MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
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(Declared Under Distinct Category by Ministry of Education, Government of India)
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BOS MEETING

DEPARTMENT OF CHEMICAL ENGINEERING

DATE: 27/05/2024

ITEM -2

To review and finalize the **scheme structure of B.Tech. VII Semester** with the provision of *Three (03) Departmental Electives (DEs) and Open Category (OC) Course*. **(Out of which One (01) Elective and o1 Open category course is to be offered in traditional mode** and **remaining Two (02) Departmental Electives are to be offered in online mode** with credit transfer **for the batch admitted in 2021-22**.

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Department of Chemical Engineering

Scheme of Evaluation

B. Tech. VII Semester *For batches admitted in academic session 2021-22*

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted									Total Marks	Contact Hours per week			Total Credits	Mode of Teaching (Online, Offline, Blended)	$^{\$\$}$Mode of Exam.
				Theory Slot				Practical Slot			MOOCs								
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation		Assignment	Exam		L	T	P			
				nd Sem. Exam.	$^{\$}$Proficiency in subject /course	Mid Sem. Exam	Quiz/ Assignment		Lab work & Sessional	Skill Based Mini Project									
1.	DE	DE	Departmental Elective (DE-2)	50	10	20	20	-	-	-	-	-	100	3	-	-	**3**	Blended	PP
2.	DE	DE	Departmental Elective* (DE-3)	-	-	-	-	-	-	-	25	75	100	3	-	-	**3**	Blended	MCQ
3.	OC	DE	Departmental Elective(DE-4)*	-	-	-	-	-	-	-	25	75	100	3	-	-	**3**	Blended	MCQ
4.	OC	OC	Open Category (OC-2)	50	10	20	20	-	-	-	-	-	100	3	-	-	**3**	Blended	MCQ
5.	170715	DLC	Process Computation Lab	-	-	-	-	60	20	20	-	-	100	-	-	4	**2**	Offline	SO
6.	170716	DLC	Creative Problem Solving (Evaluation)	-	-	-	-	25	25	-	-	-	50	-	-	2	**1**	Blended	SO
7.	170717	DLC	Summer Internship Project-III (04 weeks) (Evaluation)	-	-	-	-	60	-	-	-	-	60	-	-	4	**2**	Offline	SO
Total				**100**	**20**	**40**	**40**	**145**	**45**	**20**	**50**	**150**	**610**	**12**	**-**	**10**	**17**	-	-
8	1000008	**MAC**	Universal Human Values & Professional Ethics(UHVPE)	50	10	20	20	-	-	-	-	-	100	2	-	-	GRADE	Blended	**MCQ**
Additional Course for Honours or minor Specialization				**Permitted to opt for maximum two additional courses for the award of Honours or Minor specialization**															

$ proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.

$^{\$\$}$**MCQ:** Multiple Choice Question $^{\$\$}$**AO:** Assignment + Oral $^{\$\$}$**PP:** Pen Paper $^{\$\$}$**SO:** Submission + Oral

*** Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform with Credit Transfer**

DE-II(Offline)	DE-III(Online)	DE-IV (Online)	OC-III
Transport Phenomena -170721	Chemical Process Safety - 170761	Petroleum Reservoir Engineering-170765	Industrial Safety and Hazards - 910215
Equilibrium Staged Operations -170722	Sustainable Energy Technology -170762	Petroleum Technology-170766	-
Heterogeneous Reaction Systems -170723	Fluidization Engineering - 170767	Chemical Process Intensification - 170768	-
Multi – Component Distillation -170724			

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Mode of Teaching				Mode of Examination				Total Credits
Theory			Lab	Theory			Lab	
Offline	Online	Blended	Offline	PP	AO	MCQ	SO	
03	-	09	05	03	-	09	05	17
17.65%	-	52.94%	29.41%	17.65%	-	52.94%	29.41%	Credits %

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ITEM -3

To propose the list of courses which the students can opt from SWAYAM/NPTEL/MOOC based Platforms, to be offered in **online mode for Two (02) Departmental Electives** (DE) Course, with credit transfer in the B.Tech. VII Semester under the flexible curriculum (Batch admitted in 2021-22)

DE-III (Online)	**DE-IV (Online)**
Chemical Process Safety - 170761	Petroleum Reservoir Engineering-170765
Sustainable Energy Technology - 170762	Petroleum Technology-170766
Fluidization Engineering-170767	Chemical Process Intensification - 170768

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ITEM -4

To prepare and finalize the syllabus of courses to be offered ***(for batch admitted in 2021-22)***under ***Departmental Elective (DE) Course*** (in traditional mode) for B. Tech. ***VII Semester*** along with their COs

List of Departmental Elective-III (Offline Mode)

Course Name	Course Code
1. Transport Phenomena	170721
2. Equilibrium Staged Operations	170722
3. Heterogeneous Reaction Systems	170723
4.Multi-Component Distillation	170724

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1. Transport Phenomena

Category	Title	Code	Credits-3			Theory Paper
			L	T	P	
Departmental Elective	Transport Phenomena	170721	3	-	-	Max. Marks-50 Duration- 2 hrs

Course Objective:

This course will provide the fundamentals to solve real life problems involving transports of momentum, energy and mass in biological, mechanical and chemical systems using a unified approach.

Syllabus

Unit-I Similarity in momentum, heat and mass-transport –Newton's laws of viscosity, Fourier's laws of conduction and Fick's laws of diffusion.Flux-transport property relationships, Estimation of transport properties-measurement and correlations.

Unit-II Velocity distribution in laminar flow of falling film. Flow over an inclined plane, a circular tube annulus and between two parallel plates.

Unit-III Shell balance approach for developing equations of change for momentum, Heat and mass transport, Equations of change and their approximations for transport in one dimension.

Unit-IV Transport equations in turbulent flow and equations for turbulent fluxes.Velocity, Temperature and concentration profiles for laminar and turbulent flow conditions.Temperature and concentration profiles for conductive and convective transport in solids and fluids.

Unit-V Macroscopic momentum and heat balance equations, Kinetic energy calculations Constant area and variable area flow problems. Flow through bends. Time determination for emptying of vessels.

Course Outcomes: After the successful completion of this course, students will be able to:

CO1 **Explain** the basic terminology of Transport phenomena.

CO2 **Apply** shell balance to mass, momentum and heat transfer.

CO3 **Solve** the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration

CO4 **Analyze** industrial problems along with appropriate boundary conditions.

CO5 **Apply** analogies among momentum, heat and mass transfer.

CO6 **Describe** mechanisms of transport phenomena, present in given isothermal and non-isothermal, laminar and turbulent flow systems

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1								2		
CO2	3	3	2									2		2
CO3	3	3	3									2		2
CO4	2	2	3									2		
CO5	3	2	2									2		
CO6	3	3	3									2		

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books:

1. Transport Phenomena By Bird R.B., Stewart W.E and Lightfoot E.W.(John Wiley & Sons)
2. Transport Phenomena A Unified Approach By Brodkey R.S. and Hershey (McGraw Hill Book Co.)

Reference Books:

1. R.W.Fahien., Elementary Transport Phenomena, McGraw Hill, New York, 1983
2. Welty J.R.,Wicks C.E., Wilson R.E. and Rorer G.L, Fundamentals of momentum, heat andmass transfer, 5th edition, John Wiley & sons, New York 2007

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2. Equilibrium Staged operations

Category	Title	Code	Credits-3			Theory Paper
			L	T	P	
Departmental Elective	Equilibrium Staged Operations	170722	3	-	-	Max. Marks-50 Duration- 2 hrs

Course Objective:

To provide an adequate knowledge of equilibrium stage operations such as multi component multistage separations distillation, absorption, stripping and extraction

Syllabus

UNIT I - Distillation-Stage wise contact operation. Methods of distillation: batch, continuous, flash, steam, vacuum, molecular distillations.

UNIT II - McCabe-Thiele and Ponchon-Savarit methods. Design of distillation towers.Elements of multi component distillation, Fenske-Underwood – Gilliland Method Azeotropic and extractive distillation.

UNIT III -General principles of leaching, Bollman extractor, Hildebrandt extractor. General principles of liquid –liquid extraction, working principle of extraction equipment: mixer-settlers, spray and packed extraction towers, agitated tower extractors. Percentage extraction calculation for single stage and multistage crosscurrent operations, Minimum solvent rate and number of theoretical stages for continuous countercurrent operation

UNIT IV - Introduction to adsorption, adsorbents and adsorption processes, adsorption equipment: fixed-bed absorbers, gas-drying equipment. Pressure-swing adsorption, adsorption from liquids, adsorption isotherms. Equilibrium Consideration – Liquid adsorption, Kinetic and Transport Considerations

UNIT V - Theoretical Model for an Equilibrium Stages used in separation operation, General Strategy of Mathematical and Graphical Methods for separation operation, Bubble Point Method for Distillation operation, Triangular diagram, Isotherms.

Course Outcomes: After the successful completion of this course, students will be able to:

CO1 **Describe** the fundamentals of separation operation.
CO2 **Describe** the approximation technique and its algorithms for multicomponent multistage separations
CO3 **Analyze** the equilibrium data obtained in the various separation operation
CO4 **Analyze** industrial problems along with equilibrium stage operation.
CO5 **Apply** the knowledge of kinetics and transport.
CO6 **Apply** the mechanisms of industrial equilibrium separation operation

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2									2		
CO2	3	3	2									2		2
CO3	3	3	3									2		2
CO4	2	2	3									2		
CO5	3	2	2									2		
CO6	3	3	3									2		2

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books

1. Treybal. R .E, "Mass Transfer Operations", 3rd Edition, McGraw Hill, 1980.

Reference Books:

1. Smith. J.M., "Chemical Engineering Kinetics", 3rd edition, McGraw Hill International Editions, New Delhi, 1981.
2. Ronald. W.Missen, Charles.A.Mions, Bradley.A.Saville, "Introduction to Chemical Reaction Operation and Kinetics", John Wiley and Sons, Singapore, 1999.
3.Seader.J D, & E J Henley, "Separation Process Principles", John Wiley & Sons Inc., 1998.

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3. Heterogeneous Reaction Systems

Category	Title	Code	Credit-2			Theory Paper
Departmental Elective	Heterogeneous Reaction Systems	170723	L 3	T 0	P 0	Max.Marks-50 Duration- 2 hrs.

Course objectives: To apply the knowledge of material and energy balances, mass transfer and chemical reaction engineering–I for solving problems involving heterogeneous reaction systems and to understand and apply the principles of non-ideal flow in the design of reactors.

Unit-I Heterogeneous processes: Catalysis and adsorption; Classification of catalysts, Preparation of catalysts, Promoters and Inhibitors, General mechanism of catalytic Reactions surface area and pore size distribution Rate equation of fluid solid Catalytic reactions, Procurement and Analysis of kinetic data, kinetics of catalyst deactivation

Unit -II External transport processes and their effects on heterogeneous reactions yield and selectivity Reaction and diffusion in porous catalysts, Isothermal and non-isothermal effectiveness factors, Effect of intra-phase transport on yield, selectivity & poisoning, Global reaction rate.

Unit -III Design of catalytic reactors, Isothermal & adiabatic fixed bed reactor staged Adiabatic reactors, Non-isothermal non - adiabatic fixed bed reactors, Fluidized bed reactors, Slurry reactors, Trickle bed reactors.

Unit-IV Models for fluid - solid non-catalytic reactions, controlling mechanisms, Diffusion through gas film controls. Diffusion through ash layer controls, Chemical reaction controls, fluidized bed reactors with and without elutriation.

Unit – V Gas-liquid reactions and liquid-liquid reaction, Rate equation based on film theory, Reaction design for instantaneous reactions and slow reactions, Aerobic Fermentation, Application to Design Tools for Fast Reactions.

Course Outcomes:

CO1 **Analyze** the heterogeneous processes.
CO2 **Explain** the various catalytic processes and catalytic poisoning
CO3 **Examine** the effect of various parameters like yield selectivity etc. on catalytic reaction
CO4 **Design** the multiple phase reactors
CO5 **Design** the model for solid fluid non catalytic reaction
CO6 **Describe** the models for fluid-fluid catalytic reaction

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2									2		
CO2	3	3	2									2		2
CO3	3	3	3									2		2
CO4	2	2	3									2		
CO5	3	2	2									2		
CO6	3	3	3									2		2

1 - Slightly; 2 - Moderately; 3 – Substantially

Suggested Reading:

1 Chemical Engineering Kinetics by J.M Smith (3rd Edition McGraw Hill)
2 Chemical Reaction Theory an introduction by K.G.Denbigh & K.G. Turner (2nd Ed.United Press & ELBS 1972)
3 Chemical Kinetics and Reaction Engg. by G. Copper & G.V.J. Jeffery's
4 Chemical Reaction Engg by O.Levenspiel (2nd Ed. Wiley Eastern, Singapore.
5 Chemical process principles Part-III by Hougen, Watson & Ragatz, Kinetics & Catalysis(2nd Edition Asian Publishing House Bombay)
6 Elements of Chemical Reaction Engg. by Fogler, H.S. (2nd ed. Prentice Hall of IndiaPvt. Ltd. New Delhi - 1997

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4. MULTI – COMPONENT DISTILLATION

Category	Title	Code	Credit-2			Theory Paper
Departmental Elective	MULTI – COMPONENT DISTILLATION	170724	L 3	T 0	P 0	Max.Marks-50 Duration -2 hrs.

Course Objective: This course will enable students to understand the basic theories of multicomponent distillation and learn the design procedure for multicomponent distillation.

