Submission / Content Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Identification of the main issues / problem	Identifies and understands all the main issues in the problem statement	Identifies and understands most of the main issues in the problem statement	Identifies and understands some of the issues in the problem statement	Identifies and understands a few of the issues in the problem statement	Identifies limited issues in the problem statement	5
Analysis of the issues	Insightful and thorough analysis of all the issues	Thorough analysis of most of the issues	Superficial analysis of some of the issues in the problem statement	Incomplete analysis of the issues	No analysis of the issue	4
Comments on effective solutions / strategies (The solution may be in the problem statement already or proposed by you)	Well documented, reasoned and pedagogically appropriate comments on solutions, or proposals for solutions, to all issues in the problem statement	Appropriate, well thought out comments about solutions, or proposals for solutions, to most of the issues in the problem statement	Superficial and / or inappropriate solutions to some of the issues in the problem statement	Little and/or inappropriate solutions to all of the issues in the problem statement	No action to all issues in the problem statement	2
Links to course learning and additional research	Excellent research into the issues with clearly documented links to course learnings and beyond.	Good research and documented links to the materials read during the course	Limited research and documented links to any readings	Incomplete research and links to any reading.	No research or links to any reading	3
Total						14/20

Case Presentation Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Delivery & Enthusiasm	Very clear and concise flow of ideas Demonstrates passionate interest in the topic and engagement with class / examiner	Clear flow of ideas Demonstrates interest in the topic and engagement with class / examiner	Most ideas flow but is lost at times Limited evidence of interest in and engagement with the topic	Hard to follow the flow of ideas Lack of enthusiasm and interest	No flow in the presentation Poor presentation skills	4
Visuals	Visuals augmented and extended comprehension of the issues in unique ways	Use of visuals related to the topic	Limited use of visuals loosely related to the topic	No use of visuals	Poor visuals used and some visuals are not easy to understand its relevance.	2
Staging	Uses stage effects such as props, sound effects, and speech modulation in a unique and dramatic manner that enhances the understanding of the issues in the problem statement.	Uses stage effects such as props, sound effects, and speech modulation in an effective manner to extend the understanding of the issues in the problem statement.	Limited use of stage effects and/or used in a manner that did not enhance the understanding of the issues in the problem statement.	No use of stage effects	Poor stage effects usage	5
Involvement of the class / Examiners • Questions • Discussions • Activities	Excellent and salient discussion points that elucidated material to develop a deep understanding Appropriate and imaginative activities used to extend understanding in a creative manner	Questions and discussions addressed important information that developed understanding Appropriate activities used to	Questions and discussions addressed important superficial issues of the problem statement Limited use of activities to clarify understanding	Little or no attempt to engage the class / examiner in demonstrating their learning	Did not engage the class / examiner and poor listening skills	1

		clarify understanding				
Total						12/20

Case Results Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Problem outcome	The topic was well researched and all information and data included are accurate and from reliable sources of information like high impact journals standards, etc. The proof was enough backed up with accurate data, analysis and reasoning beyond the class learning. Outcome achieved beyond the problem brief	The topic was researched and most information and data were from reliable sources of information. The proof was backed up with good data and reasoning as taught in the class. Outcome achieved as per the problem brief	The topic was researched but information and data were only partly from reliable sources of information. The proof was not fully backed up with good data or reasoning as taught in the class. Partial outcome achieved as per the problem brief	The topic was researched and data were not from reliable sources. The proof was not backed up with data, analysis or reasoning as taught in the class. Some outcome obtained as per the problem brief	Desired results not obtained, but some relevant research was done. Outcome not obtained as per the problem brief	4
Application of class learning in problem solving	Made effective use of class principles, models and theories. Also used creativity to find effective results appropriate to industry beyond class learning.	Made good use of class principles, models and theories Some creative ideas were explored to find desired outcome but within the framework of class learning	Made some use of class principles, models and theories No creative ideas or models explored	Made limited use of class principles, models and theories	Poorly applied class principals, models and theories	3

Response to Class / Examiners Queries	Queries Excellent response to comments and discussion with appropriate content supported by theory/research	Good response to questions and discussions with some connection made to theory/research	Satisfactory response to questions and discussions with limited reference to theory/research	Limited response to questions and discussions with no reference to theory/research	Poor or no response to questions and did not participate in the discussions.	2
Conclusions	Provides detailed and appropriate conclusion for the problem statement	Provides appropriate conclusion for the problem statement	Provides adequate and mostly appropriate conclusions for the problem statement	Provides limited and somewhat appropriate conclusions for the problem statement	Has not provided appropriate conclusions for the problem statement.	4
Total						13/20

Case Innovation Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Finding new processes / models / approaches	The newly discovered processes / models / approaches are of good quality and relevant	The newly discovered processes / models / approaches are of appropriate quality but limited relevance	The newly discovered processes / models / approaches have limited application but relevant to the problem	The newly discovered processes / models / approaches has restricted application	No new processes / models / approaches were identified	5
Proposing ideas and innovative solutions in terms of processes / models / approaches and how they can be applied to solve the problem on hand	Various ideas and innovative solutions have been proposed and their application have been clearly outlined	Various ideas and innovative solutions have been proposed as well as the outline of the process to apply them	Some ideas or innovative solutions have been proposed but the process of applying them hasn't been specified	Few ideas have been proposed	No ideas or innovative solutions have been proposed	3
Using creativity techniques to provide and reason good ideas which are original and unconventional	Wherever necessary creativity techniques are utilized to analyse and solve the problem	Creativity techniques are frequently utilized in more than 50% of the occasions	Creativity techniques are utilized at times in less than 50% of the occasions	Creativity techniques are used a few times only	Creativity technique are not utilized to analyse and solve the problem	2
Finding constraints and weak points in existing processes / models / approaches or methods	Constraints and weak points are understood	Constraints and weak are identified	A critical analysis is undertaken	Only a description of the working process and methods are provided	No constraints or weak points have been identified.	3
Total						13/20

Required course facilities:

1. Industry connect:

- Mangalore refineries and petrochemicals.
- Reliance petroleum Ltd.
- Gas Authority of India Ltd.
- Hindustan petrochemicals Ltd.
- Bharath petroleum Ltd.
- Indian Oil Corporation.
- Haldia petrochemicals Ltd.
- Manali petrochemicals Ltd.
- I G petrochemicals Ltd.

2. Virtual Demonstration:

1. <http://business.mapsofindia.com/india-petroleum-industry/growth-of-indiapetrochemical.html>
2. <http://business.mapsofindia.com/india-petroleum-industry/methanol.html>
3. https://www.youtube.com/watch?v=SedGDg2K_aI
4. <https://www.youtube.com/watch?v=ERY7IHAhLe4>
5. <http://www.icis.com/resources/news/2007/11/01/9075186/caprolactamproduction-and-manufacturing-process/>
6. <https://www.youtube.com/watch?v=anGj0-yeb88>
7. <https://www.youtube.com/watch?v=SFmdcWZLWaE>

3. Lab equipments with specifications:

Sl. No.	Name of the apparatus	Quantity(Nos.)
1.	Specific gravity bottles (50 cm ³ capacity)	20
2.	Ostwald's viscometer (20 cm ³ capacity)	5
3.	Red wood viscometer (50 cm ³ capacity)	5
4.	Flash and fire point apparatus	5
5.	Pour point and cloud point apparatus	5
6.	Bomb calorimeter	2
7.	Spectrometer(UV and IR)	1
8.	Gas liquid chromatography	1

References:

1. Shreve's Chemical Technology by Austen
2. Dryden's Outlines of Chemical Technology by Gopal Rao
3. Petrochemical processes by Dr. BKB Rao
4. A text book of Chemical technology-II by G N Pandey
5. Petrochemicals by Peter Wiseman

Instrumentation and process control.



Government of Karnataka
DEPARTMENT OF COLLEGIATE and TECHNICAL EDUCATION

Program	Chemical Engineering	Semester	V
Course Code	20CH52I	Type of Course	L:T:P (104: 52: 312)
Specialization	Instrumentation and process control.	Credits	24
CIE Marks	240	SEE Marks	160

Introduction:

Welcome to the curriculum for the Specialisation Pathway – **Instrumentation and process control** is specialisation course taught in Boot camp mode. Boot camps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur. You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn how to operate, troubleshoot instruments used in an industrial process and automatically control a process that are needed for today's job skills of a chemical technologist aspiring to secure a job role in a chemical industry.

Leading to the successful completion of this boot camp, you shall be equipped to either do an internship in a chemical industry or do project in the related field. After the completion of your Diploma, you shall be ready to take up roles like production operator, Supervisor and can rise up to the level of production Manager or also can become Entrepreneur in the related field and more.

This course will teach you about process instrumentation and control, develop a block diagram of a process control, identify engineering problems in an operation or a process and troubleshoot.

Pre-requisite

Before the start of this specialisation course, you will have prerequisite knowledge gained in the first two years on the following subjects:

1st year -Engineering Mathematics, Communication Skills, Computer Aided Engineering Graphics, Statistics & Analysis, Basic IT Skills, Fundamentals of Electrical and Electronics Engineering, Project Management skills, Particulate technology and particulate technology lab.

2nd year- Inorganic chemistry, physical and organic chemistry, Momentum transfer, heat transfer, chemical process calculations, Mass transfer, Plant maintenance and pollution control, Thermodynamics and reaction kinetics.

Instruction to course coordinator

1. Each Pathway is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. Single faculty shall be the Cohort Owner.
3. This course shall be delivered in boot camp mode

4. The industry session shall be addressed by industry subject experts (in contact mode/online / recorded video mode) in the discipline only.
5. The cohort owner shall identify experts from the relevant field and organize industry session as per schedule.
6. Cohort owner shall plan and accompany the cohort for industrial visits.
7. Cohort owner shall maintain and document the industrial assignments and weekly assessments, practices and mini project.
8. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table
9. The cohort owner along with classroom can augment or use for supplementally teaching on line courses available although reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademic, SWAYAM, etc.
10. Cohort owner shall guide the cohort for the execution of mini project

Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Identify the basic elements and functions of instruments and its different characteristics, Process variables – demonstrate Temperature measurement, Pressure measurement, direct Level measuring instruments.
CO-02	Demonstrate the operation and applications of various indirect level, Humidity, Viscosity, Density measuring instruments.
CO-03	Troubleshoot pH meter, flowmeters, demonstrate conductivity measurement and different ways of liquid level measurement.
CO-04	Troubleshoot automatic control system and controllers, Process control instrumentation diagrams, Modes of control
CO-05	Develop the controllers system on the basis of actuating medium, Final control element, type of control, and analyse the composition measurement using spectrometry, chromatography and thermal analysis methods.

Detailed course plan

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 nd session (1.30pm to 4.30pm)	L	T	P
1	1	1,2,5,7	1	Introduction to Basic elements of instruments and its different characteristics, history and development of instrumentation and measurement parameters, applications, impact of modern developments.	4			Presentation and documentation on various instruments and its application in different industries.			3
			2	Measurement - Process variable – static and dynamic characteristics of process instruments	1		3	Make a presentation and document on static characteristics of an instrument with example.			3
			3	Process variables – temperature measurement – different types of thermometers – Mercury in glass thermometers – Bimetallic thermometers	1		3	Trouble shooting – to check a Faulty temperature sensors and practice conversion of temperature to different units.			3
			4	Transducer - thermocouples – principles – installation. Pyrometers – optical and radiation pyrometers.		1	3	Laboratory practice/industrial visit/virtual demonstration on calibration of thermocouples.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
2	1	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Document and present on different types of thermometers with range of operation used in chemical industries.			3
			2	Resistance thermometers - principles – installation – applications.	4			Laboratory practice/industrial visit/virtual demonstration and documentation on study of resistance temperature detector for temperature measurement.			3
			3	Instruments used for pressure measurement – bourdon gauge -Bellows-Diaphragms.		1	3	Virtual demonstration on experiment to calibrate pressure gauges.			3

			4	Vacuum measuring instruments Pirani guage - Mc leod guage	2		2	Virtual demonstration on working principles and applications of vacuum measuring instruments.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
3	1	1,2,5,7	1	PEER Discussion on Industry Assignment		1	3	Document and present on different types of pressure gauges with range of operation used in chemical industries.			3
			2	Level measuring instruments - direct measurement method.	4			Laboratory practice/industrial visit/virtual demonstration and documentation on level measurement using direct method.			3
			3	Level measuring instruments - Indirect measurement - Hydrostatic pressure type - pressure guage method, air bellows.	2		2	Laboratory practice/industrial visit/virtual demonstration and documentation on level measurement using Hydrostatic pressure type - pressure guage method, air bellows.			3
			4	Level measuring instruments - Indirect measurement - air purge system, liquid purge system.		1	3	Laboratory practice/industrial visit/virtual demonstration and documentation on air purge system, liquid purge system of liquid level measurement methods			3
			5	CIE 1- Written and practice test		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
4	2	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Document and present on different types of liquid level measurement methods used in chemical industries.			3
			2	Level measuring instruments - Indirect measurement - electrical methods - capacitance level indicators - Radiation level indicators.	4			Laboratory practice/industrial visit/virtual demonstration and documentation on capacitance level indicators - Radiation level indicators.			3

			3	Instruments used for measuring Viscosity – Redwood viscometer – Saybolt viscometer	2	2	Lab practice or virtual demonstration and documentation on viscosity measurement using Redwood viscometer/ Saybolt viscometer.			3	
			4	Ford cup viscometer, Ostwald viscometer.	1	3	Lab practice or virtual demonstration and documentation on viscosity measurement using Ford cup viscometer, Ostwald viscometer.			3	
			5	Developmental Assessment		4	Assessment Review and corrective action			3	
			6	Industry Class +Industry assessments	2	2					
5	2	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Document and present on different types of viscometers used in chemical industries.			3
			2	Density measurement – hydrometer method, using Archimedes principle.	4			Lab practice or virtual demonstration and documentation on liquid density measurement using hydrometer method, using Archimedes principle.			3
			3	Humidity measurement, methods. Basic concepts, Psychometric chart.	1	3	Lab practice and documentation on psychometric chart .			3	
			4	Humidity measurement by Psychometric method, Dew point method ,Chemical method.	2	2	Lab practice or virtual demonstration and documentation by Psychometric method, Dew point method ,Chemical method.			3	
			5	CIE 2- Written and practice test			Assessment Review and corrective action			3	
			6	Industry Class	2	2					
6	3	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Presentation and documentation on industrial applications of density measurement, humidity measurement.			3
			2	pH, pH scale, Industrial method of pH measurement. Types.	1	3	Lab practice on pH, Presentation and documentation on pH meters in different fields.			3	
			3	Flow measurement by Orifice meter, venturimeter.	4		Lab practice on Flow measurement by Orifice meter, venturimeter .			3	

			4	Flow measurement by pitot tube, rotameter.	1		3	Lab practice on Flow measurement by pitot tube, rotameter.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class + Industry assessments	2		2				
7	3	1,2,5,7	1	PEER Discussion on Industry Assignment		1	3	Submission of records.			3
			2	Conductivity measurement principle, ways of liquid measurement.	4			Laboratory practice/industrial visit/virtual demonstration and documentation on industrial applications of conductivity measurement.			3
			3	Mini project on process variable measuring instruments	1		3	Mini project on process variable measuring instruments			3
			4	Mini project on process variable measuring instruments	2		2	Mini project on process variable measuring instruments			3
			5	CIE 3- Written and practice test				Assessment Review and corrective action			3
			6	Industry Class + Industry assessments	2		2				
8	4	1,2,5,7	1	PEER Discussion on Industry Assignment		1	3	Discussion and assessment on Mini projects			3
			2	Principles and uses of automatic control system and controllers – basic functions with examples, advantages.	4			virtual demonstration and documentation on automatic control system in industries.			3
			3	Process control instrumentation diagrams - , Nomenclature, identification, examples, types of process control diagrams - block diagram, physical diagram, operational diagram	1		3	Industrial visit/virtual demonstration and documentation on process control diagrams with examples.			3
			4	Process control variables – types – basic definitions in process control	2		2	Industrial visit/virtual demonstration and documentation to identify variables in a process.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3

			6	Industry Class +Industry assessments	2		2			
9	4	1,2,5,7.	1	PEER Discussion on Industry Assignment		1	3	Presentation and documentation on process variables and importance of process control in industries.		3
			2	Modes of control – Principles of ON/OFF or two-position controller, proportional (P) controller and integral (I) controller.	4			Industrial visit/virtual demonstration and documentation on principles of on- off, P and I controller		3
			3	Derivative controller (D) controller, PI, PD and PID controllers .	1		3	Industrial visit/virtual demonstration and documentation on principles PI, PD and PID controller.		3
			4	Comparison of P, PI,PD,PID controllers, criteria for selection of a controller, types of actuating error signals.	2		2	Industrial visit/virtual demonstration and documentation on selection of a controllers and types of actuating error signals.		3
			5	CIE 4- Written and practice test				Assessment Review and corrective action		3
			6	Industry Class +Industry assessments	2		2			
10	5		1	PEER Discussion on Industry Assignment			3	Presentation and documentation on controllers identified in a process.		3
			2	Classification of controllers on the basis of actuating medium – constituents of a controller	4			presentation and documentation on Classification of controllers on the constituents of a controller		3
			3	pneumatic controller – basic components, Pneumatic flapper nozzle, pneumatic relays.	4			Industrial visit/virtual demonstration and documentation on pneumatic controller with examples.		3
			4	Pneumatic proportional , Pneumatic proportional + integral, pneumatic Proportional + derivative controller.	2		2	Industrial visit/virtual demonstration and documentation on pneumatic controller P,PI,PD		3
			5	Developmental Assessment		4		Assessment Review and corrective action		3
			6	Industry Class +Industry assessments	2		2			
11	5	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Presentation and documentation on controllers identified in industries with different actuating systems.		3