UNIT-I Multi component systems consisting of hydrocarbons of different molecular structure, Thermodynamics and vapor liquid equilibrium, Distribution coefficients, the effect of temperature, pressure and composition. Definition and expressions of bubble point, dew point in multi component systems.

UNIT-II Key components-light and heavy key components, Flash Distillation, material balance and equilibrium, relationship for conventional distillation column, convergence methods.

UNIT-III Enthalpy balance for conventional columns, refinements for conventional column, total reflux, product composition , Lewis and Matheson methods, Composition corrections, Liquid/Vapor ratios, Method of Thiele and Geddes.

UNIT-IV Conventional and complex columns at total and minimum reflux, minimum reflux. Minimum reflux calculations, Plate efficiencies, Q- method of convergence for systems of distillations columns. Use of efficiencies for mass and heat transfer in conventional complex columns.

UNIT-V Equipments for distilling by non-conventional methods, Azeotropic extractive and molecular distillations. Use of packed columns, columns diameter and height of transfer unit (HTU). Super critical flux and extraction.

Course Outcomes:-

CO1 **Select** key component

CO2 **Solve** number of theoretical and actual stages required for multi component distillation by using various methods.

CO3 **Examine** how to break azeotrope using azeotropic and extractive distillation.

CO4 **Estimate** reflux ratio required for the distillation operation.

CO5 **Estimate** tower diameter and operating pressure for multi distillation column.

CO6 **Analyze** various design options for energy conservation in the distillation column.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2									2		
CO2	3	2	2									2		2
CO3	3	3	2									2		2
CO4	2	2	3									2		3
CO5	3	2	2									2		3
CO6	3	3	3									2		2

1 - Slightly; 2 - Moderately; 3 – Substantially

Suggested Reading:

1. Holland-Fundamentals to multi component distillation –McGraw Hill, NY.
2. Holland and liaps – Computer methods for solving dynamic separation problems – McGraw Hill, N.Y.
3.Treybal RE- Mass transfer operation- McGraw Hill, International edition. New Delhi.

4. Smith BD-Design of Equilibrium Stage Process- McGraw Hill, New Delhi.
5.Van Winkle- Distillation – McGraw Hill, Booh Co., New Delhi.

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ITEM -5

To prepare and finalize the syllabus of courses to be offered (**for batch admitted in 2021-22**) under the **Open Category (OC) Courses** (in traditional mode) for B.Tech. VII semester students of other departments along with their COs

Open Category (OC) Course
Industrial Safety & Hazards (OC-2)

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Industrial Safety & Hazard Analysis (OC-2)

Category	Title	Code	Credits-4			TheoryPaper
Departmental OC	Industrial Safety & Hazard Analysis	**910215**	L	T	P	Max.Marks-50 Duration-1.5hrs.
			3	1	-	

Course Objective:
This course will provide effective use of chemical industries utilities. This course also emphasizes the knowledge of loss prevention, personal safety, industrial safety, hazard analysis, toxicology and personal pro-active equipment.

Syllabus:

Unit-I: Origin of process hazards: Laws Codes, Standards, Case Histories, properties of Chemicals, Health hazards of industrial substances.

Unit-II: Toxicology:Toxic materials and their properties, effect of dose and exposure time, Relationship and predictive models for response, Threshold value and its definitions, material safety data sheets, industrial hygiene evaluation.

Unit-III: Fire & Explosion:Fire are exposure hazards causes fire and preventive methods Flammability characteristics of chemical, fire and explosion hazard, rating of process plant, Propagation of fire and effect of environmental factors, Ventilation, Dispersion, Sprinkling, Safety and relief values.

Unit-IV: Other Energy Hazards: Electrical hazards, noise hazards, Radiation hazards in Process operations, Hazards communication to employees, Plant management and maintenance to reduce energy hazards.

Unit-V: Risk Analysis and Hazard Identification: Event probability and failure, Plant reliability and risk analysis, HAZOP, HAZON event and consequence analysis, Measurement and calculation of Risk analysis, Safety Training program, Disaster management and emergency planning.

Course Outcomes: After the completion of this course, Students will be able to

CO1:**Analyze** the origin of hazards and fundamental principles of safety

CO2:**Analyze** the issues related to toxicants and minimize the toxicants dose.

CO3:**Explain** the fire & explosion hazard and the controlling measurement techniques used in the chemical industries

CO4:**Evaluate** the professional obligations related to the plant management and maintenance to reduce energy hazards.

CO5:**Analyze** the risk analysis and plant reliability to reduce the hazard

CO6:**Formulate** the HAZOP study, event tree analysis and fault tree analysis

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	2		1		1	2		2	2	2
CO2	3	3	3	2	3				2	2		2	3	3
CO3	3	2	2	1	2					2		2	2	2
CO4	2	2	1	1	1	1	1			1		2	1	2
CO5	3	2	2	1	2					2		2	2	2
CO6	2	3	2	1	2	1	2			2		2	2	2

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books:

1. D. A. Crawl, J. A. Louvar (Prentice Hall of India, New Delhi, 1990) - Chemical Process Safety Fundamentals with Applications

Reference Books:

1. C. A. Wentz (2th Edition 2001, McGraw Hill) - Safety, Health and Environmental Protection
2. B. D. Smith (4th Edition 2003, McGraw Hill) - Design of Equilibrium State Process

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ITEM -6

To review and finalize the Experiment list/ Lab manual for Departmental Laboratory Course (DLC) to be offered in B. Tech. VII semester ***(for batches admitted in 2021-22)***

Departmental Laboratory Course (DLC)
Process Computation Lab (170715)

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170715: Process Computation Lab

1. To apply mass balance for a process situation using excel
2. To apply energy balance for a process situation using excel
3. To plot and learn Duhring's plot
4. To plot various time changing plots for parameters involved in a process
5. To analysis parameter relations in a process situation using in-out relations
6. To develop flow-sheet in excel
7. To develop balance sheet for a process situation
8. To develop understanding of calling of workbooks for use at one time
9. To learn about data validation and consolidation in excel

After completion of this laboratory course, the student will be able to

CO1: **Operate** and program in MS Excel

CO2: **Construct** the flow sheets of chemical process units.

CO3: **Solve** mass balance for a process situation using excel.

CO4: **Apply** energy balance for a process situation using excel.

CO5: **Construct** various time changing plots for parameters involved in a process.

CO6: **Perform** data validation and consolidation in excel.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2					2		3				3	3
CO2	3	3										3	3	3
CO3	3	3										3		3
CO4	2	3		2									2	3
CO5	3	3	2							3		3	3	3
CO6	3	2				3			3	3		3	2	2

1 - Slightly; 2 - Moderately; 3 – Substantially

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Skill Based Mini Project

170715: Process Computation Lab

1. To study and illustrate unit conversion applied for physical and chemical properties related in Chemical engineering based on user defined functions
2. To illustrate optional arguments in excel for parameters like pressure, density and volume concentrations
3. Illustrate data checking on case study like The data table can include valid temperature limits that the (User Defined Function) UDF can check.
4. Illustrate error handling in excel
5. Illustrate derived data entry for certain case study related to chemical engineering problems
6. Illustrate "Solver" as a powerful version of Goal Seek that allows solving systems of equations, and in particular, linear equations that you will come across from mass and energy balances.
7. Study the "Project Tracker Excel" feature for a particular flow sheet
8. Study and illustrate "Spreadsheets in Chemical Engineering as a tool in Process Design and Process Integration
9. Create a Dew Point Calculator in Excel
10. Study and create Centrifugal Pump Calculation sheet

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ITEM -7

To propose the list of "Additional Courses" which can be opted for getting an

(i) Honours (for students of the host department)

(ii) Minor Specialization (for students of other departments)

These will be offered through SWAYAM/NPTEL/MOOC based Platforms for the B.Tech. ***VII semester students*** *(for the batch admitted in 2021-22) and for* B.Tech. ***V semester*** *(for the batch admitted in 2022-23)*

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List of Additional Courses to be offered in July-Dec .2024 (From SWAYAM/NPTEL

S.No.	Purpose	Name of Course	Duration of the course in weeks
1.	For Minor Specialization(Others Department) (VII Semester)	Fluidization Engineering	12 Weeks
		Polymers: concepts, properties, uses and sustainability	12 Weeks
		Transport Phenomena of Non-Newtonian Fluids	12 Weeks
2.	For Minor Specialization (Others Department) (V Semester)	Heat Transfer	12 Weeks
		Chemical Reaction Engineering-I	12 Weeks
		Mechanical Unit Operations	12 Weeks

The details of Courses offered for **Honours (V Semester) track wise** for 2022 admitted students:

Tracks --->	**Energy Engineering**	**Separation Processes**	**Unit Operations**	**Polymer Technology**	**Environmental Engineering**
S. No.	**Courses**	**Courses**	**Courses**	**Courses**	**Courses**
1	Artificial Lift (12 weeks)	Thermal Processing of Foods (12 weeks)	Rheology and Processing of Paints, Plastic and Elastomer Based Composites (08 weeks)	Introduction to Polymer Physics (12 weeks)	Basic Environmental Engineering and Pollution Abatement (12 weeks)

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2	Energy Conversion Technologies (Biomass and Coal) (08 weeks)	Colloids and Surfaces (08 weeks)	Transport Phenomena of Non-Newtonian Fluids (12 weeks)	Polymer Process Engineering (12 weeks)	**Trace And Ultra-Trace Analysis of Metals Using Atomic Absorption Spectrometry** (08 weeks)
3	Hydrogen Energy: Production, Storage, Transportation and Safety (12 weeks)			Polymers: Concepts, Properties, Uses and Sustainability (12 weeks)	

The details of Courses offered for **Honours (VII Semester) track wise** for 2021 admitted students:

Tracks --->	**Energy Engineering**	**Separation Processes**	**Unit Operations**	**Polymer Technology**	**Environmental Engineering**
S. No.	**Courses**	**Courses**	**Courses**	**Courses**	**Courses**
1	Technologies for Clean and Renewable Energy Production (08 weeks)	Adsorption Science and Technology: Fundamentals and Applications (08 weeks)	Solid – Fluid Operations (12 weeks)	Fundamentals of Protein Chemistry (12 weeks)	Environmental Chemistry (12 weeks)

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2	Enhanced Oil Recovery Techniques (12 weeks)	Thermal Operations in Food Process Engineering: Theory and Applications (12 weeks)	Principles of Downstream Techniques in Bioprocess (12 weeks)	Mechanical Behavior of Polymers and Composites (12 weeks)	Environmental Modeling and Simulation (12 weeks)
3	Petroleum Formation Evaluation (12 weeks)				Municipal Solid Waste Management (12 weeks)

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ITEM -8

To review and finalize the ***scheme structure of B.Tech. V Semester under*** the flexible curriculum (***Batch admitted in 2022-23***)

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B.Tech. V Semester (Chemical Engineering) *For batches admitted in academic session 2022 – 23*

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching (Offline/Online)	Mode of Exam
				Theory Slot				Practical Slot									
				End Sem.		Mid Sem. Exam.	Quiz/ Assignment	End Sem	Lab Work & Sessional	Skill Based Mini Project		L	T	P			
				End Term Evaluation	$Proficiency in subject /course												
1.	2170511	MC	Data Science	50	10	20	20	60	20	20	200	3	0	2	4	Blended	MCQ
2.	2170512	DC	Mass Transfer –II	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP
3.	2170513	DC	Chemical Reaction Engineering – I	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP
4.	2170514	DC	Computational Methods in Chemical Engg	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP
5.	2170515	DC	Process Engineering & Costing	50	10	20	20	-	-	-	100	2	-	-	2	Blended	PP
6.	2170516	DLC	Minor Project-I	-	-	-	-	60	40	-	100	-	-	4	2	Offline	SO
7.	2170517	DLC	Self-learning/Presentation (SWAYAM/NPTEL/MOOC)# or Interdisciplinary course from other institutions and platforms with credit transfer	-	-	-	-	-	40	-	40	-	-	2	1	Online + Mentoring	SO
8.	200XXX	CLC	Novel Engaging Course (Informal Learning)	-	-	-	-	50	-	-	50	-	-	2	1	Interactive	SO
9.	2170518	DLC	Summer Internship Project–II (Institute Level) (Evaluation)	-		-	-	60	-	-	60	-	-	4	2	Offline	SO
Total				250	50	100	100	410	160	60	1150	10	3	20	**24**	-	-
10.	1000006	MAC	Disaster Management (MC)	50	10	20	20	-	-	-	100	2	-		Grade	Blended	MCQ
Additional Course for Honours or minor Specialization				**Permitted to opt for maximum two additional courses for the award of Honours or Minor specialization**													

MCQ: Multiple Choice Question **AO:** Assignment + Oral **OB:** Open Book **PP:** Pen Paper SO: Submission+ Oral

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#compulsory registration for one online course using SWAYAM/NPTEL/ MOOC, evaluation through attendance, assignments and presentation

$Proficiency in course/subject – includes the weightage towards ability/ skill/ competence /knowledge level /expertise attained /attendance etc. in that particular course/subject

Mode of Teaching				Mode of Examination				Total Credits
Theory			Lab	Theory			Lab	
Offline	Online	Blended	Offline	PP	AO	MCQ	SO	
-	1	19	04	14	-	04	06	24
-	4.17%	79.17%	16.67%	58.33%	-	16.67%	25%	Credits %

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ITEM -9

To prepare and recommend the syllabi for all ***Departmental Core (DC) Courses*** of B. Tech. ***V Semester (for the b*atch admitted in 2022-23)** under the flexible curriculum along with their COs.