			2	Pneumatic proportional + integral+ derivative controller (PID), electronic controllers- ON/OFF, P,PI,PD,PID controllers	4			Industrial visit/virtual demonstration and documentation on PID pneumatic controller			3
			3	Magnetic level switch liquid level control , Microprocessor based control system	1		3	Industrial visit/virtual demonstration and documentation on Magnetic level switch liquid level control.			3
			4	Final control element, types of control, valves- Sliding stem , rotating shaft, louvers, actuators	1		3	virtual demonstration and documentation on Final control element, types of control valves			3
			5	CIE 5- Written and practice test				Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
12	5	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Presentation and documentation pneumatic controllers identified in industries.			3
			2	Analytical instruments, methods of compositional analysis, composition measuring instruments, spectrometric analysis and its types, <ul style="list-style-type: none"> • Absorption • Emission • Fluorescence • Mass 	4			Virtual demonstration and documentation on composition measuring instruments, spectrometric analysis, IR, UV spectrometers			3
			3	Chromatography, classification, gas – liquid chromatography	1		3	Industrial visit/virtual demonstration and documentation on IR, UV spectrometers applications, gas –liquid chromatography			3
			4	Thermal analysis – DTA and TGA	1		3	Industrial visit/virtual demonstration and documentation on DTA and TGA			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	1		3				

13		1	PEER Discussion on Industry Assignment				Make a presentation on any analytical instrument for a specific industry			3
		2	Mini project-presentation and demonstration			4	Mini project-presentation and demonstration			3
		3	Mini project-presentation and demonstration			4	Mini project-presentation and demonstration			3
		4	Mini project-presentation and demonstration			4	Mini project-presentation and demonstration			3
		5	CIE 6- Comprehensive assessment based on mini project (Only practice)			1	CIE 6- Comprehensive assessment based on mini project (Only practice)			3
		6	CIE 6- Comprehensive assessment based on mini project (Only practice)							

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE (1 to 5)

Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam – 4 hours

Programme	Chemical Engineering	Semester	V		
Course	Instrumentation and Process control	Max Marks	30		
Course Code	20CH52I	Duration	4 hours		
Name of the course coordinator					
Note: Answer one full question from each section.					
Qn.No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) - 10 marks					
1.a)	Identify various static and dynamic characteristics of instruments	L3	1	1,2,5,7	05
b)	Analyse the working principle of Bimetallic thermometer.	L4	1	1,2,5,7	05
2.a)	List the types of level measuring instruments.	L3	1	1,2,5,7	02
b)	Construct and identify the working of Vapour – Pressure thermometers	L3	1	1,2,5,7	03
c)	Construct a neat sketch of Pirani vacuum gauge	L4	1	1,2,5,7	05
Section-2 (Practical) - 20 marks					
3)	Demonstrate the working principle of Resistance thermometer	L4	1	1,2,5,7	20
4)	Construct and identify the working of Vapour – Pressure thermometers	L4	1	1,2,5,7	20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme : Chemical Engineering		Semester : V		
Course : Instrumentation and Process control		Max Marks : 100		
Course Code : 20CH52I		Duration : 3 Hrs		
Instruction to the Candidate: Answer one full question from each section.				
Q.No	Question	CL	CO	Marks
Section-1				
1.a)	Choose the various static and dynamic characteristics of instruments.	L3	1	10
b)	Compare direct and indirect level measuring instruments	L4		10
2.a)	Conclude working principle of Vapour - Pressure thermometers	L3		10
b)	Construct a neat sketch of a Bourdon gauge and demonstrate the working of it	L4		10
Section-2				
3.a)	Build the working principle of density measurement by Archimedes principle	L3	2	10
b)	Construct a neat figure to show the working principle of capacitance level indicator	L4		10
4.a)	Construct a psychometric chart to show the working principle of Humidity measurement by Psychometric method	L3		10
b)	Develop a neat figure to show the working principle of Ostwald's viscometer	L4		10
Section- 3				
5.a)	Construct a neat figure of pH meter and explain its working .	L3	3	10
b)	Conclude the functions of Flow measurement by Orifice meter	L4		10
6.a)	Construct and identify the working of Float and tape method of level measurement.	L3		10
b)	Analyze the Conductivity measurement principle	L4		10
Section-4				
7.a)	Identify and define the terms offset, proportional band, manual reset.	L3	4	10
b)	Compare the performance of ON-OFF and P control mode	L4		10
8.a)	Develop neatly Block diagram, operational diagram & physical diagram of automatic controller	L3		10
b)	Distinguish the functions of basic elements of an elements of automatic controller by a block diagram with suitable examples	L4		10
Section-5				

9.a)	Plan and elaborate Pneumatic proportional + integral+ derivative controller (PID)	L3	5	10
b)	Construct Magnetic level switch liquid level control	L4		10
10.a)	Construct a Final control element and types of control	L3		10
b)	Examine the functions Pneumatic flapper	L4		10

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
1	Case submission	20
2	Case presentation	20
3	Case innovation	20
4	Result	20
5	Viva voce	20
Total		100

Case Submission / Content Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Identification of the main issues / problem	Identifies and understands all the main issues in the problem statement	Identifies and understands most of the main issues in the problem statement	Identifies and understands some of the issues in the problem statement	Identifies and understands a few of the issues in the problem statement	Identifies limited issues in the problem statement	5
Analysis of the issues	Insightful and thorough analysis of all the issues	Thorough analysis of most of the issues	Superficial analysis of some of the issues in the problem statement	Incomplete analysis of the issues	No analysis of the issue	4
Comments on effective solutions / strategies (The solution may be in the problem statement already or proposed by you)	Well documented, reasoned and pedagogically appropriate comments on solutions, or proposals for solutions, to all issues in the problem statement	Appropriate, well thought out comments about solutions, or proposals for solutions, to most of the issues in the problem statement	Superficial and / or inappropriate solutions to some of the issues in the problem statement	Little and/or inappropriate solutions to all of the issues in the problem statement	No action to all issues in the problem statement	2
Links to course learning and additional research	Excellent research into the issues with clearly documented links to course learnings and beyond.	Good research and documented links to the materials read during the course	Limited research and documented links to any readings	Incomplete research and links to any reading.	No research or links to any reading	3
Total						14/20

Case Presentation Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Delivery & Enthusiasm	Very clear and concise flow of ideas Demonstrates passionate interest in the topic and engagement with class / examiner	Clear flow of ideas Demonstrates interest in the topic and engagement with class / examiner	Most ideas flow but is lost at times Limited evidence of interest in and engagement with the topic	Hard to follow the flow of ideas Lack of enthusiasm and interest	No flow in the presentation Poor presentation skills	4
Visuals	Visuals augmented and extended comprehension of the issues in unique ways	Use of visuals related to the topic	Limited use of visuals loosely related to the topic	No use of visuals	Poor visuals used and some visuals are not easy to understand its relevance.	2
Staging	Uses stage effects such as props, sound effects, and speech modulation in a unique and dramatic manner that enhances the understanding of the issues in the problem statement.	Uses stage effects such as props, sound effects, and speech modulation in an effective manner to extend the understanding of the issues in the problem statement.	Limited use of stage effects and/or used in a manner that did not enhance the understanding of the issues in the problem statement.	No use of stage effects	Poor stage effects usage	5
Involvement of the class / Examiners • Questions • Discussions • Activities	Excellent and salient discussion points that elucidated material to develop a deep understanding Appropriate and imaginative activities used to extend understanding in a creative manner	Questions and discussions addressed important information that developed understanding Appropriate activities used to	Questions and discussions addressed important superficial issues of the problem statement Limited use of activities to clarify understanding	Little or no attempt to engage the class / examiner in demonstrating their learning	Did not engage the class / examiner and poor listening skills	1

		clarify understanding				
Total						12/20

Case Results Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Problem outcome	The topic was well researched and all information and data included are accurate and from reliable sources of information like high impact journals standards, etc. The proof was enough backed up with accurate data, analysis and reasoning beyond the class learning. Outcome achieved beyond the problem brief	The topic was researched and most information and data were from reliable sources of information. The proof was backed up with good data and reasoning as taught in the class. Outcome achieved as per the problem brief	The topic was researched but information and data were only partly from reliable sources of information. The proof was not fully backed up with good data or reasoning as taught in the class. Partial outcome achieved as per the problem brief	The topic was researched and data were not from reliable sources. The proof was not backed up with data, analysis or reasoning as taught in the class. Some outcome obtained as per the problem brief	Desired results not obtained, but some relevant research was done. Outcome not obtained as per the problem brief	4
Application of class learning in problem solving	Made effective use of class principles, models and theories. Also used creativity to find effective results appropriate to industry beyond class learning.	Made good use of class principles, models and theories Some creative ideas were explored to find desired outcome but within the framework of class learning	Made some use of class principles, models and theories No creative ideas or models explored	Made limited use of class principles, models and theories	Poorly applied class principals, models and theories	3

Response to Class / Examiners Queries	Queries Excellent response to comments and discussion with appropriate content supported by theory/research	Good response to questions and discussions with some connection made to theory/research	Satisfactory response to questions and discussions with limited reference to theory/research	Limited response to questions and discussions with no reference to theory/research	Poor or no response to questions and did not participate in the discussions.	2
Conclusions	Provides detailed and appropriate conclusion for the problem statement	Provides appropriate conclusion for the problem statement	Provides adequate and mostly appropriate conclusions for the problem statement	Provides limited and somewhat appropriate conclusions for the problem statement	Has not provided appropriate conclusions for the problem statement.	4
Total						13/20

Case Innovation Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Finding new processes / models / approaches	The newly discovered processes / models / approaches are of good quality and relevant	The newly discovered processes / models / approaches are of appropriate quality but limited relevance	The newly discovered processes / models / approaches have limited application but relevant to the problem	The newly discovered processes / models / approaches has restricted application	No new processes / models / approaches were identified	5
Proposing ideas and innovative solutions in terms of processes / models / approaches and how they can be applied to solve the problem on hand	Various ideas and innovative solutions have been proposed and their application have been clearly outlined	Various ideas and innovative solutions have been proposed as well as the outline of the process to apply them	Some ideas or innovative solutions have been proposed but the process of applying them hasn't been specified	Few ideas have been proposed	No ideas or innovative solutions have been proposed	3
Using creativity techniques to provide and reason good ideas which are original and unconventional	Wherever necessary creativity techniques are utilized to analyse and solve the problem	Creativity techniques are frequently utilized in more than 50% of the occasions	Creativity techniques are utilized at times in less than 50% of the occasions	Creativity techniques are used a few times only	Creativity technique are not utilized to analyse and solve the problem	2
Finding constraints and weak points in existing processes / models / approaches or methods	Constraints and weak points are understood	Constraints and weak are identified	A critical analysis is undertaken	Only a description of the working process and methods are provided	No constraints or weak points have been identified.	3
Total						13/20

Other course facilities:**Lab Equipments:**

1. Mercury in glass thermometers – 20 NO's
2. Bimetallic thermometers - 10 no's
3. Thermocouples - 10 no's
4. pyrometers – optical and radiation types – 05 no's
5. pressure measurement – bourdon gauge -Bellows-Diaphragms – 05 no's
6. Vacuum measuring instruments Pirani gauge – Mc lead
7. gauge - 05 no's
8. Indirect level measurement – Hydrostatic pressure type – pressure gauge method, air bellows, electrical methods – capacitance level indicators – Radiation level indicators. - Each 05 no's
9. Redwood viscometer, Say bolt viscometer – 05 no's
10. Ford cup viscometer, Ostwald viscometer – 05 no's
11. Density measurement – hydrometer method, using Archimedes principle -05 no's
12. Flow measurement by Orifice meter. pitot tube, rotameter. – 05 no's

e-links :

1. <https://www.youtube.com/watch?v=HHFdJ6dyeDA>
2. www.supercoolsliderule.com
3. <http://www.explainthatstuff.com/how-pyrometers-work.html>
4. <https://www.youtube.com/watch?v=o0GZA-vU3MY>
5. <https://www.youtube.com/watch?v=-9IfpNAESIM>
6. <https://www.youtube.com/watch?v=DCzu4e9Q80k>
7. <https://www.youtube.com/watch?v=xWWg8J60r3A>
8. <https://www.youtube.com/watch?v=jNVePBvI2ps>
9. <https://www.youtube.com/watch?v=CRI-Un3FY8M>
10. <http://instrupedia.blogspot.in/2012/02/bubbler-level-measurement-system.html>
11. <https://www.youtube.com/watch?v=vwY-xWMam7o>

Reference:

1. Industrial instrumentation by – Donald P Eckman weley eastern Ltd, 1984.
2. Instrumental methods of chemical analysis by – B.K Sharma Yrel Pub :- House.
3. Outline of chemical instrumentation and process control by Dr A. Suryanarayan, Khanna publications
4. Instrumentation & process control by R P Vyas.
5. Process control by Harriott.
6. Instrumentation & process control by S K Singh



Government of Karnataka
DEPARTMENT OF COLLEGIATE and TECHNICAL EDUCATION

Program	Chemical Engineering	Semester	V
Course Code	20CH53I	Type of Course	L:T:P (104: 52: 312)
Specialization	Food Processing and Preservation.	Credits	24
CIE Marks	240	SEE Marks	160

Introduction:

Welcome to the curriculum for the Specialisation Pathway - Food Processing and preservation, is specialisation course taught in Boot camp mode. Boot camps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur. You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll food processing techniques, food preservation methods that are needed for today's job skills of a chemical technologist.

Leading to the successful completion of this boot camp, you shall be equipped to either do an internship in food industry or do project in the related field. After the completion of your Diploma, you shall be ready to take up roles like field operator, Supervisor and can rise up to the level of production Manager, also can become Entrepreneur in the related field and more.

This course will teach you about food technology, prepare a food product, identify engineering problems in an operation or a process and troubleshoot and analyse a process from a point of view of environmental concerns to identify pollution problems and suggest remedies.

Pre-requisite:

Before the start of this specialisation course, you will have prerequisite knowledge gained in the first two years on the following subjects:

1st year -Engineering Mathematics, Communication Skills, Computer Aided Engineering Graphics, Statistics & Analysis, Basic IT Skills, Fundamentals of Electrical and Electronics Engineering, Project Management skills, Particulate technology and particulate technology lab.

2nd year- Inorganic chemistry, physical and organic chemistry, Momentum transfer, heat transfer, chemical process calculations, Mass transfer, Plant maintenance and pollution control, Thermodynamics and reaction kinetics.

Instruction to course coordinator

1. Each Pathway is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. Single faculty shall be the Cohort Owner.
3. This course shall be delivered in boot camp mode
4. The industry session shall be addressed by industry subject experts (in contact mode/online / recorded video mode) in the discipline only.
5. The cohort owner shall identify experts from the relevant field and organize industry session as per schedule.
6. Cohort owner shall plan and accompany the cohort for industrial visits.

7. Cohort owner shall maintain and document the industrial assignments and weekly assessments, practices and mini project.
8. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table
9. The cohort owner along with classroom can augment or use for supplementally teaching on line courses available although reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademic, SWAYAM, etc.
10. Cohort owner shall guide the cohort for the execution of mini project

Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Illustrate the role and importance of food industries in the global scenario.
CO-02	Appreciate the characteristics of food, ingredients and their role in enhancement of food quality and standard.
CO-03	Exhibit the understanding of principle and working of food processing equipments in storing, processing, packaging.
CO-04	Apply unit operations in food processing.
CO-05	Analyze the importance of food additives in various food products

Detailed course plan

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 nd session (1.30pm to 4.30pm)	L	T	P
1	1	1,2,5,7	1	Present an overview on general aspects of food industry, world food demand and Indian scenario.	4			Virtual demonstration on aspects of food industry, its status in India.			3
			2	Constituents of food, quality and nutritive aspects, need for food additives and preservatives and their applications.	1		3	Virtual demonstration and documentation on Constituents of food - Carbohydrates, Lipids, Proteins, Vitamins, Minerals and Moisture etc.,.			3
			3	Food additives and preservatives and their applications.	1		3	Virtual demonstration and documentation on quality and nutritive aspects, need for food additives and preservatives and their applications			3
			4	Stabilizers and thickeners, other additives. food safety. Food contamination and adulteration. Food laws and standards			4	Virtual demonstration and documentation on appearance factors, Textural factors, Flavour factors. Visual and objectively measurable attributes, Food laws and standards			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
2	1	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Presentation and documentation on food safety, food contamination and adulteration, Food laws and standards in a particular food industry.			3
			2	Food processing methods: general processing methods for various food products - Primary, secondary and tertiary processing, historical perspective.	4			Preparation of Jam, Jelly			3
			3	Traditional technologies used in food processing. Effects of processing on components, properties and nutritional value of foods.			4	Cereals and pulses: Milling of wheat - extraction of flour, refined wheat flour and pasta products			3

			4	Milling of rice – parboiled rice, rice based instant food Processing of corn, barley and millets – pearling	2		2	Visit to rice milling industry.			3	
			5	Developmental Assessment			4	Assessment Review and corrective action			3	
			6	Industry Class +Industry assessments	2		2					
3	1	1,2,5,7	1	PEER Discussion on Industry Assignment			2	2	Presentation and documentation on food processing methods followed in a dairy industry, pollution problems and methods of treatment followed.			3
			2	Flaking and puffing, corn starch products, Malting-Pulses – Red gram	4				Virtual demonstration/industrial visit/documentation on pulse products.			3
			3	Bengal gram, black gram, green gram, soy-based products, Decortication and dhal milling, elimination of toxic factors, fermentation and germination .	2			2	Virtual demonstration/industrial visit/documentation on fermentation and germination			3
			4	Soft and alcoholic beverages				4	Virtual demonstration/industrial visit/documentation on Treatment and Disposal of food processing wastes.			
			5	CIE 1- Written and practice test					Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2					
4	2	1,2,5,7	1	PEER Discussion on Industry Assignment & identify the topic for mini project.			2	2	Presentation and documentation on food processing methods followed in a beverages industry, pollution problems and methods of treatment followed.			3
			2	Meat, poultry and fish products	4				Visit to a meat processing industry/ virtual demonstration on meat processing.			3