S.No.	Semester	Code	Name of the course
1	V	2170512	Mass Transfer-II
2	V	2170513	Chemical Reaction Engg. –II
3	V	2170514	Computational Methods in Chemical Engg.
4	V	2170515	Process Engineering & Costing

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2170512: Mass Transfer -II

Category	Title	Code	Credit-4			Theory Paper
Departmental Core- DC	Mass Transfer-II	2170512	L	T	P	Max.Marks-50 Duration-2hrs.
			2	1	1	

Course Objectives: To know the brief knowledge of different separation techniques and the design of distillation column and adsorber and calculations involved in liquid-liquid extraction and solid liquid extraction as well.

Syllabus

Unit-I Fundamentals of Mass Transfer & Leaching: Analogies in transport processes, Determination of mass transfer coefficient in co- current and counter current processes in two phase packed beds, Flooding, Loading column internals: types of trays /plates and packing, point and plate efficiency. Leaching: Solid liquid equilibrium, Equipments, Principal of leaching, Co- current and counter-current system and calculation of number of stage required

Unit-II Distillation Operations: Vapor liquid Equilibria, Boiling point diagram, Relative volatility, Flash and differential/ Batch distillation for two component mixtures, Steam distillation, Azeotropic distillation and Extractive distillation.

Unit–III Continuous and Batch Distillation: Rectification, Reflux ratio, Calculation of numbers of plates by NTU, Optimum reflux ratio, Open steam , multiple feed and multiple product calculations, Enthalpy concentration diagram, Mc-Cabe Thiele and Panchon-Savarit method for calculation of number of theoretical plates, Approximate equations, Fensky and Underwood equations, Gilliland Correlation for actual numbers of plate calculation.

Unit- IV Extraction: Liquid–Liquid equilibria, packed & spray column, conjugate curve and tie line data, plait point, ternary liquid – liquid extraction, operation and design of extraction towers, analytical & graphical solution of single and multistage operation in extraction, Co-current, counter current and parallel current system.

Unit-V Adsorption: Adsorption theories, Types of adsorbent: activated carbon, silica and molecular sieves, Batch and column adsorption, Break through curves, Liquid percolation and gas adsorption, single & multi stage gas – solid and liquid - solid adsorption calculations.

Course Outcomes: After the successful completion of this course, students will be able to

CO1: Explain the fundamentals of adsorption, leaching, distillation, & liquid-liquid extraction.

CO2: Infer the necessary information useful in design of mass transfer equipment.

CO3: Analyze the different contacting patterns & Analogies in the transfer process.

CO4: Apply the theoretical concepts for solving the practical problems.

CO5: Interpret the equilibrium data obtained in various mass transfer operations.

CO6: Propose favorable conditions for a separation to be carried out.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	2	1	2	1	2	2		2		1
CO2	2	2	2	1		1	2	2	2	1	1	2		1
CO3	2	2	2	2		2	3	1		2		2		
CO4	3	3	2	1		2	2			2		2	1	2
CO5	3	3	2	2			2		2	2		2		1

CO6	3	2	1	1			2		2	2		2		1

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books

1. R.E. Treybal, “Mass Transfer Operations", McGraw Hill
2. Binay K. Dutta, “Principles of Mass Transfer and Separation Processes”, PHI learning private ltd.

Reference Books

1. W.L. Mc Cabe, J.M. Smit, “Unit Operation in Chemical Engineering”, Tata Mc Graw Hill
2. J.M. Coulson, J.F. Richardson, “Colson & Richardson’s Chemical Engineering", Butterworth Heinemann, Oxford
3. T.K. Shrewood, R.L. Pigford and C.R. Wilke., “Mass Transfer”, Mc- Graw Hill

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2170513: Chemical Reaction Engineering –I

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Chemical Reaction Engineering – I	2170513	L	T	P	Max.Marks-50 Duration-2hrs.
			2	1	1	

Course Objectives: To examine reaction rate data and determine the rate laws for designing chemical reactors with/ without temperature and heat effects & account for non-idealities prevailing in real reactors.

Syllabus

Unit-I Basic Concepts in Chemical Reaction Engineering and Classification of reactions: Definition of reaction rate, Variables affecting the rate, Concept of reaction equilibria, Order of reaction and its determination, Theoretical study of reaction rate, collision and activated complex theories, Mechanism of series reaction, Parallel or consecutive reactions, Autocatalytic reactions, Chain reactions & Polymerization reactions.

Unit-II Reactions Kinetics and Interpretation of data: Interpretation of kinetic data, integral and differential method of analysis, variable volume reactions, total pressure method of kinetic analysis.

Unit-III Reactor Design for Single Reactions: Classification of reactors, Concept of ideality, Development of design equation s for Batch, Semi batch, Continuous Stirred Tank & Plug Flow Reactors, Design of isothermal and non isothermal Batch reactor, CSTR & PFR, Combination of reactors, Reactors with recycle.

Unit-IV Reactor Design for Multiple Reactions: Multiple Reactions in Batch, Continuous stirred tank and Plug flow reactors, Yield and selectivity in multiple reactions. **Temperature & Heat Effects:** Multiple steady states in continuous stirred tank reactor, Optimum temperature progression and thermal characteristics of reactors.

Unit- V Basics of Non-Idea Flow: Non ideal reactors, RTD, Dispersion model, Tank in Series Model, Recycle Reactor, Segregated flow, Evaluation of RTD characteristics.

Course Outcomes: After the successful completion of this course, Students will be able to:

CO1: Apply the basic concepts in the analysis of homogeneous systems and deviation from ideal behavior.

CO2: Propose the different steps in reaction mechanisms and identify the Rate-determining step.

CO3: Develop Batch, CSTR, and PFR performance equations from general material balances.

CO4:Analyze Non-Isothermal operation in industrial Reactors

CO5: Determine conversion, selectivity & yield for Multiple chemical reactions.

CO6: **Analyze** the Non-Ideal behavior for any flow reactor.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	2	1	2	1	2	2		2		1
CO2	2	2	2	1		1	2	2	2	1	1	2		1
CO3	2	2	2	2		2	3	1		2		2		

CO4	3	3	2	1		2	2			2		2	1	2
CO5	3	3	2	2			2		2	2		2		1
CO6	3	2	1	1			2		2	2		2		1

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books

1. Octave Levenspiel, "Chemical Reaction Engineering", John Willey & Sons
2. H. S. Fogler., "Elements of Chemical Reaction Engineering", Prentice Hall of India Pvt. Ltd., New Delhi.

Reference Books

1. J.M. Smith, "Chemical Reaction Kinetics", McGraw Hill
2. K.G. Denbigh & K.G. Turner, "Chemical Reaction Theory an Introduction", United Press & ELBS

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2170514: Computational Methods in Chemical Engg.

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Computational Methods in Chemical Engg.	2170514	L	T	P	Max.Marks-50 Duration-2hrs.
			2	1	1	

Course Objectives: To get the exposure about finite differences and interpolation, to find numerical solutions of ordinary differential equations and unsteady state heat and mass transfer problems and also find numerical solutions of partial differential equations.

Syllabus

Unit-I Treatment of Engineering Data: Graphical representation, Empirical equation, Interpolation, Newton's formula, Lagrange's Interpolation formula, Extrapolation, Integration, Graphical integration, Graphical construction of integral curves, Numerical integration.

Unit-II Interpretation of Engineering Data: Significant figures, Classification of measurements, Propagation of error, Variation and distribution of random errors, Properties of variance, Confidence limit for small samples.

Unit-III Ordinary Differential Equation: Formulation, Application of law of conservation of mass- mixing in flow process, Classification of ordinary-differential equations and its application of common chemical engineering problems.

Unit-IV Numerical Solution of Ordinary Differential Equations: Linear second order equation with variable coefficients, Numerical solution by Runge-Kutta method and its application to higher order equations.

Unit-V Formulation of Partial Differential Equations: Finite difference, Linear finite difference equations, Non linear difference equations, Optimization types and methods, its application related to chemical processes.

Course outcomes: After the successful completion of this course, students will be able to:

CO1: Explain the mathematical problems as applied to Chemical Engineering.

CO2: Interpret the engineering data& the features of different numerical methods.

CO3: Illustrate the use of numerical methods in Chemical Engineering scenarios.

CO4: Outline the scope of optimization in chemical processes & use of numerical solution of the ODEs.

CO5: Simplify the solution of engineering problems using PDEs & ODEs.

CO6: Solve PDEs & ODEs in various physico-chemical systems.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1			2		2	2	3
CO2	3	2	2	2	2					2		2	1	1
CO3	3	3	2	2	3				2	2		2	3	3
CO4	3	3	2	2	2	1	1			2		2	2	3
CO5	3	2	2	2	2					2		2		1
CO6	3	2	2	2	3					2		2	2	2

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books:

1. Jenson and Jeffrey's, "Mathematical Methods in Chemical Engineering", Academic Press
2. S. K. Gupta, "Numerical Methods for Engineers", New Academic Science

Reference Books:

1. H.S. Mickley, T.K. Sherwood, C.R. Reed, "Applied Mathematics in Chemical Engineering", McGraw Hill publication
2. Alan Myers and Warren Seider, "Introduction to Chemical Engineering and Computer Calculations", Prentice Hall.

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2170515: Process Engineering & Costing

Category	Title	Code	Credit-2			Theory Paper
Departmental Core-DC	Process Engineering & Costing	2170515	L	T	P	Max.Marks-50 Duration-2 hrs.
			2	-	-	

Course Objectives: To understand the basic concepts of flow sheeting, material and energy balances and process development, To apply algorithms for feasibility and optimization of flow sheet, To gain knowledge of estimation of capital investment, , total product costs, depreciation, cash flows, and profitability, To carry out process optimization based on economic profitability by connecting economics with design principles for real chemical engineering processes.

Syllabus

Unit I: System and subsystem in process engineering, system analysis, Economic degree of freedom, various algorithms, Synthesis of processes, Flow sheeting, Mathematical representation of steady state flow sheet.

Unit II: Equal time value of money, equivalence comparisons, discrete interest and continuous interest, develop0ment of its formula, comparison of alternative investment based on capitalized cost.

Unit III: Design Criteria Terms involved in profitability analysis, Gross income, depreciation, taxes, net profit, rate of return, venture profit, payout time, break even point.

Unit IV: Time value of money, net present value and venture worth. Capital cost and manufacturing cost estimation methods, Economic analysis and evaluation. Sensitivity & risk analysis, simplifying scale –up cost estimation.

Unit V: Analysis of R&D investment, Technological Forecasting for the process industries, interaction between design and cost equation for optimal design of equipment's, inflation, energy conservation and environmental control.

Course Outcomes: After the successful completion of this course, students will be able to

CO1 **Explain** the flowsheet and synthesis of process.

CO2 **Compare** the various alternate methods for investments.

CO3 **lllustrate** the various methods of depreciation and its impact.

CO4 **Analyse** the rate of return, venture profit, payout time, breakeven point for the any investment.

CO5 **Describe** the capital cost and manufacturing cost estimation methods.

CO6 **Analyze** R&D investment and technological for recasting for the process industries.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	1	1					2	2		2
CO2	3	2	2		2						2	2		2
CO3	3		2		2						2	2		
CO4	3				2						2	2		
CO5	2										2	2		
CO6		2		2										

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books:

Peters, M.S. and Timmerhause, K.D. – PLANT DESIGN AND ECONOMICS FOR CHEMICAL ENGINEERS –Ed. Mc. Graw- Hill.

References:

Schwery H.E. – PROCESS ENGINEERING ECONOMICS – Mc. Graw Hill (1955)

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ITEM -10

To review and recommend the Experiment list/ Lab manual for all the Laboratory Courses to be offered in B. Tech. ***V Semester (for b*atch admitted in 2022-23)**

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2170512- Mass Transfer –II Lab

1. Preparation of the Vapor Liquid Equilibrium and Boiling point diagram for binary liquid mixture
2. Determination of relative volatility of a given system of acetic-acids water
3. To verify Rayleigh equation for differential distillation of binary system
4. To determine height equivalent to a Theoretical Plate (HETP) of a Packed Distillation Column
5. To study Steam distillation Process
6. To study Batch distillation Process
7. To study Continuous distillation Process
8. Experimental study on packed tower distillation unit
9. Experimental study on Sieve plate distillation unit
10. To study Bubble cap distillation column
11. To estimate percentage leaching of oxalic acid from sand using water as a solvent.
12. To estimate percentage leaching of oxalic acid from sand using water as a solvent using three stages cross current operation
13. To study the adsorption of a gas in a packed column and calculation of NTU and HTU
14. To perform Batch Adsorption and verify Freundlich Law and Langmuir Isotherm.

Note: Each student should perform at least eight experiments out of the above list.