			3	Dairy products - composition and Nutritive value, physical properties of milk, Different types of milk and milk products, -Role of milk and milk products in cookery.	2		2	Visit to dairy industry.			
			4	Food additives: Introduction and need for food additives. Types of additives – antioxidants, chelating agents, coloring agents, curing agents,	1		3	Bring a food additive and demonstrate their importance, usage, and properties			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
5	2	1,2, 5,7	1	PEER Discussion on Industry Assignment		2	2	Make a presentation and documentation on anti-caking agents, leavening agents, non - nutritive sweeteners			3
			2	Emulsions, flavors and flavor enhancers, flavor improvers, humecants and anti-caking agents, leavening agents, nutrient supplements, non - nutritive sweeteners	4			Bring a flavor enhancer and demonstrate their importance, usage, and properties.			3
			3	pH control agents, stabilizers and thickeners, other additives. Additives and food safety	1		3	Bring a pH control agent and demonstrate their importance, usage, and properties.			3
			4	Food contamination and adulteration: Types of adulterants and contaminants, Intentional adulterants, incidental adulterants and its effects	2		2	Make a presentation on Intentional adulterants, incidental adulterants and its effects with example.			3
			5	CIE 2- Written and practice test				Assessment Review and corrective action			3
			6	Industry Class	2		2				
6	3	1,2, 5,7	1	PEER Discussion on Industry Assignment		2	2	Make a presentation on Emulsions, flavors and flavor enhancers, flavor improvers, humecants and anti-caking agents.			3

			2	Aim and objectives of preservation of foods, primary sources of microorganisms found in foods.	1		3	Deterioration of food quality, causes of quality deterioration and spoilage of perishable foods, spoilage in canned foods			3
			3	Low temperature Preservation of foods: Chilling temperatures: Considerations relating to storage of foods at chilling temperatures.	4			virtual demonstration and documentation on different preservatives in different food products.			3
			4	low temperature applications in food preservation, controlled and modified atmosphere storage of foods.	1		3	Make a presentation on chilling method of preservation.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
7	3	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Make a presentation on controlled and modified atmosphere storage of foods.			
			2	Freezing temperature: Preparation of foods for freezing, freezing process, slow and fast freezing of foods and its consequences.	4			storage stability of frozen foods, effect of freezing on microorganisms.			3
			3	High temperature preservation of foods: Basic concepts in thermal destruction of microorganisms-D, Z, F, values	1		3	Heat resistance and thermophilisms in microorganisms.			3
			4		2		2	Virtual demonstration and documentation on freezing process and high temperature preservation of food.			3
			5	CIE 3- Written and practice test				Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
8	4	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Make a presentation on Cooking, blanching, pasteurisation and sterilisation methods of food preservation			3
			2	Preservation by Dehydration: Principles, technological aspects and applications of drying and dehydration of foods.	4			Principles, technological aspects and applications of evaporative concentration processes,			3
			3	Freeze concentration and membrane processes for food concentrations.	1		3	Virtual demonstration and documentation on preservation by dehydration			3

			4	Drying irradiation, microwave heating and other important methods of food preservation	2		2	Virtual demonstration and documentation on freeze concentration and membrane concentration process.			3	
			5	Developmental Assessment		4		Assessment Review and corrective action			3	
			6	Industry Class +Industry assessments	2		2					
9	4	1,2,5,7	1	PEER Discussion on Industry Assignment			2	2	Make a presentation on drying irradiation, microwave heating and other important methods of food preservation			3
			2	Other techniques in preservation: Principles, technological aspects and applications of sugar and salt.	4				anti-microbial agents, non-ionising and ionising radiations in preservations of foods,			3
			3	Fermented foods, Pickling	1		3	3	Make a presentation on and applications of sugar and salt in preservation of food.			3
			4	Virtual demonstration and documentation on, Pickling process.	2		2	2	Make a presentation on anti-microbial agents, non-ionising and ionising radiations in preservations of foods.			3
			5	CIE 4- Written and practice test					Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2					
10	5	1,2,5,7	1	PEER Discussion on Industry Assignment			2	2	Review on mini project work done and discussion.			3
			2	Separation processes in food processing: Electro-dialysis Systems,	4		2		Membrane Systems, Reverse-Osmosis			3
			3	Ultra filtration Systems, Drying Processes,.	1		3	3	Make a presentation on separation processes in different food industries.			3
			4	Dehydration System, Sedimentation, Centrifugation and Mixing	2		2	2	Make a presentation on Electro-dialysis Systems, Membrane Systems, Reverse-Osmosis operations in food industry			3
			5	Developmental Assessment		4			Assessment Review and corrective action			
			6	Industry Class +Industry assessments	2		2					

11	5	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Review on mini project work done and discussion.			3
			2	Packaging: Introduction, Food Protection, Product Containment, Product Communication, Product Convenience,	4			Mass Transfer in Packaging Materials. Innovations in Food Packaging, Product Shelf-life.			3
			3	Food canning technology-fundamentals. Heat sterilization of canned food, containers	1		3	Metal, glass and flexible packaging. Canning procedures for fruits, vegetables, meats, poultry and marine products.			3
			4	Virtual demonstration and documentation on food canning technology.	2		2	Practice on packaging food product and demonstration and documentation.			3
			5	CIE 5- Written and practice test				Assessment Review and corrective action			
			6	Industry Class +Industry assessments	2		2				
12		1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Review on mini project work done and discussion.			3
			2	Recent technologies in food industry	4			Virtual demonstration on technologies.			3
			3	Mini project – components, preservation and packaging.	1		3	Mini project – components, preservation and packaging.			3
			4	Mini project – components, preservation and packaging.	2		2	Mini project – components, preservation and packaging.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			
			6	Industry Class +Industry assessments	2		2				
13		1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Mini project			3
			2	Mini project			4	Mini project			3
			3	Mini project			4	Mini project			3
			4	Mini project			4	Mini project			3

			5	CIE 6- Comprehensive assessment based on mini project (Only practice)				CIE 6- Comprehensive assessment based on mini project (Only practice)			
			6	CIE 6- Comprehensive assessment based on mini project (Only practice)							

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard))		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE (1 to 5)

Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam – 4 hours

Programme	Chemical Engineering	Semester	V		
Course	Food processing and Preservation	Max Marks	30		
Course Code	20CH53I	Duration	4 hours		
Name of the course coordinator					
Note: Answer one full question from each section.					
Qn.No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) - 10 marks					
1.a)	Choose the Constituents of food, quality of food	L3	1	1,2,5,7	05
b)	Distinguish the Flaking and puffing process	L3	1	1,2,5,7	05
2.a)	Identify the preservatives and their applications.	L3	1	1,2,5,7	03
b)	Identify the corn starch products	L3	1	1,2,5,7	02
c)	Build the steps involved in the fermentation and germination methods	L3	1	1,2,5,7	05
Section-2 (Practical) - 20 marks					
3)	Conclude the Traditional technologies used in food processing	L4	1	1,2,5,7	10
4)	Survey the general processing methods for any one food	L4	1	1,2,5,7	10

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme : Chemical Engineering		Semester : V		
Course : Food processing and preservation		Max Marks : 100		
Course Code : 20CH53I		Duration : 3 Hrs		
Instruction to the Candidate: Answer one full question from each section.				
Q.No	Question	CL	CO	Marks
Section-1				
1.a)	Identify the need for food additives	L3	1	10
b)	Conclude the general processing methods for various food products	L4		10
2.a)	Identify and state the Food laws and standards	L3		10
b)	Distinguish the Flaking and puffing process	L4		10
Section-2				
3.a)	Identify the physical properties of milk	L3	2	10
b)	Categorize the pH control agents and its importance	L4		10
4.a)	Organize the Role of milk and milk products in cookery.	L3		10
b)	List the non - nutritive sweeteners and its importance	L4		10
Section- 3				
5.a)	Choose the primary sources of microorganisms found in foods.	L3	3	10
b)	Test for slow and fast freezing of foods and its consequences	L4		10
6.a)	Utilize the low temperature applications in food preservation and its importance	L3		10
b)	Conclude the Preparation of foods for freezing,	L4		10
Section-4				
7.a)	Build the technological aspects and applications of drying	L3	4	10
b)	Analyse the various applications of sugar and salt.	L4		10
8.a)	Apply the important methods of food preservation	L3		10
b)	List the various Fermented foods and microorganisms importance used in fermentation process	L4		10
Section-5				
9.a)	Build the Ultra filtration Systems,	L3	5	10

b)	Categorize the Food canning technology and explain briefly	L4	10
10.a)	Experiment with Separation processes in food processing by centrifugation	L3	10
b)	Categorize the Food protection in packaging system.	L4	10

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
1	Case submission	20
2	Case presentation	20
3	Case innovation	20
4	Result	20
5	Viva voce	20
Total		100

Case Submission / Content Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Identification of the main issues / problem	Identifies and understands all the main issues in the problem statement	Identifies and understands most of the main issues in the problem statement	Identifies and understands some of the issues in the problem statement	Identifies and understands a few of the issues in the problem statement	Identifies limited issues in the problem statement	5
Analysis of the issues	Insightful and thorough analysis of all the issues	Thorough analysis of most of the issues	Superficial analysis of some of the issues in the problem statement	Incomplete analysis of the issues	No analysis of the issue	4
Comments on effective solutions / strategies (The solution may be in the problem statement already or proposed by you)	Well documented, reasoned and pedagogically appropriate comments on solutions, or proposals for solutions, to all issues in the problem statement	Appropriate, well thought out comments about solutions, or proposals for solutions, to most of the issues in the problem statement	Superficial and / or inappropriate solutions to some of the issues in the problem statement	Little and/or inappropriate solutions to all of the issues in the problem statement	No action to all issues in the problem statement	2
Links to course learning and additional research	Excellent research into the issues with clearly documented links to course learnings and beyond.	Good research and documented links to the materials read during the course	Limited research and documented links to any readings	Incomplete research and links to any reading.	No research or links to any reading	3
Total						14/20

Case Presentation Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Delivery & Enthusiasm	Very clear and concise flow of ideas Demonstrates passionate interest in the topic and engagement with class / examiner	Clear flow of ideas Demonstrates interest in the topic and engagement with class / examiner	Most ideas flow but is lost at times Limited evidence of interest in and engagement with the topic	Hard to follow the flow of ideas Lack of enthusiasm and interest	No flow in the presentation Poor presentation skills	4
Visuals	Visuals augmented and extended comprehension of the issues in unique ways	Use of visuals related to the topic	Limited use of visuals loosely related to the topic	No use of visuals	Poor visuals used and some visuals are not easy to understand its relevance.	2
Staging	Uses stage effects such as props, sound effects, and speech modulation in a unique and dramatic manner that enhances the understanding of the issues in the problem statement.	Uses stage effects such as props, sound effects, and speech modulation in an effective manner to extend the understanding of the issues in the problem statement.	Limited use of stage effects and/or used in a manner that did not enhance the understanding of the issues in the problem statement.	No use of stage effects	Poor stage effects usage	5
Involvement of the class / Examiners • Questions • Discussions • Activities	Excellent and salient discussion points that elucidated material to develop a deep understanding Appropriate and imaginative activities used to extend understanding in a creative manner	Questions and discussions addressed important information that developed understanding Appropriate activities used to	Questions and discussions addressed important superficial issues of the problem statement Limited use of activities to clarify understanding	Little or no attempt to engage the class / examiner in demonstrating their learning	Did not engage the class / examiner and poor listening skills	1

		clarify understanding				
Total						12/20

Case Results Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Problem outcome	The topic was well researched and all information and data included are accurate and from reliable sources of information like high impact journals standards, etc. The proof was enough backed up with accurate data, analysis and reasoning beyond the class learning. Outcome achieved beyond the problem brief	The topic was researched and most information and data were from reliable sources of information. The proof was backed up with good data and reasoning as taught in the class. Outcome achieved as per the problem brief	The topic was researched but information and data were only partly from reliable sources of information. The proof was not fully backed up with good data or reasoning as taught in the class. Partial outcome achieved as per the problem brief	The topic was researched and data were not from reliable sources. The proof was not backed up with data, analysis or reasoning as taught in the class. Some outcome obtained as per the problem brief	Desired results not obtained, but some relevant research was done. Outcome not obtained as per the problem brief	4
Application of class learning in problem solving	Made effective use of class principles, models and theories. Also used creativity to find effective results appropriate to industry beyond class learning.	Made good use of class principles, models and theories Some creative ideas were explored to find desired outcome but within the framework of class learning	Made some use of class principles, models and theories No creative ideas or models explored	Made limited use of class principles, models and theories	Poorly applied class principals, models and theories	3

Response to Class / Examiners Queries	Queries Excellent response to comments and discussion with appropriate content supported by theory/research	Good response to questions and discussions with some connection made to theory/research	Satisfactory response to questions and discussions with limited reference to theory/research	Limited response to questions and discussions with no reference to theory/research	Poor or no response to questions and did not participate in the discussions.	2
Conclusions	Provides detailed and appropriate conclusion for the problem statement	Provides appropriate conclusion for the problem statement	Provides adequate and mostly appropriate conclusions for the problem statement	Provides limited and somewhat appropriate conclusions for the problem statement	Has not provided appropriate conclusions for the problem statement.	4
Total						13/20

Case Innovation Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Finding new processes / models / approaches	The newly discovered processes / models / approaches are of good quality and relevant	The newly discovered processes / models / approaches are of appropriate quality but limited relevance	The newly discovered processes / models / approaches have limited application but relevant to the problem	The newly discovered processes / models / approaches has restricted application	No new processes / models / approaches were identified	5
Proposing ideas and innovative solutions in terms of processes / models / approaches and how they can be applied to solve the problem on hand	Various ideas and innovative solutions have been proposed and their application have been clearly outlined	Various ideas and innovative solutions have been proposed as well as the outline of the process to apply them	Some ideas or innovative solutions have been proposed but the process of applying them hasn't been specified	Few ideas have been proposed	No ideas or innovative solutions have been proposed	3
Using creativity techniques to provide and reason good ideas which are original and unconventional	Wherever necessary creativity techniques are utilized to analyse and solve the problem	Creativity techniques are frequently utilized in more than 50% of the occasions	Creativity techniques are utilized at times in less than 50% of the occasions	Creativity techniques are used a few times only	Creativity technique are not utilized to analyse and solve the problem	2
Finding constraints and weak points in existing processes / models / approaches or methods	Constraints and weak points are understood	Constraints and weak are identified	A critical analysis is undertaken	Only a description of the working process and methods are provided	No constraints or weak points have been identified.	3
Total						13/20

Required course facilities:

1. pH meter
2. Colorimeter
3. Hot plate
4. Milk fat centrifuge
5. Sample grinder or mixer
6. Hot air oven
7. Water bath
8. Chromatograph chamber
9. Lactometer
10. UV spectrophotometer
11. GLC apparatus
12. HPLC equipment

e-links:

1. <https://www.youtube.com/watch?v=WRYoGiOobqU>
2. <https://www.youtube.com/watch?v=vKOsdpurx7U>
3. <https://www.youtube.com/watch?v=4Xq-7qP6VIs>
4. <https://www.youtube.com/watch?v=f141C9Kw3jo>
5. <https://www.youtube.com/watch?v=mzcy3xXyZV8>

Reference:

1. Norman N. Potter and Joseph H. Hotchkiss (2013) Food Science, CBS publishers and Distributors.
2. James M Jay (2012) Modern food microbiology, 5th Edn, CBS publishers and Distributors.
3. B. Sivasankar (2009) Food processing and preservation, Eastern economy edition, Prentice-Hall of India Pvt. Ltd.
4. Shakuntala, N., Manay and Shadaksharamurthy, M., Foods: Facts and Principles, 3rd Edition, NewAge International, 2008.
5. Subbulakshmi, G., and Udipi, S.A., Food Processing and Preservation, 1st Edition, NewAge International, 2006.
6. Sahu, J.K., Fundamentals of Food Process Engineering, Narosa Publishing, 2014.

Process Plant Technology



Government of Karnataka
DEPARTMENT OF COLLEGIATE and TECHNICAL EDUCATION

Program	Chemical Engineering	Semester	V
Course Code	20CH54I	Type of Course	L:T:P (104: 52: 312)
Specialization	Process Plant Technology	Credits	24
CIE Marks	240	SEE Marks	160

Introduction:

Welcome to the curriculum for the Specialisation Pathway - Process plant technology is specialisation course taught in Boot camp mode. Boot camps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur. You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn how to develop flowsheets in industrial manufacturing processes that are needed for today's job skills of a chemical technologist.

Leading to the successful completion of this boot camp, you shall be equipped to either do an internship in chemical manufacturing industry or do project in the related field. After the completion of your Diploma, you shall be ready to take up roles like an operator, Supervisor and can rise up to the level of production Manager, also can become Entrepreneur in the related field and more.

This course will teach you about chemical process technology, developing a flowsheet, identify engineering problems in an operation or a process and troubleshoot and analyse a process from a point of view of environmental concerns to identify pollution problems and suggest remedies.

Pre-requisite:

Before the start of this specialisation course, you will have prerequisite knowledge gained in the first two years on the following subjects:

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10. Cohort owner shall guide the cohort for the execution of mini project.

Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Develop flow sheets and demonstrate the manufacturing processes of various acids and alkalis.
CO-02	Identify the applications, raw materials, chemical reactions in the manufacturing processes of various Fertilizers & Pesticides and glass & cement and demonstrate the various steps in these processes.
CO-03	Recall the properties & applications of different types of oils, fats, soaps and detergents and pulp and paper, identify the raw materials and illustrate the various steps in their manufacturing processes.
CO-04	Recall the principles of fermentation, identify raw materials and chemical reactions & illustrate the manufacturing process in, sugar and fermentation and polymer industries.
CO-05	Outline the importance of safety and risk management in industries, Sustainable Green Chemical Technology for Developments in Process Industries.