After completion of this laboratory course, the student will be able to

CO 1: demonstrate an understanding of mass transfer modes and models.
CO 2: formulate the idea of the different types of distillation columns
CO 3: apply principles of mass transfer phenomena to chemical process industries.
CO 4: enable solving the problems on process and materials related combined mass transfer phenomena.
CO 5: demonstrate surface phenomena like adsorption
CO 6: apply comparative analysis in choice of types of plate and packing in a distillation column

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Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	2	1	2	2		2	3	3
CO2	2	2	2	2	2				2	2	1	2	2	2
CO3	3	3	2	2	2					2		2	2	2
CO4	3	3	3	2	2	1	2	1	2	2		2	3	3
CO5	3	3	2	2	2				2	2		2	3	2
CO6	3	2	2	2	2	2	2	2	2	2	2	2	2	2

1 - Slightly; 2 - Moderately; 3 – Substantially

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2170513 CHEMICAL REACTION ENGINEERING –I

1. To determine the rate constant of hydrolysis of an ester-catalyzed by acid.
2. To determine temperature dependency of rate constant evaluation of activation energy andverification of Arrhenius law.
3. To study a homogeneous reaction in semi- batch reactor under isothermal conditions.
4. To determine the order of reaction (n) and the reaction rate constant (k) for the given saponification reaction of ethyl acetate in aqueous sodium hydroxide solution in a Batch Reactor
5. Study of non-catalytic homogeneous saponification in CSTR.
6. To study a non-catalytic homogeneous reaction in a plug flow reactor.
7. To determine the residence time distribution behaviour of batch mix- reactor.
8. To determine the RTD behaviour of tubular reactor.
9. To determine the RTD behaviour of CSTR.
10. To determine the velocity rate constant of the hydrolysis of ethyl acetate by sodium hydroxide.
11. To determine the conversion in PFTR, for Saponification of ethyl acetate with NaOH at ambient conditions.
12. Determine the rate constant and order of reaction between potassium per sulfate and potassium iodide.
13. To study a homogeneous catalytic reaction in a batch reactor under adiabatic conditions.
14. Study of catalytic saponification reaction in a tubular flow reactor.

Note: Each student should perform at least eight experiments out of the above list.

After completion of this laboratory course, the student will be able to

CO 1: Demonstrate the basic concepts of chemical reaction engineering like estimation of order of a reaction

CO 2: Compare various reactors for a particular reaction in term of conversion and time of completion.

CO 3: Analyze the Optimum temperature progression for single reaction, Isothermal, adiabatic, non adiabatic operation.

CO 4: Determine the residence time distribution of fluid in vessel & concept of micro and macro mixing.

CO 5: Identify related calculation and solutions to chemical reaction engineering problems for designing chemical reactors.

CO 6: Design industrial scale reactor on the basis of kinetic data obtained at labscale.

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Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1			2		2	2	3
CO2	3	2	2	2	2					2		2	1	1
CO3	3	3	2	2	3				2	2		2	3	3
CO4	3	3	2	2	2	1	1			2		2	2	3
CO5	3	2	2	2	2					2		2		1
CO6	3	2	2	2	3					2		2	2	2

1 - Slightly; 2 - Moderately; 3 – Substantially

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2170514 Computational Methods in Chemical Engineering Lab

1. Data representation and treatment by graphical methods, pressure volume, temperature and concentration relationship for gases and their mixtures
2. Redlich-Kwong equation of state and other Viral equations to estimate thermodynamic properties like compressibility factor, molar volume and P-V-T relationship
3. Estimation of properties from empirical correlations
4. Estimation of critical properties from group contribution method
5. Measurement errors their propagation and minimization of random errors, selection of confidence limits
6. Numerical solutions of quadratic and linear algebraic equations using various methods on the solvers in MATLAB
7. Numerical solutions of batch reactor problems using Euler Algorithm
8. Polynomial root finding using "Newton Raphson method and Secant method"
9. Numerical integration by Trapezoidal rule, Simpsons 1/3rd and 3/8rd rule
10. Approximate solutions of ordinary differential equations by Runge-Kutta algorithm and its application in chemical engineering
11. Numerical solution of transient flow temperature profile of fluid using different computational methods on MATLAB solver
12. Mass balance problem using continuity equation applied to a dynamic system. Formation of differential equations (component balance) and their solutions

Note: Each student should perform at least eight experiments out of the above list.

After completion of this laboratory course, the student will be able to

CO 1: solve problems of algebraic and differential equations, simultaneous equation, partial differential equations

CO 2: convert problem solving strategies to procedural algorithms and to write program structures

CO 3: solve engineering problems using computational techniques

CO 4: assess reasonableness of solutions for selecting appropriate levels of solution sophistication

CO 5: apply basics of MATLAB for solving ODE and PDE forms of modeling equations

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Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	1	1	1	2	2	1	2	1	2
CO2	3	3	2		2				2			2	2	2
CO3	3	2	2		2					2		2	1	1
CO4	2	3	2	2	2					2		2	2	1
CO5	3	3	2	2	2					2		2	2	2
CO6	3	3	1	1	2					2		2	2	2

1 - Slightly; 2 - Moderately; 3 – Substantially

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2170511: DATA SCIENCE

1. Introduction to Python for data analytics science
2. Basic Statistics and Visualization in Python by-
    a. Write a Python script to find basic descriptive statistics using summary
    b. Write a Python script to find subset of dataset by using subset
3. K-means Clustering
4. Association Rules
5. Linear Regression
6. Logistic Regression
7. Naive Bayesian Classifier
8. Decision Trees
9. Simulate Principal component analysis
10. Simulate Singular Value Decomposition
11. Classification model
    a. Install relevant packages for classification.
    b. Choose a classifier for classification problems.
    c. Evaluate the performance of the classifier.
12. Clustering model
    a. Clustering algorithms for unsupervised classification.
    b. Plot the cluster data using Matplotlib

Note: Each student should perform at least eight experiments out of the above list.

After completion of this laboratory course, the student will be able to

CO 1: Apply the Python Programming Language.

CO 2: Solve data science problems.

CO 3: Differentiate the classification and Regression Model.

CO 4: Simulate component analysis

CO 5: Apply Regression to data set

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3						1	2	1	
CO2	3	3	2		2							2	2	
CO3	3	2	2		2							2	1	
CO4	2	3	2	2	2							2	2	
CO5	3	3	2	2	2							2	2	
CO6	3	3	1	1	2							2	2	

1 - Slightly; 2 - Moderately; 3 – Substantially

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ITEM -11

To review and recommend the list of projects which can be assigned under the 'Skill based mini-project' category in various laboratory components based courses to be offered in B.Tech. **V Semester *(for the batch admitted in* 2022-23*)***.

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Skill Based Mini Projects V Semester

2170511 MC Data Science

1. Design an AI Healthcare Bot System using Python
2. Design Chronic Obstructive Pulmonary Disease Prediction System
3. Design College Placement System Using Python
4. Design Face Recognition Attendance System for Employees using Python
5. Design Liver Cirrhosis Prediction System using Random Forest
6. Design Multiple Disease Prediction System using Machine Learning
7. Design Secure Persona Prediction and Data Leakage Prevention System using Python
8. Design Stroke Prediction System using Linear Regression
9. Design Heart Failure Prediction System
10. Design Yoga Poses Detection using OpenPose
11. Design Credit Card Fraud Detection System Python
12. Design Recipe Recommendation from the Ingredients Flutter App

2170512 DC Mass Transfer –II

1. Design Application of distillation in extraction of essential oil
2. Design Application of Vapour liquid equilibrium
3. Design application of Mc Cabe Thiele for determining number of stages
4. Design role of reflux ratio in distillation column
5. Design comparative columns (plate vs packed) for distillation
6. Study of breakthrough curves with experimental runs
7. Designing enthalpy concentration diagram
8. Design Application of azeotropic distillation (positive or negative deviation)
9. Design Application of extractive distillation
10. Design Application of Batch column Adsorption

2170513 DC Chemical Reaction Engineering – I

1. Case study on various theories of reaction rate
2. Design application of variable volume reactors
3. Design application of batch reactor
4. Design application of Semi Batch reactors
5. Design application of continuous reactors
6. Design application of Optimum Temperature Progression
7. Design application of Recycle Reactors
8. Design application of Tank in Series Model
9. Design application of Dispersion Model
10. Design application of Residence time distribution

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2170514 DC Computational Methods in Chemical Engg

1. Design application of Interpolation in Chemical Engineering with case study
2. Design application of Extrapolation in Chemical Engineering with case study
3. Design application of Graphical Integration in Chemical Engineering with case study
4. Design Application of law of conservation of mass in mixing flow process
5. Design application of ODE to common chemical engineering problems.
6. Design role of Propagation of error, Variation and distribution of random error in specific chemical engineering case study
7. Design application of Linear second order equation with variable coefficients,
8. Design application of Numerical solution by Runge-Kutta method to higher order equations.
9. Design application of Finite difference,
10. Design any one Optimization method with its application related to chemical processes.

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To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered ***(for batch admitted in 2022-23)*** in online mode under ***Self-Learning/ Presentation***, in the B.Tech. ***V Semester***

Tentative list of Seminar/Self Study Courses V Semester

S.No.	Course Name (From SWAYAM/NPTEL)	Semester	Name of Faculty
1	Natural Gas Engineering (8 weeks)	V Sem	Prof. Shivangi Sharma
2	Body Language: Key To Professional Success (4 weeks)		
3.	Moral Thinking: An Introduction To Values And Ethic (4 weeks)		

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To review and finalize the ***scheme structure of B.Tech. III Semester under*** the flexible curriculum (***Batch admitted in 2023-24***)

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Department of Chemical Engineering

Scheme of Evaluation

B. Tech. III Semester *For batches admitted in academic session 2023 – 24*

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching (Online, Offline, Blended)	$^{\$\$}$Mode of Exam.
				Theory Slot				Practical Slot									
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation			L	T	P			
				End Sem. Exam	$^{\$}$Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project							
1.	3100028	**BSC**	Engineering Mathematics-II	50	10	20	20	-	-	-	100	3	1	-	**4**	Offline	PP
2.	3170311	**DC**	Fluid Mechanics	50	10	20	20	40	30	30	200	2	1	2	**4**	Blended	PP
3.	3170312	**DC**	Organic Process Technology	50	10	20	20	-	-	-	100	3	-	-	**3**	Blended	PP
4.	3170313	**DC**	Chemical Engineering Thermodynamics	50	10	20	20	-	-	-	100	3	-	-	**3**	Blended	PP
5.	3170314	**DC**	Heat Transfer	50	10	20	20	40	30	30	200	3	-	2	**4**	Blended	PP
6.	3170315	**DLC**	Chemical Synthesis Lab	-	-	-	-	40	30	30	100	-	-	2	**1**	Offline	SO
7.	3170316	**DLC**	Self-learning/Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	40	-	40	-	-	2	**1**	Online + Mentoring	SO
8.	200XXX	**CLC**	**Novel Engaging Course (Informal Learning)**	-	-	-	-	50	-	-	50	-	-	2	**1**	Interactive	SO
9.	3170317	**DLC**	Skill Internship Project (Institute Level) (Evaluation)	-	-	-	-	60	-	-	60	-	-	4	**2**	Offline	SO
Total				**250**	**50**	**100**	**100**	**230**	**130**	**90**	**950**	**14**	**2**	**14**	**23**	-	-
10.	3000002	**Natural Sciences & Skills**	Engineering Chemistry	50	10	20	20	30	10	10	150	1	-	2	GRADE	Blended	MCQ
11.	1000001	**MAC**	Indian Constitution & Traditional Knowledge	50	10	20	20	-	-	-	100	2	-	-	GRADE	Blended	MCQ

$ proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.

Natural Sciences& Skills: Engineering Physics / Engineering Chemistry / Environmental Science/ Language (Credits of Natural Sciences & Skills will be added in the VI Semester)

$^{\$\$}$**MCQ:** Multiple Choice Question $^{\$\$}$**AO:** Assignment + Oral $^{\$\$}$**PP:** Pen Paper $^{\$\$}$**SO:** Submission + Oral

Mode of Teaching	Mode of Examination	Total Credits

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Theory			Lab	Theory			Lab	
Offline	Online	Blended	Offline	PP	AO	MCQ	SO	
18	-	02	03	18	-	–	05	23
78.26%	-	8.7%	13.04%	78.26%	-	-	21.74%	Credits %

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ITEM -14

To review and finalize the syllabi for all Departmental Core (DC) Courses of ***B. Tech. III Semester*** (for **batch admitted in 2023-24**) under the flexible curriculum along with their COs.

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3170311: FLUID MECHANICS

Category	Title	Code	Credits-4			Theory Paper
Departmental Core-DC	Fluid Mechanics	3170311	L	T	P	Max.Marks-50 Duration-2hrs.
			2	1	2	

Course Objective:

To understand the basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery like pumps and various flow meters.

Syllabus:

Unit –I: Introduction: Properties of fluid, forces on fluid, stresses, the concept of constitution relations, fluid statics, Normal forces in fluid, pressure measurement, forces on submerged bodies, buoyancy, Stability.

Unit-II: Classification of Fluids: Newtonian and Non – Newtonian fluid, Viscosity measurement, Equations of changes: Equation of Continuity & Equation of Motion, Navier stokes equation, concept of Reynolds number and friction factor: friction for rough and smooth pipes, loss of head due to friction in pipes and fittings.

Unit-III: Boundary layer theory, Bernoulli's equation, fluid machinery, pumps, fans, blowers, compressors and vacuum pumps, Power and head requirement for pumps.

Unit-IV: Flow of incompressible fluid in conduits and thin layers, flow past immersed bodies, Dimensional analysis, Buckingham π- Theorem, dimensionless numbers and their significance, similitude criteria.

Unit-V: Measurement of Flow: Fluid flow Measurement pitot tube, orifice meter, venture meter, rotameter, weirs and notches.