Detailed course plan

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
1	1	1,2,5,7	1	Present an overview of development of chemical and allied industries in India and their role in different sectors with fact and figures.	4			Present an overview of development of chemical and allied industries in India and their role in different sectors with fact and figures.			3
			2	An overview on conventional Production starting from procurement of raw materials to finished product and delivery to the customer.	1		3	An overview on conventional unit operations and unit processes in a production process.			3
			3	General principles applied in studying an industry. <ul style="list-style-type: none"> • Market and sales • Methods of production • Major engg. problems 	1		3	General principles applied in studying an industry. <ul style="list-style-type: none"> • Market and sales • Methods of production • Major engg. problems 			3
			4	Current environmental concerns in chemical and allied industries.			4	General Pollution problems and effluent treatment methods followed in chemical and allied industries through virtual demonstration.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
2	1	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	Presentation on Current environmental concern scenario in chemical process industries.			3
			2	Manufacture of sulfuric acid by contact process and industrial applications, virtual demonstration	4			Manufacture of nitric acid and industrial applications, virtual demonstration			3
			3	Demonstrate manufacture of phosphoric acid by wet process,			4	Manufacture of Hydrochloric acid			3

			4	Pollution problems and treatment methods in acid industries.	2		2	Pollution problems and treatment methods in acid industries.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
3	1	1,2,5,7	1	PEER Discussion on Industry Assignment		1	3	Presentation on above discussed topics			3
			2	Manufacture of chlorine and caustic soda by mercury cell and membrane cell process and industrial applications, virtual demonstration.	4			Manufacture of soda ash by Solvay process and industrial applications, virtual demonstration			3
			3	Manufacture of Bleaching powder and their industrial applications, virtual demonstrations, major engineering problems in above discussed industries	2		2	Virtual tour/ demonstration on alkali industries.			3
			4	Pollution problems and treatment methods in alkali industries.			4	Virtual demonstration/industrial visit and documentation on Pollution problems and treatment methods in alkali industries.			3
			5	CIE 1- Written and practice test				Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
4	2	1,2,5,7	1	PEER Discussion on Industry Assignment		1	3	Presentation and documentation on above discussed topics			3
			2	Nitrogenous fertilizers - Manufacture of ammonia and industrial applications, virtual demonstration	4			Manufacture of ammonium sulphate, Ammonium chlorides and industrial applications, virtual demonstration			3
			3	Ammonium nitrate - Ammonium phosphates and industrial applications, virtual demonstration.	2		2	Manufacture of Urea by total recycle process. Manufacture of NPK fertilizers - Pesticides.			3

							Manufacture of DDT, BHC, 2,4D parathion and major engineering problems in above discussed industries.			
			4	Pollution problems and treatment methods in fertilizer industries.	1	3	Virtual demonstration/industrial visit and documentation on Pollution problems and treatment methods in fertilizer industries.			3
			5	Developmental Assessment		4	Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2	2				
5	2	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	PEER Discussion on fertilizers and its environmental impact on soil.		3
			2	Glass , Composition , Raw material , types of glasses and its Commercial applications and virtual demonstration.	4			Manufacture of plate glass, Coloured and safety glass and its Commercial applications and virtual demonstration.		3
			3	Cement, Raw material for cements, types of cements and its Commercial applications and virtual demonstration.	1	3	3	Manufacture of cements by wet and dry process and its Commercial applications and virtual demonstration.		3
			4	Pollution problems and treatment methods in glass and cement industries.	2	2	2	Virtual demonstration/industrial visit and documentation on Pollution problems and treatment methods in glass and cement industries.		3
			5	CIE 2- Written and practice test				Assessment Review and corrective action		3
			6	Industry Class	2	2	2			
6	3	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	PEER Discussion on recent technologies in glass and cement		3
			2	Oil and Fats, Chemical composition and physical properties of edible oils, distinction between oils and fats.	1	3	3	Definition of acid value, saponification value, Iodine value ,Mechanical expression of oil.		3
			3	Solvent extraction of vegetable oil, Hydrogenation of oil.	4			Manufacture of linear alkyl benzene – ABS-Surf- Sanitizers.		3

				Definition of detergents, soaps - Manufacture of soaps by full boiled process Recovery of glycerine from spent lye						
			4	Pollution problems and treatment methods in oil and fats and soaps and detergent industries.	1		3	Virtual demonstration/industrial visit and documentation on pollution problems and treatment methods in soaps and detergent industries.		3
			5	Developmental Assessment		4		Assessment Review and corrective action		3
			6	Industry Class +Industry assessments	2		2			
7	3	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	PEER presentation and Discussion on Industrial visit		3
			2	Pulp and Paper, Raw materials for paper, pulp process. Major engineering problems involved Pulp production, types of pulping processes, mechanical, semi chemical and chemical pulping. -production of pulp by Kraft or sulphate	4			Practice on flowsheet of pulp and paper production.		3
			3	Sulphite process (magnetite process), Major engineering problems involved Production of paper from pulp Types of paper and industrial applications.	1		3	presentation and documentation on above discussed topics.		3
			4	Pollution problems and treatment methods in pulp and paper industries	2		2	Virtual demonstration/industrial visit and documentation on pollution problems and treatment methods in pulp and paper industries.		3
			5	CIE 3- Written and practice test				Assessment Review and corrective action		
			6	Industry Class +Industry assessments	2		2			
8	4	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	PEER Discussion on paper quality and applications.		3

			2	Sugar industry, terms used in Sugar industries, (Brix - Polarity – Purity – Masecuite – Molasses - Bagasse)	4			Virtual demonstration/industrial visit and documentation on Manufacture of cane sugar – refining of sugar and industrial applications, Major engineering problems involved.			3
			3	Fermentation industry, Terms used in fermentation process	1		3	Virtual demonstration and documentation on environmental concerns in sugar and fermentation industries.			3
			4	Manufacture of Citric acid and its application, Vinegar Gelatin, Their uses.	2		2	Manufacture of starch from maize and its industrial applications.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			
			6	Industry Class +Industry assessments	2		2				
9	4	1,2, 5, 7.	1	PEER Discussion on Industry Assignment		2	2	Report on industrial visit.			3
			2	Polymer industry, Definition of polymer, Classifications, reactions involved in the formation of polymers ,Methods of polymerization, Manufacture of poly ethylene by Ziegler process and field of applications	4			Virtual demonstration and documentation on formation of polymers and methods of polymerization.			3
			3	Phenol formaldehyde - Polystyrene - Polyester	1		3	Virtual demonstration and documentation on production of polymers.			3
			4	Natural rubber, manufacture of synthetic rubber(SBR), Manufacture of polyvinylchloride and its field of application.	2		2	Virtual demonstration/industrial visit and documentation on pollution problems and treatment methods in polymer industries.			3
			5	CIE 4- Written and practice test				Assessment Review and corrective action			3
			6	Industry Class +Industry assessments	2		2				
10	5	1,2, 5, 7	1	PEER Discussion on Industry Assignment			2	Presentation and documentation on Industry visit.			3
			2	Safety and risk assessments followed in acid and alkali industries.	4		2	Virtual demonstration/industrial visit and documentation on Safety and risk assessments in fertilizer industries.			3

			3	Safety and risk assessments followed in glass and cement industries.	1		3	Virtual demonstration/industrial visit and documentation on Safety and risk assessments in oil , fats, and fermentation industries.			3
			4	Safety and risk assessments followed in soaps and detergent industries.	2		2	Virtual demonstration/industrial visit and documentation on Safety and risk assessments in paper and pulp, and polymer industries.			3
			5	Developmental Assessment		4		Assessment Review and corrective action			
			6	Industry Class +Industry assessments	2		2				
11	5	1,2,5,7	1	PEER Discussion on Industry Assignment		2	2	PEER Discussion , presentation and documentation on Safety and risk assessment of visited industry.			3
			2	Document on Sustainable Green Chemical Technology for Developments in Process Industries- A case study	4			Document on Sustainable Green Chemical Technology for Developments in Process Industries- A case study			3
			3	Green technology -in waste water treatment.	1		3	Green technology-elimination of industrial emissions			3
			4	Green technology in Waste-to-Energy	2		2	Green technology- Harnessing solar energy, Natural gas boilers			3
			5	CIE 5- Written and practice test				Assessment Review and corrective action			
			6	Industry Class +Industry assessments	2		2				
12			1	PEER Discussion on Industry Assignment		2	2	PEER Discussion on			3
			2	Mini project	4			Mini project			3
			3	Mini project	1		3	Mini project			3
			4	Mini project	2		2	Mini project			3
			5	Developmental Assessment		4		Assessment Review and corrective action			
			6	Industry Class +Industry assessments	2		2				

13	CO5	PO 3,4	1	PEER Discussion on Industry Assignment	4	Mini project-presentation and demonstration	3
			2	Mini project-presentation and demonstration	4	Mini project-presentation and demonstration	3
			3	Mini project-presentation and demonstration	4	Mini project-presentation and demonstration	3
			4	Mini project-presentation and demonstration	4	Mini project-presentation and demonstration	3
			5	CIE 6- Comprehensive assessment based on mini project (Only practice)		CIE 6- Comprehensive assessment based on mini project (Only practice)	
			6	CIE 6- Comprehensive assessment based on mini project (Only practice)			

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE (1 to 5)

Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam – 4 hours

Programme	Chemical Engineering	Semester	V		
Course	Process Plant Technology	Max Marks	30		
Course Code	20CH54I	Duration	4 hours		
Name of the course coordinator					
Note: Answer one full question from each section.					
Qn.No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) – 10 marks					
1.a)	Develop a flowsheet of manufacture of sulphuric acid along with the reactions involved in it	L4	1	1,2,5,7	05
b)	Build an unit operations and processes in manufacture of soda ash	L4	1	1,2,5,7	05
2.a)	Apply electro chemical reaction in manufacture of caustic soda	L4	1	1,2,5,7	4
b)	Build an unit operations and processes in manufacture of caustic soda and chlorine	L4	1	1,2,5,7	3
c)	Develop a flowsheet of manufacture of Hydrochloric acid	L4	1	1,2,5,7	3
Section-2 (Practical) - 20 marks					
3)	Demonstration on preparation of sulphuric acid on a lab scale	L3	1	1,2,5,7	20
4)	Demonstration on preparation of Caustic soda on a lab scale	L3	1	1,2,5,7	20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme : Chemical Engineering		Semester : V		
Course : Process Plant Technology		Max Marks : 100		
Course Code : 20CH54I		Duration : 3 Hrs		
Instruction to the Candidate: Answer one full question from each section.				
Q.No	Question	CL	CO	Marks
Section-1				
1.a)	Develop a flowsheet Manufacture of nitric acid and industrial applications	L3	1	10
b)	Analyse the manufacture of Bleaching powder and their industrial applications	L4		10
2.a)	Demonstrate manufacture of phosphoric acid by wet process	L3		10
b)	Identify the Pollution problems and treatment methods in alkali industries	L4		10
Section-2				
3.a)	Construct the flow diagram and explain the production of Sodium phosphate	L3	2	10
b)	Choose the method of reduction of Biuret formation in Urea manufacture	L4		10
4.a)	Construct the flow diagram to explain the manufacture of Plate glass	L3		10
b)	Discover the manufacture of Cement with the flow diagram	L4		10
Section- 3				
5.a)	Construct a flowsheet to explain the manufacture of soap	L3	3	10
b)	Analyse fillers and sizing materials are added to the pulp	L4		10
6.a)	Construct a flowsheet to explain the hydrogenation of oils	L3		10
b)	Analyse beating and refining of pulp for paper production	L4		10
Section-4				
7.a)	Construct the flow diagram for the production of crystalline sugar	L3	4	10
b)	Categorise a report on methods of polymerization	L4		10
8.a)	Summarize refining of cane sugar	L3		10
b)	Develop the production of synthetic rubber	L4		10
Section-5				
9.a)	Build Safety and risk assessments followed in soaps and detergent industries	L3		10

b)	Analyze the Green technology in Waste-to-Energy	L4	5	10
10.a)	Apply Safety and risk assessments followed in Fertilizer industries	L3		10
b)	Conclude Green technology -in waste water treatment.	L4		10

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
1	Case submission	20
2	Case presentation	20
3	Case innovation	20
4	Result	20
5	Viva voce	20
Total		100

Case Submission / Content Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Identification of the main issues / problem	Identifies and understands all the main issues in the problem statement	Identifies and understands most of the main issues in the problem statement	Identifies and understands some of the issues in the problem statement	Identifies and understands a few of the issues in the problem statement	Identifies limited issues in the problem statement	5
Analysis of the issues	Insightful and thorough analysis of all the issues	Thorough analysis of most of the issues	Superficial analysis of some of the issues in the problem statement	Incomplete analysis of the issues	No analysis of the issue	4
Comments on effective solutions / strategies (The solution may be in the problem statement already or proposed by you)	Well documented, reasoned and pedagogically appropriate comments on solutions, or proposals for solutions, to all issues in the problem statement	Appropriate, well thought out comments about solutions, or proposals for solutions, to most of the issues in the problem statement	Superficial and / or inappropriate solutions to some of the issues in the problem statement	Little and/or inappropriate solutions to all of the issues in the problem statement	No action to all issues in the problem statement	2
Links to course learning and additional research	Excellent research into the issues with clearly documented links to course learnings and beyond.	Good research and documented links to the materials read during the course	Limited research and documented links to any readings	Incomplete research and links to any reading.	No research or links to any reading	3
Total						14/20

Case Presentation Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Delivery & Enthusiasm	Very clear and concise flow of ideas Demonstrates passionate interest in the topic and engagement with class / examiner	Clear flow of ideas Demonstrates interest in the topic and engagement with class / examiner	Most ideas flow but is lost at times Limited evidence of interest in and engagement with the topic	Hard to follow the flow of ideas Lack of enthusiasm and interest	No flow in the presentation Poor presentation skills	4
Visuals	Visuals augmented and extended comprehension of the issues in unique ways	Use of visuals related to the topic	Limited use of visuals loosely related to the topic	No use of visuals	Poor visuals used and some visuals are not easy to understand its relevance.	2
Staging	Uses stage effects such as props, sound effects, and speech modulation in a unique and dramatic manner that enhances the understanding of the issues in the problem statement.	Uses stage effects such as props, sound effects, and speech modulation in an effective manner to extend the understanding of the issues in the problem statement.	Limited use of stage effects and/or used in a manner that did not enhance the understanding of the issues in the problem statement.	No use of stage effects	Poor stage effects usage	5
Involvement of the class / Examiners • Questions • Discussions • Activities	Excellent and salient discussion points that elucidated material to develop a deep understanding Appropriate and imaginative activities used to extend understanding in a creative manner	Questions and discussions addressed important information that developed understanding Appropriate activities used to	Questions and discussions addressed important superficial issues of the problem statement Limited use of activities to clarify understanding	Little or no attempt to engage the class / examiner in demonstrating their learning	Did not engage the class / examiner and poor listening skills	1

		clarify understanding				
Total						12/20

Case Results Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Problem outcome	The topic was well researched and all information and data included are accurate and from reliable sources of information like high impact journals standards, etc. The proof was enough backed up with accurate data, analysis and reasoning beyond the class learning. Outcome achieved beyond the problem brief	The topic was researched and most information and data were from reliable sources of information. The proof was backed up with good data and reasoning as taught in the class. Outcome achieved as per the problem brief	The topic was researched but information and data were only partly from reliable sources of information. The proof was not fully backed up with good data or reasoning as taught in the class. Partial outcome achieved as per the problem brief	The topic was researched and data were not from reliable sources. The proof was not backed up with data, analysis or reasoning as taught in the class. Some outcome obtained as per the problem brief	Desired results not obtained, but some relevant research was done. Outcome not obtained as per the problem brief	4
Application of class learning in problem solving	Made effective use of class principles, models and theories. Also used creativity to find effective results appropriate to industry beyond class learning.	Made good use of class principles, models and theories Some creative ideas were explored to find desired outcome but within the framework of class learning	Made some use of class principles, models and theories No creative ideas or models explored	Made limited use of class principles, models and theories	Poorly applied class principals, models and theories	3

Response to Class / Examiners Queries	Queries Excellent response to comments and discussion with appropriate content supported by theory/research	Good response to questions and discussions with some connection made to theory/research	Satisfactory response to questions and discussions with limited reference to theory/research	Limited response to questions and discussions with no reference to theory/research	Poor or no response to questions and did not participate in the discussions.	2
Conclusions	Provides detailed and appropriate conclusion for the problem statement	Provides appropriate conclusion for the problem statement	Provides adequate and mostly appropriate conclusions for the problem statement	Provides limited and somewhat appropriate conclusions for the problem statement	Has not provided appropriate conclusions for the problem statement.	4
Total						13/20

Case Innovation Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Finding new processes / models / approaches	The newly discovered processes / models / approaches are of good quality and relevant	The newly discovered processes / models / approaches are of appropriate quality but limited relevance	The newly discovered processes / models / approaches have limited application but relevant to the problem	The newly discovered processes / models / approaches has restricted application	No new processes / models / approaches were identified	5
Proposing ideas and innovative solutions in terms of processes / models / approaches and how they can be applied to solve the problem on hand	Various ideas and innovative solutions have been proposed and their application have been clearly outlined	Various ideas and innovative solutions have been proposed as well as the outline of the process to apply them	Some ideas or innovative solutions have been proposed but the process of applying them hasn't been specified	Few ideas have been proposed	No ideas or innovative solutions have been proposed	3
Using creativity techniques to provide and reason good ideas which are original and unconventional	Wherever necessary creativity techniques are utilized to analyse and solve the problem	Creativity techniques are frequently utilized in more than 50% of the occasions	Creativity techniques are utilized at times in less than 50% of the occasions	Creativity techniques are used a few times only	Creativity technique are not utilized to analyse and solve the problem	2
Finding constraints and weak points in existing processes / models / approaches or methods	Constraints and weak points are understood	Constraints and weak are identified	A critical analysis is undertaken	Only a description of the working process and methods are provided	No constraints or weak points have been identified.	3

Total	13/20
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Required course facilities:

1. DP Heat exchanger
2. Centrifugal mixers
3. Electronic weighing balance
4. Hot air oven

4. Virtual Demonstration:

e-links:

1. <http://www.essentialchemicalindustry.org/chemicals/sulfuric-acid.html>
2. <https://www.youtube.com/watch?v=mym1rRPX6F4>
3. <https://www.youtube.com/watch?v=Flxz7biiIG0>
4. <http://www.kemira.com/en/industries-applications/pages/hydrochloric-acid.aspx>
5. <https://www.youtube.com/watch?v=yLa5VkJNaBqs>
7. <https://www.youtube.com/watch?v=mBUWOPh11yU>
8. <https://www.youtube.com/watch?v=R9J7pOU5FSg>
9. https://www.youtube.com/watch?v=dyxL_BvkhJg
10. <https://www.youtube.com/watch?v=vJ37sYrCt-8>

References:

- 1 Shreves Chemical Technology by Austen
- 2 Dryden's Outlines of Chemical Technology by Gopal Rao
- 3 A text book of Chemical technology-II by G N Pandey