Course Outcomes: After the completion of this course, Students will be able to

CO1 **Explain** the fundamentals of fluid statics & fluid flow.
CO2 **Estimate** pressure drops, forces acting on bodies & power and head requirements of pumps.
CO3 **Apply** equations of change to various fluid flow systems.
CO4 **Formulate** the interdependence of various parameters using dimensional analysis.
CO5 **Determine** the flow rate through different flow measuring devices.
CO6 **Examine** the losses due to friction in pipes and other fluid machinery.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	2					3		2		1
CO2	3	3	3	1		1		1	1	2	1	2	2	2
CO3	3	2	2	2	2	1	1		1	2	1	2	2	2
CO4	3	2	2	2	2	1	1			1	1	1	1	2
CO5	3	3	2	1	1	1				1	1	2	1	
CO6	3	3	1	2	2				1	2	1	2	1	1

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books

1.W.L. McCabe & J.C. Smith- UNIT OPERATIONS IN CHEMICAL ENGG- 7rd edition McGraw Hill.

Reference Books

1. J.M. Coulson & J.F. Richardson- Chemical Engineering- Vol I & II.
2. B.S. Maney, Zel(SI) Van Nostand & Reinhold- Mechanics of Fluid-ELBS, 1970.
3. I. Grannet- Fluid Mechanics for Engineering and Technology.
4. S.K. Gupta- Momentum Transfer- New Age Publication

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3170312: ORGANIC PROCESS TECHNOLOGY

Category	Title	Code	Credits-3			Theory Paper
Departmental Core-DC	Organic Process Technology	3170312	L	T	P	Max.Marks-50 Duration-2hrs.
			3	0	0	

Course Objective:

The purpose of the organic process technology course is to improve knowledge of the chemical processes along with emphasis on recent technological development.

Syllabus:

Unit-I: Pulp and paper industry-Raw Materials, types of pulp and its preparation, Manufacturing of paper, Agro based industries, Fermentation industry, Alcohol by fermentation, Citric acid and Antibiotics like Penicillin.

Unit-II: Intermediates for petrochemicals from petroleum based stocks, phenol, methanol, ethylene propylene, aromatic, toluene and xylene, polymer industries.

Unit-III: Preparation, manufacturing and properties of Fats and oil, man made fiber; rayon, polyester polyamides and acrylics, cellulose and acetate, Rubber industries, Soap and detergent. Insecticides and pesticides, Dyes and dyes intermediate.

Unit-IV: Carbon Technology: Introduction, Classification of activated carbons, raw materials and manufacture of activated carbons, classification of carbon fibers, precursors for carbon fibers, manufacture of carbon fibers from polyacrylonitrile, manufacture of carbon black by furnace black process, applications.

Unit-V: Nanotechnology: Introduction, properties of Nanoparticles like optical properties, reactivity, synthesis, Introduction, Structure and properties of carbon Nanotubes and fabrication of carbon nanotubes & applications.

Course Outcomes: After the completion of this course, Students will be able to

CO1: **Explain** the processing of natural products.
CO2: **Describe** microbial processes and edible oil refining process.
CO3: **Elaborate** the processes for producing petrochemicals.
CO4: **Characterize** polymers and elaborate its production processes.
CO5: **Describe** the production processes of fibers.
CO6: Evaluate the different processes from economical aspects.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	1	1	2	1	1	2		2		1
CO2	2	2	2	1		1	2	2	2	1	1	2		1
CO3	2	2	2	2		2	3	1		2		2		
CO4	3	3	2	1		1	1			2		2	1	2
CO5	3	2	1	1			2		2	2		2		1
CO6	3	2	1	1			2		2	2		2		1

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books

1. Austin, G.T. Shreve's Chemical Process Industries -5th edition McGraw Hill New York 1984.
2. Dryden C.E., Outlines of chemical technology-3rd edition affiliated East – West Press, New Delhi, 1997.

Reference Books

1.V. B. Gupta & V.K. Kothari- Manufacturing Fiber Technology- Chapman Hall, New York I

edition 1997.
2. V.K. Kothari-Process in Textile, science Technology, Vol –I & II –IAFL publication, S-351 Greater Kailash part-I New Delhi.-48 Ed.

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3170313: Chemical Engineering Thermodynamics

Category	Title	Code	Credit-3			Theory Paper
Departmental Core-DC	Chemical Engineering Thermodynamics	3170313	L	T	P	Max.Marks-50 Duration-2hrs.
			3	0	0	

Course Objective:

To understand the basic concepts and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase and chemical equilibria.

Syllabus

Unit- I The First law of Thermodynamics and Equations of State: Steady and unsteady closed and flow process, Critical properties corresponding state, Compressibility, P-V-T behavior of pure fluids, Virial-equations, Generalized correlations and eccentric factor.

Unit-II The Second and Third Law of Thermodynamics: Entropy of various systems, Thermodynamics equations, Effect of pressure on specific heat, Joule-Thompson effect, Third law of thermodynamics, Compression of ideal gas, Refrigeration capacity, Carnot cycle, Vapor compression cycle, Air refrigeration cycle.

Unit-III Thermodynamic Properties of Fluids: Thermodynamic properties of homogeneous mixtures, Property relations for systems of variable compositions, Partial properties, Fugacity and Fugacity coefficient in ideal solutions, Properties change of mixing, Activity, Heat effects of mixing process, Excess properties, Activity coefficient of gaseous mixtures.

Unit-IV Phase Equilibria: Criteria of phase equilibrium and stability, Phase equilibrium in single component system, Phase rule, Gibbs-Duhem's equation, Vapor-liquid equilibria.

Unit- V Chemical Reaction Equilibria: Chemical potential, Effect of pressure and temperature on heat of reaction and on free energy, Van't Hoff's equation, Clausius-Clapeyron equation, Chemical Reaction Equilibria and its applications

Course Outcomes: After the successful completion of this course, students will be able to

CO1: infer the fundamental concepts of thermodynamics to chemical engineering applications.
CO2: explain the first and second laws of thermodynamics with their practical implications.
CO3: analyze the processes involving refrigeration and compression.
CO4: classify the thermodynamic properties of solutions with their relationships.
CO5: infer the detail of vapor liquid equilibria and its use in practical situations.
CO6: analyze the chemical equilibrium with thermodynamics for predicting behavior of reacting systems.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2					2		2	1	1
CO2	2	2	1	2					1	2		2		
CO3	3	2	2	2	1		1			2		2	1	2
CO4	3	3	2	2	1					1		1	2	1
CO5	3	3	3	2	2		1		1	1	1	2	2	2
CO6	3	2	2	2	1					1		1	1	1

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books

1. Smith J.M. & Van Ness., "Introduction to Chemical Engineering Thermodynamics", McGraw Hill
2. Sandler, S.I., "Chemical Engineering Thermodynamics", John Wiley & Sons
3. Dodge B.F., "Chemical Engineering Thermodynamics", McGraw Hill
4. Narayanan K.V., "Chemical Engineering Thermodynamics", Prentice Hall India Learning Private Limited

Reference Books

1. Balzhiser, Samuels and Eliassen, "Chemical Engineering Thermodynamics", Prentice Hall.
2. Rao Y.V.C, "Chemical Engineering Thermodynamics", University Press (I) Ltd., Hyderabad
3. Kyle B.G., "Chemical Process Thermodynamics", Prentice Hall of India Pvt. Ltd., New Delhi

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3170314: HEAT TRANSFER

Category	Title	Code	Credits-4			Theory Paper
Departmental Core-DC	Heat Transfer	3170314	L	T	P	Max.Marks-50 Duration-2hrs.
			2	1	2	

Course Objective:

To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

Syllabus:

Unit – I: Modes of heat transfer one-dimensional and two dimensional, heat rate equations, theory of insulation, critical radius calculations, types of insulation material, conduction through slab, cylindrical and sphere.

Unit-II: Consecutive heat transfer, heat transfer in boundary layer and in film, natural and forced convection, co/ counter /cross current contacting for heat transfer, individual and overall heat transfer coefficient, fouling factor.

Unit- III: Radiative heat transfer, Black body radiation, concept of shape factor, method of determination of shape factor, radiation exchange in enclosure with black surfaces.

Unit-IV: Heat transfer under phase change conditions, boiling and condensation of pure components, heat flux temperature diagram for boiling and condensation under vertical and horizontal surfaces, nucleate and pool boiling, effect of surface condition of condensation, correlation for heat transfer under condensation. Evaporation: Types of evaporators and their applications, single and multiple effect evaporators, Design and operation of forward, backward and mixed feed operations, effect of boiling point elevation and hydrostatic heat vapor recompression.

Unit- V: Heat exchange equipment- General design of shell and tube exchangers, condensers, extended surface equipment, heat exchanger equation – coli to fluid, jacket to fluid, double pipe, shell and finned tube heat exchanger.

Course Outcomes: After the completion of this course, Students will be able to

CO1: Explain the mechanism of heat transfer by conduction, convection and radiation.
CO2: **List** dimensionless Numbers applicable in heat transfer and their physical significance.
CO3: **Illustrate** individual and overall heat transfer coefficient.
CO4: **Explain** all parts of the Heat Exchangers and Evaporators.
CO5: **Analyze** the design of various types of Heat exchangers.
CO6: Analyze the design of various types of Evaporators.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	2	2	2	1	1	2		2	2	2
CO2	1	2	2	1	1					2		2	2	2
CO3	3	3	2	2	2		1			2		2	3	3
CO4	2	1	2	1			1		1	2		2	1	1
CO5	3	1	2	2	2	1	1	1	2	2	1	2	2	2
CO6	3	1	2	2	2	1	1	1	2	2	1	2	2	2

1 - Slightly; 2 - Moderately; 3 – Substantially

Text Books

1. J. P. Holman – Heat Transfer – P.H.I.

Reference Books

1. Donald Q. Kern- Process Heat Transfer– Tata Mc Graw Hill.
2. Alan J. Chapman- Heat Transfer IV ED. – Collier Mc. Millan

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ITEM -15

To review and recommend the list of experiments and skill-based mini projects of ***B.Tech. III semester*** **(**for **batch admitted in 2023-24**

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3170311: FLUID MECHANICS

List of Experiments:

1. To determine the local point pressure with the help of pitot tube.

2. To find out the terminal velocity of a spherical body in water.

3. To determine the viscosity of a spherical body in water.

4. To find the pressure drop in a packed bed,

5. To study the flow behavior of a Non-Newtonian fluid and to determine the flow constants.

6. To determine the power number- Reynolds Number curve.

7. To differentiate between laminar and turbulent flow using Reynolds experiments.

8. To study the characteristics of an air compressor.

9. To study the characteristics of a centrifugal pump.

10. To study the flow of a fluid in a pipeline and to prepare the friction factor-NRe plot.

11. To determine the friction losses, expansion losses and reduction losses in bends and pipes and verify the Bernoulli equation.

12. To prepare the calibration curve for an orifice meter and Rotameter.

13. To prepare the calibration curve for a Venturimeter.

Note: Every student should perform at least eight experiments out of the above list.

Lab Course Outcomes

After the completion of this lab course, Students will be able to
CO1 Analyze the effects of flow measurement by flow measuring devices.
CO2 Calculate the degree of error in discharge rate of rotameter.
CO3 Calculate the coefficient of discharge for venturimeter and orifice meter.
CO4 Calculate the coefficient of discharge for notches & weirs.
CO5 Analyze the losses in pipe fittings & pressure drop in packed bed
CO6 Analyze transportation of fluids via pumps & other devices.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3												2
CO2	3	3	3	3										2
CO3	3	3	3	3										2
CO4		3		3										2
CO5		3	3	3										2

CO6	**3**	**3**	**2**	**3**									**2**

1 - Slightly; 2 - Moderately; 3 – Substantially

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3170311: FLUID MECHANICS

Skill Based Mini Project

1. Study of fluid flow through a pipe with a sudden expansion or contraction.

2. Analysis of laminar and turbulent flow in a pipe using computational fluid dynamics (CFD) software.

3. Design and fabrication of a wind tunnel to study the flow around a model of a car or airplane.

4. Study of the flow characteristics of a fluid in a rotating tank.

5. Analysis of heat transfer in a fluid flow using computational software.

6. Investigation of the flow of a fluid through a packed bed of particles.

7. Design and fabrication of a water turbine to study the effects of blade shape on turbine efficiency.

8. Study of the flow of a fluid through a porous medium.

9. Study of Bird Flight Aerodynamics

10. Drag Estimations on Experimental Aircraft

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3170314: HEAT TRANSFER

List of Experiments:

1. To determine the thermal conductivity of metal rod.

2. To determine the equivalent thermal conductivity of composite wall.

3. To determine heat transfer coefficient in forced convection.

4. To determine heat transfer coefficient in natural convection.

5. To determine heat transfer coefficient with the help of Stephan Boltzman Apparatus.

6. To calculate emissivity of the test plate by emissivity measurement apparatus.

7. To determine heat transfer coefficient in double pipe heat exchangers.

8. To study the heat transfer characteristics of a shell and tube heat exchanger (Heating / cooling) of water.

9. To determine heat transfer coefficient in counter and parallel flow heat exchanger.

10. To measure the rate of evaporation using an open pan evaporator.

11. To measure the rate of condensation of pure water vapor and to determine the heat transfer coefficient.

12. Demonstrate the film wise, drop wise condensation and determination of heat transfer coefficient.

13. To study the single effect evaporator and find out the heat transfer coefficient.

Note: Each student should perform at least eight experiments out of the above list.

Lab Course Outcomes

After the completion of this lab course, Students will be able to

CO1: Analyze the modes of heat transfer conduction, convection and radiation

CO2: Apply various experimental heat transfer correlations in engineeringapplications

CO3: Evaluate the thermal analysis and sizing of heat exchangers.

CO4: Evaluate the emissivity of materials

CO5: Demonstrate the thermal conduction in metal rod

CO6: Infer the application of heat exchanging equipment in chemical process industries.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2			3		2	2	2			
CO2	3	2		2			3	2	2	2	2		3	
CO3	3	3												
CO4	3	3		2			2	3	2	2	2		3	
CO5	3			2				2	3	3	2		3	
CO6	3			2				2	3	3	2		3	

1 - Slightly; 2 - Moderately; 3 – Substantially

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3170314: HEAT TRANSFER

Skill Based Mini Project

1. Based on the general operation happening near you, differentiate between variousmodes of Heat transfer.

2. Estimate the heat transfer rate within solid metal rod.

3. Estimate the various factors that are responsible for fouling in Heat Exchangers.

4. Compare the emissivity of two different metal plates/rod.

5. List out the different blackbody materials available around us and compare the

radiation laws proposed for black bodies

6. Illustrate the different condensation process.

7. Demonstrate the film wise, drop wise condensation.

8. Demonstrate and interpret of Evaporation process of two different fluid.

9. Differentiate the Heat transfer and Thermodynamics with appropriate example/s

10. Compare the various types of industrial Heat Exchangers

11. Explain the importance of Heat transfer in your daily life and industrial aspect.

12. List out the thermal conductivity of the various materials (industrial aspect) and compare other properties.

13. Perform Greenhouse effect experiment –Climate change in a Jar

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3170315: CHEMICAL SYNTHESIS LAB

Course Objective

The aim of this course is to give you exposure to advanced synthetic techniques, introduce you to chemical literature searches, give you experience following and expanding on literature preparations, provide you with an opportunity to improve your technical writing.

List of Experiments:

1. To determine BOD & COD for given wastewater sample.

2. Preparation of acetic acid from ethyl alcohol.

3. To find out the sucrose content in aqueous solution by polarimeter.

4. To evaluate the viscosity of molasses.

5. To determine the percentage of formaldehyde in formalin.

6. To determine iodine value of the given oil sample.

7. To determine the acetic acid, ethanol concentration in aqueous solutions.

8. To prepare azo dye and find the yield.

9. Prepare a standard phenol solution and estimate the percentage of phenol in the given unknown sample of phenol.

10. To prepare urea formaldehyde resin and report percentage conversion.

11. To determine total dissolved and suspended solids in water and waste water

12. To determine turbidity in water and waste water

13. To determine hardness of water

Note: Each student should perform at least eight experiments out of the above list.

Course Outcomes: After the completion of this course, Students will be able to

CO1. Research a specific compound, or a family of compounds, to propose a synthetic route for isolation of this compound.

CO2. Perform advanced manipulations of apparatus relevant to a synthetic chemistry laboratory; use a Schlenk line to synthesize oxygen- and moisture-sensitive products.

CO3. Characterize chemical compounds using modern spectroscopic techniques.

CO4. Maintain a laboratory notebook following scientific best practices.

CO5. Communicate findings in a format consistent with the scholarly standards of the chemical sciences.

CO6. Articulate and follow ethical principles in a scientific context, including professional standards of laboratory practice, the communication of literature research without plagiarism, and the crediting of collaborators.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				2			3		2	2	2			
CO2				2			3	2	2	2	2		3	
CO3														
CO4				2			2	3	2	2	2		3	
CO5				2				2	3	3	2		3	
CO6				2				2	3	3	2		3	

1 - Slightly; 2 - Moderately; 3 – Substantially

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3170315: CHEMICAL SYNTHESIS LAB

Skill Based Mini Project

1. Develop laboratory setup to learn principles of cellulose fiber spinning according to theviscose process

2. Synthesis and application of Indigo dye

3. Synthesis of fuel from rapeseed oil

4. Synthesis of biodiesel from waste cooking oil

5. Synthesis of Alum from waste beverage cans

6. Quantitative determination of functional groups like Acid, Phenol, Nitro, Amino, Ester, Hydroxy, Aldehyde.

7. Organic Preparations and purification through activated charcoal treatment/ crystallization (Single/ two-step) of the following; (1) Acetanilide, (2) p-Nitro- Acetanilide, (3) p- Bromo-Acetanilide, (4) Aspirin,(5) m- Dinitrobenzene, (6) Oxalic Acid.

8. To perform Esterification reaction

9. To perform Sulfonation reactions

10. To synthesize emulsion polymer using emulsion polymerization set up

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ITEM -16

To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered in the ***B.Tech .III Semester (for batches admitted in 2023-24)*** in online mode under ***Self-Learning/ Presentation***.

Tentative list of Seminar/Self Study Courses in III

S.No.	Course Name (From SWAYAM/NPTEL)	Semester	Name of Faculty
1	Ethics in Engineering Practise (8 weeks)	III Sem	Prof. Shivangi Sharma
2	Mechanical Operations (4 weeks)		
3	Water, Society & Sustainability (4 weeks)		

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(Deemed to be University)
NAAC Accredited with A++ Grade

ITEM -17

To review and recommend the ***Scheme structure &Syllabi*** of **PG Programme** (M.E./M.Tech./MCA/MBA) along with their Course Outcomes (COs)

(**Not Applicable**)

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(Deemed to be University)
NAAC Accredited with A++ Grade
ITEM -18

To review and recommend the ***Scheme structure and Syllabus*** of **Ph.D. Course Work** (specific to Doctoral Research Scholars, if any)

(**Not Applicable)**

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(Deemed to be University)
NAAC Acredited with A++ Grade

ITEM -19

To review the CO attainments, to identify gaps and to suggest corrective measures for the improvement in the CO attainment levels for all the courses taught during July-Dec 2023 session.

Madhav Institute of Technology & Science, Gwalior

(Deemed to be University)

Chemical Engineering

Course Outcome Attainment & Gap Analysis of July - Dec 2023 Semester

S. No.	Name of the Course &Code	Course Outcomes		CO Attainment						Corrective Actions
				Direct attainment	Indirect attainment	Overall	Target	Gap	Status	
1	Fuel Technology (3170121)	CO1	**Differentiate** between various Fuels	2.6	2.6	**2.6**	2.2	**-0.4**	Attained	Case study can be given
		CO2	**Analyze** Quality Control Parameters fordifferent types of fuels	2.3	2.4	**2.32**	2.2	**-0.12**	Attained	Questions with more difficulty level to beincluded
		CO3	**Develop** process flow for petroleum fuel.	2.4	2.4	**2.4**	2.2	**-0.2**	Attained	Explanation should be correlated with industry
		CO4	**Analyze** the major engineering problemsinvolved in the process.	2.4	2.5	**2.42**	2.2	**-0.22**	Attained	Explanation should begiven with more illustrations
		CO5	**Make** interpretation about the renewableenergy sources.	2.8	2.7	**2.78**	2.2	**-0.58**	Attained	Explanation should be given with more illustrations
		CO6	**Explain** the current status of fuel consumption and requirement in India.	2.3	2.6	**2.4**	2.2	**-0.2**	Attained	Seminar Presentation tobe taken
2	Organic Process Technology (2170312)	CO1	**Explain** the processing of natural products	2.4	2.8	**2.48**	2.3	**-0.18**	Attained	Seminar Presentation tobe taken
		CO2	**Describe** about microbial processes andedible oil refining process	2.4	2.6	**2.44**	2.3	**-0.14**	Attained	Assignments to beincluded
		CO3	**Elaborate t**he processes for producingpetrochemicals	2.3	2.5	**2.34**	2.3	**-0.04**	Attained	Mini project to be included
		CO4	**Characterize** polymers and elaborate itsproduction processes.	2.4	2.5	**2.42**	2.3	**-0.12**	Attained	Questions with moredifficulty level to be included
		CO5	**Describe** the production processes offibers	2.5	2.6	**2.52**	2.3	**-0.22**	Attained	Quiz to be included
		CO6	**Evaluate** the different processes fromeconomical aspects	2.3	2.6	**2.36**	2.3	**-0.06**	Attained	Case study can be given
3	Fluid Mechanics (2170311)	CO1	**Explain** the basic fundamentals of fluidstatics & fluid flow.	2.7	2.6	**2.68**	2.7	**0.02**	Not Attained	Application basedtutorial to be given
		CO2	**Estimate** pressure drops, forces acting on bodies & power and head requirements ofpumps.	2.8	2.7	**2.78**	2.7	**-0.08**	Attained	Numerical based quizzesto be given

		CO3	**Apply** equations of change to various fluidflow systems.	2.7	2.7	**2.7**	2.7	**0**	Attained	Application basedtutorial to be given
		CO4	**Formulate** the inter-dependency of various parameters using dimensional analysis.	2.9	3	**2.92**	2.7	**-0.22**	Attained	Explanation should begiven with more illustrations
		CO5	**Determine** the flow rate through differentflow measuring devices.	2.7	2.8	**2.72**	2.7	**-0.02**	Attained	Teaching along with experimentation
		CO6	**Examine** the losses due to friction in pipesand other fluid machinery.	2.9	2.6	**2.84**	2.7	**-0.14**	Attained	Mini project to beincluded
4	**Fluid Mechanics Lab (2170311)**	CO1	**Analyze** the effects of flow measurementby flow measuring devices.	2.7	2.5	**2.66**	2.4	**-0.26**	Attained	Skill based project to begiven
		CO2	**Calculate** the degree of error in dischargerate of rotameter.	2.8	2.7	**2.78**	2.4	**-0.38**	Attained	Practical demonstrationsto be given
		CO3	**Calculate** the coefficient of discharge forventurimeter and orifice meter.	2.7	2.5	**2.66**	2.4	**-0.26**	Attained	Skill based project to begiven
		CO4	**Calculate** the coefficient of discharge forrectangular notch.	2.9	2.8	**2.88**	2.4	**-0.48**	Attained	
		CO5	**Calculate** the coefficient of discharge fortriangular notch.	2.6	2.7	**2.62**	2.4	**-0.22**	Attained	
		CO6	**Calibrate** the flow measuring instruments.	2.4	2.4	**2.4**	2.4	**0**	Attained	Practical demonstrationsto be given
5	**Chemical Engineering Thermodynamics (2170313)**	CO1	**Infer** the fundamental concepts of thermodynamics to chemical engineeringapplications.	2.8	3	**2.84**	2.6	**-0.16**	Attained	Weekly quizzes to beconducted
		CO2	**Explain** the first and second laws of thermodynamics with their practical implications.	2.6	3	**2.68**	2.6	**-0.08**	Attained	Application basedtutorial to be given
		CO3	**Analyze** the processes involving refrigeration and compression.	2.4	2.6	**2.44**	2.6	**0.16**	Not Attained	Practice problems to begiven
		CO4	**Classify** the thermodynamic properties ofsolutions with their relationships.	2.8	2.5	**2.74**	2.6	**-0.14**	Attained	Tutorial to be given along with practiceproblems
		CO5	**Infer** the detail of vapour liquid equilibria and its use in practical situations.	2.5	2.8	**2.56**	2.6	**0.04**	Not Attained	Analysis based questions to be given
		CO6	**Analyze** the chemical equilibrium with thermodynamics for predicting behavior ofreacting systems.	2.6	2.7	**2.62**	2.6	**-0.02**	Attained	Analysis based questions to be given
6	**Heat Transfer (2170314)**	CO1	**Explain** the mechanism of heat transfer by conduction, convection and radiation.	2.7	2.9	**2.74**	2.2	**-0.54**	Attained	Tutorial to be givenalong with practice problems
		CO2	**List** dimensionless Numbers applicable inheat transfer and their physical significance.	2.6	2.8	**2.64**	2.2	**-0.44**	Attained	Case study can be given
		CO3	**Illustrate** individual and overall heat transfer coefficient.	2.7	2.9	**2.74**	2.2	**-0.54**	Attained	Seminar presentation tobe included

		CO4	**Explain** all parts of the Heat Exchangers and Evaporators.	2.8	2.7	**2.78**	2.2	**-0.58**	Attained	Teaching along with experimentation
		CO5	**Analyze** the design of various types of Heatexchangers.	2.6	2.8	**2.64**	2.2	**-0.44**	Attained	Mini project work to begiven
		CO6	**Analyze** the design of varioustypes of Evaporators.	2.4	3	**2.52**	2.2	**-0.32**	Attained	Analysis based questions to be given
7	**Heat Transfer Lab (2170314)**	CO1	**Describe** the modes of heat transfer conduction, convection andradiation.	3	2.5	**2.9**	2.5	**-0.4**	Attained	More sessions on virtuallabs to be conducted
		CO2	**Analyze** the application of various experimental heat transfer correlations in engineering applications.	2.9	2.4	**2.8**	2.5	**-0.3**	Attained	More sessions on virtuallabs to be conducted
		CO3	**Evaluate** the thermal analysis and sizing of heat exchangers.	2.5	2	**2.4**	2.5	**-0.1**	Attained	More sessions on virtuallabs to be conducted
		CO4	**Evaluate** the emissivity ofmaterials	3	2.6	**2.92**	2.5	**-0.42**	Attained	More sessions on virtuallabs to be conducted
		CO5	**Study** the thermal conduction in metal rod	2.7	2.3	**2.62**	2.5	**-0.12**	Attained	More sessions on virtuallabs to be conducted
		CO6	**Explain** the application of heat exchanging equipment in chemical process industries.	2.9	2.3	**2.78**	2.5	**-0.28**	Attained	More sessions on virtuallabs to be conducted
8	**Chemical Synthesis Lab(2170315)**	CO1	**Research** a specific compound, or a family of compounds, to propose a synthetic route for isolation of this compound.	2.3	2.4	**2.32**	2.3	**-0.02**	Attained	Application based explanation to be given
		CO2	**Perform** advanced manipulations of apparatus relevant to a synthetic chemistrylaboratory, use a Schlenk line to synthesize oxygen- and moisture-sensitiveproducts.	2.4	2.3	**2.38**	2.3	**-0.08**	Attained	Practical demonstrationsto be given
		CO3	**Characterize** chemical compounds usingmodern spectroscopic techniques.	2.5	2.4	**2.48**	2.3	**-0.18**	Attained	Practical demonstrationsto be given
		CO4	**Maintain** a laboratory notebook followingscientific best practices.	2.6	2.8	**2.64**	2.3	**-0.34**	Attained	Practical demonstrationsto be given
		CO5	**Communicate** findings in a format consistent with the scholarly standards of the chemical sciences.	2.7	2.6	**2.68**	2.3	**-0.38**	Attained	Practical demonstrationsto be given
		CO6	**Articulate** and follow ethical principles ina scientific context, including professionalstandards of laboratory practice, the communication of literature research without plagiarism,and the crediting of collaborators	2.5	2.3	**2.46**	2.3	**-0.16**	Attained	Practical demonstrationsto be given
9	**Data Science (170511)**	CO1	**Define** different Data Science techniques.	2.7	3	**2.76**	2.2	**-0.56**	Attained	Analysis based questions to be given

		CO2	**Illustrate** various tools used for Data Science technique.	2.8	3	**2.84**	2.2	**-0.64**	Attained	Mini project to be given
		CO3	**Apply** data visualization techniques to solve real world problems.	2.7	3	**2.76**	2.2	**-0.56**	Attained	Analysis based questions to be given
		CO4	**Build** exploratory data analysis for Data Science methods.	2.5	3	**2.6**	2.2	**-0.4**	Attained	Analysis based questions to be given
		CO5	**Apply** Data Science techniques for solvingreal world problems.	2.4	3	**2.52**	2.2	**-0.32**	Attained	Analysis based questions to be given
		CO6	**Evaluate** the performance of algorithms indata science.	2.4	2.8	**2.48**	2.2	**-0.28**	Attained	Application basedtutorial to be given
10	**Mass Transfer - II (170512)**	CO1	**Examine** the basics of adsorption, leaching, distillation, liquid-liquid extraction & the principle of diffusion underlying them.	2.7	2.8	**2.72**	2.7	**-0.02**	Attained	Explanation should begiven with more illustrations
		CO2	**Infer** the necessary information useful in design of mass transfer equipment.	2.8	3	**2.84**	2.7	**-0.14**	Attained	Practical problems to begiven
		CO3	**Analyze** the different contacting patterns & Analogies in transfer process.	2.8	2.8	**2.8**	2.7	**-0.1**	Attained	Explanation should begiven with more illustrations
		CO4	**Apply** the theoretical concepts for solvingpractical problems.	2.6	2.7	**2.62**	2.7	**0.08**	Not Attained	Analysis based questions to be given
		CO5	**Interpret** the equilibrium data obtained invarious mass transfer operations.	2.6	2.8	**2.64**	2.7	**0.06**	Not Attained	Analysis based questions to be given
		CO6	**Propose** favourable conditions for a separation to be carried out.	2.7	2.5	**2.66**	2.7	**0.04**	Not Attained	Tutorial to be given along with practiceproblems
11	**Mass Transfer - II Lab(170512)**	CO1	**Design** calculation of distillation column	2.4	2.8	**2.48**	2.4	**-0.08**	Attained	More sessions on virtuallabs to be conducted
		CO2	**Estimation** of number of theoretical stages and composition of each plate	2.7	2.6	**2.68**	2.4	**-0.28**	Attained	More sessions on virtuallabs to be conducted
		CO3	**Analyze** the separation by adsorption anddesign of adsorber	2.7	2.5	**2.66**	2.4	**-0.26**	Attained	More sessions on virtuallabs to be conducted
		CO4	**Design** the spray and packed tower separation by liquid liquid extraction	2.6	2.8	**2.64**	2.4	**-0.24**	Attained	More sessions on virtuallabs to be conducted
		CO5	**Analyze** the separation by leaching	2.6	2.7	**2.62**	2.4	**-0.22**	Attained	More sessions on virtuallabs to be conducted
		CO6	**Analyze** the industrial application of separation equipments in process plant	2.5	2.6	**2.52**	2.4	**-0.12**	Attained	More sessions on virtuallabs to be conducted
12	**Chemical Reaction Engineering - I (170513)**	CO1	**Apply** the basic concepts in the analysis of homogenous system and deviation from ideal behavior.	2.5	2.7	**2.54**	2.5	**-0.04**	Attained	Assignment to be given

		CO2	**Explain** the different steps in reaction mechanisms and identify the Rate-determining step.	2.6	2.8	**2.64**	2.5	**-0.14**	Attained	Explanation should begiven with more illustrations
		CO3	**Develop** Batch, CSTR, and PFR performance equations from general material balances.	2.8	2.6	**2.76**	2.5	**-0.26**	Attained	Application basedtutorial to be given
		CO4	**Analyze** Non-Isothermal operation inindustrial Reactors	2.3	2.6	**2.36**	2.5	**0.14**	Not Attained	Explanation should begiven with more illustrations
		CO5	**Determine** conversion, selectivity & yieldfor Multiple chemical reactions.	2.5	2.8	**2.56**	2.5	**-0.06**	Attained	More practice numerical problems to be given
		CO6	**Discuss** the Non-Ideal Behaviour for anyflow reactor.	2.4	2.7	**2.46**	2.5	**0.04**	Not Attained	Explanation should begiven with more illustrations
13	**Chemical Reaction Engineering - I Lab(170513)**	CO1	**Analyze** the chemical reactors and reaction systems.	2.6	2.7	**2.62**	2.4	**-0.22**	Attained	More sessions on virtuallabs to be conducted
		CO2	**Examine** the design of experiments involving chemical reactors.	2.4	2.7	**2.46**	2.4	**-0.06**	Attained	More sessions on virtuallabs to be conducted
		CO3	**Analyze** non ideality in real reactors.	2.6	2.5	**2.58**	2.4	**-0.18**	Attained	More sessions on virtuallabs to be conducted
		CO4	**Examine** the experimental analysis of batch reactor, plug flow reactor and CSTR**.**	2.7	2.8	**2.72**	2.4	**-0.32**	Attained	More sessions on virtuallabs to be conducted
		CO5	**Examine** the design and sizing of industrial scale reactor on the basis of kinetic data obtained at lab scale.	2.6	2.9	**2.66**	2.4	**-0.26**	Attained	More sessions on virtuallabs to be conducted
		CO6	**Interpret** the experimental data for usefulpurposes.	2.5	2.5	**2.5**	2.4	**-0.1**	Attained	More sessions on virtuallabs to be conducted
14	**Computational Methodsin Chemical Engineering (170514)**	CO1	**Explain** mathematical problems as appliedto Chemical Engineering.	2.7	2.8	**2.72**	2.5	**-0.16**	Attained	Analysis based questions to be given
		CO2	**Interpret** the engineering data & the features of different numerical methods.	2.5	2.8	**2.56**	2.5	**-0.06**	Attained	Tutorial to be givenalong with practice problems
		CO3	**Illustrate** the use of numerical methods inChemical Engineering scenario.	2.8	3	**2.84**	2.5	**-0.34**	Attained	Practical problems to begiven
		CO4	**Outline** the scope of optimization in chemical processes & use of numerical solution of the ODEs.	2.6	2.9	**2.66**	2.5	**-0.16**	Attained	Mini project work to begiven.
		CO5	**Simplify** the solution of engineering problems using PDEs & ODEs.	2.4	2.7	**2.46**	2.5	**0.04**	Not Attained	Tutorial to be givenalong with practice problems
		CO6	**Solve** PDEs & ODEs in various physico-chemical systems.	2.6	2.9	**2.66**	2.5	**-0.16**	Attained	Tutorial to be givenalong with practice problems

15	**Computational Methodsin Chemical Engineering Lab (170514)**	CO1	**Choose** between various computational methods to solve a process problem.	2.5	2.6	**2.52**	2.5	**-0.02**	Attained	More simulation exercises be given
		CO2	**Present** a contrast between analytical & numerical solutions.	2.4	2.5	**2.42**	2.5	**0.08**	Not Attained	More simulation exercises be given
		CO3	**Construct** functions & codes for differentnumerical methods.	2.7	2.7	**2.7**	2.5	**-0.2**	Attained	More simulation exercises be given
		CO4	**Solve** ordinary & partial differential equations using the solvers in MATLAB.	2.9	2.4	**2.8**	2.5	**-0.3**	Attained	More simulation exercises be given
		CO5	**Analyze** the solution of engineering problems using ordinary differential equations.	2.8	2.6	**2.76**	2.5	**-0.26**	Attained	More simulation exercises be given
		CO6	**Make use of** numerical integration & interpolation while solving chemical engineering problems	2.6	2.5	**2.58**	2.5	**-0.08**	Attained	More simulation exercises be given
16	**Inorganic Process Technology (170515)**	CO1	**Explain** the basics of heavy and inorganicchemical industry	2.7	2.6	**2.68**	2.5	**-0.18**	Attained	Explanation should begiven with more industrial examples
		CO2	**Relate** the importance of different unit operation and different unit processes involved in heavy and inorganic chemicalindustry	2.6	2.8	**2.64**	2.5	**-0.14**	Attained	Explanation should begiven with more industrial examples
		CO3	**Develop** process flow diagram	2.4	2.9	**2.5**	2.5	**0**	Attained	Explanation should begiven with more industrial examples
		CO4	**Analyze** the major engineering problems involved in the process	2.7	3	**2.76**	2.5	**-0.26**	Attained	Practical assignments tobe given
		CO5	**Evaluate** different types of processes based on the conversion and yield of desirable products	2.8	2.7	**2.78**	2.5	**-0.28**	Attained	Explanation should begiven with more industrial examples
		CO6	**Analyze** the importance of Fertilizer and cement technology	2.8	2.6	**2.76**	2.5	**-0.26**	Attained	Explanation should begiven with more industrial examples
17	**Minor Project - I (170516)**	CO1	**Tell** the basics of various unit operations & unit processes.	2.8	2.6	**2.76**	2.6	**-0.16**	Attained	Topic with practicalrelevance to be encouraged
		CO2	**Outline** the necessary features to be utilized in undergoing any project work.	2.7	2.8	**2.72**	2.6	**-0.12**	Attained	Outline of the work tobe clearly specified
		CO3	**Choose** among experimental work, modeling & a combination of both for anyproblem statement.	3	2.9	**2.98**	2.6	**-0.38**	Attained	Proper guidelines to begiven

		CO4	**Justify** the background for selecting a suitable project title.	2.4	2.6	**2.44**	2.6	**0.16**	Not Attained	Proper guidelines to begiven
		CO5	**Plan** the work in phases for accomplishment of the project objective.	2.6	2.8	**2.64**	2.6	**-0.04**	Attained	Proper guidelines to begiven
18	**Transport Phenomena (170721)**	CO1	**Explain** the basic terminology of Transport phenomena.	2.7	2.7	**2.7**	2.2	**-0.5**	Attained	Quizzes to be given
		CO2	**Apply** shell balance to mass, momentum and heat transfer.	2.6	2.7	**2.62**	2.2	**-0.42**	Attained	Mini project & presentation to be given
		CO3	**Solve** the appropriate equations of change to obtain desired profiles for velocity, temperature andconcentration	2.7	2.8	**2.72**	2.2	**-0.52**	Attained	Assignments & quizzesto be given
		CO4	**Analyze** industrial problems along with appropriate boundaryconditions.	2.5	2.8	**2.56**	2.2	**-0.36**	Attained	Tutorial questions to begiven
		CO5	**Apply** analogies among momentum,heat and mass transfer.	2.7	2.8	**2.72**	2.2	**-0.52**	Attained	Practical Problems to be discussed
		CO6	**Describe** mechanisms of transport phenomena, present in given isothermal and non- isothermal, laminar and turbulent flow systems.	2.6	2.7	**2.62**	2.2	**-0.42**	Attained	More practice problemsto be given
19	**Industrial Safety & Hazards (910215)**	CO1	**Analyze** the origin of hazards and fundamental principles of safety	2.7	2.8	**2.72**	2.6	**-0.12**	Attained	Mini project & presentation to be given
		CO2	**Analyze** the issues related to toxicants andminimize the toxicants dose	2.6	3	**2.68**	2.6	**-0.08**	Attained	Case studies can begiven
		CO3	**Explain** the fire & explosion hazard and the controlling measurement techniques used in chemical industries	2.8	2.7	**2.78**	2.6	**-0.18**	Attained	Practical illustrationswith explanation to be given
		CO4	**Evaluate** the professional obligations related to the plant management and maintenance to reduce energy hazard	2.6	2.8	**2.64**	2.6	**-0.04**	Attained	Practical illustrations with explanation to begiven
		CO5	**Analyze** the risk analysis and plant reliability to reduce the hazard	2.7	3	**2.76**	2.6	**-0.16**	Attained	Case studies can begiven
		CO6	**Formulate** the HAZOP study, event treeanalysis and fault treeanalysis	2.8	2.9	**2.82**	2.6	**-0.22**	Attained	Assignments & tutorials to be given
20	**Process Computation Lab (170715)**	CO1	**Operate** and program in MS Excel	2.3	2.8	**2.4**	2.3	**-0.1**	Attained	More simulation exercises be given
		CO2	**Construct** the flowsheets of chemical process unit.	2.5	2.6	**2.52**	2.3	**-0.22**	Attained	More simulation exercises be given
		CO3	**Apply** mass balance for a process situationusing excel.	2.6	2.8	**2.64**	2.3	**-0.34**	Attained	More simulation exercises be given

		CO4	**Apply** energy balance for a process situation using excel.	2.6	2.8	**2.64**	2.3	**-0.34**	Attained	More simulation exercises be given
		CO5	**Construct** various time changing plots forparameters involved in a process.	2.7	3	**2.76**	2.3	**-0.46**	Attained	More simulation exercises be given
		C06	**Carry out** data validation and consolidation in excel.	2.4	2.6	**2.44**	2.3	**-0.14**	Attained	More simulation exercises be given
21	**Universal Human Values & Professional Ethics (1000008)**	CO1	**Become more aware** of their surroundings, society, social problems and their sustainable solutions.	2.7	3	**2.76**	2.5	**-0.18**	Attained	Mini project & presentation to be given
		CO2	**Become sensitive** to their commitment towards what they believe in (humane values, humane relationships and humanesociety).	2.8	3	**2.84**	2.5	**-0.34**	Attained	Case studies can begiven
		CO3	**Apply** what they have learnt to theirown self in different day-to-day settings in real life.	2.9	2.7	**2.86**	2.5	**-0.36**	Attained	Practical illustrations with explanation to begiven
		CO4	**Sustain** human relationships andhuman nature in mind.	2.7	2.6	**2.68**	2.5	**-0.18**	Attained	Practical illustrations with explanation to be given
		CO5	**Develop** better critical ability.	2.7	3	**2.76**	2.5	**-0.26**	Attained	Case studies can begiven
		CO6	**Negotiate** living in harmony with self and others.	2.8	3	**2.84**	2.5	**-0.34**	Attained	Assignments & tutorialsto be given
22	**Creative Problem Solving(170716)**	**CO1**	**Interpret** about contemporary issues in chemical engineering & its allied areas through literature survey.	2.6	2.7	**2.62**	2.7	**0.08**	Not Attained	Case studies & relevanttopics can be given
		CO2	**Distinguish** state of art & relevance of thetopic in national & internationalarena	2.9	2.8	**2.88**	2.7	**-0.18**	Attained	Assignment tobe given
		CO3	**Demonstrate** written communication skills	2.9	2.7	**2.86**	2.7	**-0.16**	Attained	Case studies can begiven
		CO4	**Practice** in lifelong learning	3	2.8	**2.96**	2.7	**-0.26**	Attained	Case studies can begiven
		CO5	**Simplify** complex problems in Chemical Engineering	2.7	2.8	**2.72**	2.7	**-0.02**	Attained	Case studies canbe given
		CO6	**Summarize** different aspectsinvolved in aparticular field of study	2.8	2.9	**2.82**	2.7	**-0.12**	Attained	Case studies canbe given

Total No. of COs	No. of Cos Attained	No. of Cos not Attained	% Cos Attained	% Cos Not Attained
131	119	12	90.84%	9.16%

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ITEM -20

To review the PO attainments levels and suggest the actions to be taken forimprovement in PO attainment

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Madhav Institute of Technology & Science Gwalior-5

Department : CHEMICAL ENGG. Year 2019-2023

S.No.	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
1	100001: Engineering Mathematics II	2.29	2.29	2.30	2.30	2.29		2.30					2.37	2.29	2.29
2	170302 (Organic Process Technology)	2.71	2.75	2.75	2.75	2.52	2.79	2.74	2.84	2.73	2.71	3.00	2.73	2.76	2.72
3	170303 (Fluid Mechanics)	2.65	2.65	2.63	2.67	2.68	2.57	2.62	2.68	2.72	2.69	2.63	2.65	2.63	2.69
4	170303 (Fluid Mechanics Lab)	2.50	2.56	2.57	2.57										2.56
5	170304 (Material & Energy Balance)	2.54	2.54	2.54	2.54	2.53	2.56	2.54	2.57	2.55	2.54	2.54	2.54	2.54	2.54
6	170304 (Material & Energy Balance Lab)	2.88	2.88	2.88	2.88									2.88	
7	170305 (Fluid Particle Mechanics	2.63	2.63	2.61	2.58	2.58	2.65	2.53	2.61	2.65	2.66	2.52	2.64	2.49	2.60
8	170305 (Fluid Particle Mechanics Lab)	2.93	2.93	2.93										2.93	2.93
9	170306 (Chemical Synthesis Lab)	2.96	2.96	2.95	2.96	2.95	2.94	2.94	2.87	2.90	2.96	3.00	2.96	2.95	2.96
10	170308 (Summer Internship Project - I)	2.89	2.88	2.88	2.89	2.86	2.84	2.91	2.86	2.88				2.88	
11	170402 (Heat Transfer)	2.62	2.61	2.61	2.62	2.59	2.70	2.69	2.65	2.65	2.61	2.56	2.61	2.59	2.59
12	170402 (Heat Transfer Lab)				2.71			2.72	2.68	2.72	2.72	2.71		2.72	
13	170403 (Mass Transfer - I)	2.52	2.52	2.49	2.51	2.51	2.57	2.57	2.51	2.44	2.49	2.44	2.51	2.50	2.50
14	170403 (Mass Transfer - I Lab)	2.97	2.96										2.96	2.88	2.97
15	170404 (Instrumentation & Process Control)	2.72	2.72	2.71	2.72	2.71	2.79	2.84	2.76	2.79	2.71	2.76	2.72	2.60	2.75
16	170405 (Mechanical Design of Process Equipment)	2.50	2.48	2.49	2.45	2.49	2.40	2.40	2.56	2.43	2.46	2.53	2.50	2.47	2.49
17	Cyber Security (100004)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00		3.00		3.00	3.00	3.00
18	170407 (Process Control Lab)	2.54	2.54	2.39									2.39	3.00	2.54
19	170501 (Chemical Engineering Thermodynamics.)	2.54	2.53	2.53	2.55	2.53		2.48		2.59	2.59	2.42	2.58	2.48	2.50
20	170502 (Mass Transfer II)	2.63	2.59	2.60	2.60	2.76	2.57	2.61	2.62	2.68	2.62	2.64	2.62	2.58	2.64
21	170502 (Mass Transfer II Lab)	2.85	2.84	2.86	2.85	2.85	2.94	2.91	2.94	2.88	2.85	2.95	2.85	2.85	2.85

22	**170503 (Chemical Reaction Engg. I)**	2.70	2.77	2.67	2.60	2.48	2.44	2.48		2.44	2.68	3.00	2.71	3.00	2.50
23	**170503 (Chemical Reaction Engg. I Lab)**	2.98	2.98	2.98	2.98	2.98	3.00	3.00		2.90	2.98		2.98	2.97	2.98
24	**170504 (Computational Methods in Chemical Engg.)**	2.72	2.72	2.73	2.64	2.73	2.82	2.82	2.82	2.86	2.68	2.82	2.72	2.71	2.72
25	**170506(Minor Project I)**	2.96	2.97	2.98	2.94	3.00	2.97	2.98			2.96	3.00	2.97	2.96	2.97
26	**170508 (SWAYAM/NPTEL)**	2.85	2.85	2.85		2.84		3.00		2.85		3.00		2.85	
27	**170507 (Summer Internship - II)**	2.94	2.94	2.94	2.92	2.84	2.96	2.92	2.90	2.94	2.92	2.92	2.95	2.94	
28	**100005 (Ethics, Economics, Entrepreneurship & Management)**	2.76		2.92	3.00	3.00	2.87	2.84	2.79	2.89	3.00	2.87			2.88
29	**170602 (Process Modeling & Simulation)**														
30	**170602 (Process Modeling & Simulation Lab)**	2.89	2.88	2.91					2.98				2.91	2.88	2.95
31	**DE 1: Process Equipment Design (170611)**	2.63	2.64	2.65	2.64	2.65		2.60		2.57	2.59	2.68	2.59	2.65	2.63
32	**DE 1: Polymer Technology (170614)**	2.66	2.60	2.64	2.66	3.00	2.64	2.68	2.63	2.65	2.67	2.40	2.65	2.38	2.59
33															
34	**OC 1: Fuels & Combustion (900109)**	2.44	2.36	2.00	2.63		3.00	3.00	3.00		2.50		2.50		1.00
35	**Industrial Pollution Prevention & Control (170713)**	2.69	2.71	2.71	2.70	2.69	2.76	2.76	2.76	2.76	2.69		2.69	2.71	2.68
36	**Petrochemical Technology (170714)**	2.73	2.73	2.74	2.74	2.73	2.68	2.68	2.68	2.68	2.72	2.68	2.72	2.74	2.68
37	**Petroleum Processing Technology (900211)**	2.37	2.30	2.84	2.58	2.84		2.96			2.85		2.85	2.86	2.35
38	**Industrial Safety & Hazards (900223)**	2.83	2.81	2.83	2.82	2.83	2.77	2.77		2.79	2.83		2.82	2.83	2.82
39	**Process Computation Lab (170706)**	2.99	2.99	3.00	2.98		3.00	3.00		3.00	3.00		2.99	3.00	2.99
40	**Creative Problem Solving (170708)**	2.97	2.95	2.96	3.00	3.00	3.00	2.96			2.96		2.96	2.96	2.96
41	**Intellectual Property Rights (100008)**	2.87	2.87	2.87	2.87	2.86	2.88	2.82	2.76	2.84	2.87		2.87		2.88
44	**Internship/Project (170801)**	2.91	2.90	2.90	2.92	2.90	3.00	3.00	3.00	3.00	2.91	2.89	2.91	3.00	2.87
45	**Professional Development (170802)**	2.99	2.99	3.00	3.00								2.98	3.00	2.98

	INDIRECT PO ATTAINMENT	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
Survey 1	(Exit Survey)	2.26	2.29	2.47	2.26	2.36	2.54	2.51	2.47	2.51	2.44	2.26	2.4	2.4	1.34
Survey 2	(Alumni Survey)	2.06	2.10	2.05	2.15	2.04	2.08	2.11	2.17	2.17	2.22	2.21	2.32	2.14	2.10
Survey 3	(Employer Survey)	1.88	1.94	1.91	1.79	1.65	1.68	1.87	1.89	1.82	1.90	1.68	1.42	1.70	1.63
	Indirect PO Attainment	2.04	2.08	2.09	2.09	1.99	2.03	2.12	2.16	2.10	2.14	2.06	1.99	2.03	2.08

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Department : CHEMICAL ENGG. Year 2019-2023

PO ATTAINMENT	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
Direct PO Attainment	2.77	2.77	2.76	2.77	2.76	2.80	2.79	2.78	2.76	2.77	2.75	2.77	2.77	2.68
Indirect PO Attainment	2.04	2.08	2.09	2.09	1.99	2.03	2.12	2.16	2.10	2.14	2.06	1.99	2.03	2.08
Overall PO Attainment	2.62	2.63	2.63	2.63	2.61	2.65	2.66	2.66	2.63	2.64	2.61	2.63	2.64	2.58

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Chemical Engineering

Program Outcomes (PO) Attainment, Gap Analysis & ATR for 2022 -23

		Direct Attainment	Indirect Attainment	Overall Attainment	Target	Gap	Action to be taken
PO1	Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	2.77	2.04	**2.62**	**2.6**	**-0.02**	PO is achieved. Visit to core process Industries to boost the technical knowledge/skills. More focus on discussions related to approaching a problem, using foundational engineering knowledge for solving problem is included.
PO2	Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.	2.77	2.08	**2.63**	**2.6**	**-0.03**	PO is achieved. Students to be motivated to learn on their own & give presentations. Emphasis on solution of complex engineering problems of visiting industries
PO3	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations	2.76	2.09	**2.63**	**2.6**	**-0.03**	PO is achieved. Students to be encouraged to include all standard parameters within the constraints of safety& sustainability, while designing a chemical process. Design products with special emphasis on environmental concerns
PO4	Use research-based knowledge and research methods including design of experiments, analysis	2.77	2.09	**2.63**	**2.6**	**-0.03**	PO is achieved. Technical events/workshops/STC's /Online Courses to be utilized to impart more

	and interpretation of data, and synthesis of the information to provide valid conclusions.						knowledge & research methods to formulate innovative solutions to complex Chemical Engineering Problems.
PO5	Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	2.76	1.99	**2.61**	**2.6**	**-0.01**	PO is achieved. Labs to be modernized & developed to inculcate modern analytical & computational tools like TGA, FTIR, CHNS Analyser, FLUENT, MATLAB, ASPEN etc.
PO6	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice..	2.80	2.03	**2.65**	**2.6**	**-0.05**	PO is achieved. Course delivery to be oriented towards the relevant practical applications of concepts. To understand the safety, environmental & Social aspects of process Industries & take up collaborative projects for their professional growth.
PO7	Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate knowledge of, and need for sustainable development.	2.79	2.12	**2.66**	**2.6**	**-0.06**	PO is achieved. Projects addressing the global energy & environmental issues to be taken up by the students with a focus on consumption, utilization & proper management of energy. Students to be motivated to attend technical workshops related to environmental issues & utilization of renewable energy resource

PO8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2.78	2.16	**2.66**	**2.6**	**-0.06**	PO is achieved. Motivational talks, cooperative lectures & programmes on mutual & ethical practices to be arranged in order to inculcate professional ethics & sense of honesty in students
PO9	Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.	2.76	2.10	**2.63**	**2.6**	**-0.03**	PO is achieved. Various programmes and counseling sessions to be organized to help the students to groom the skills like leadership, team work, coordination, commitment and being an effective team member.
PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2.77	2.14	**2.64**	**2.6**	**-0.04**	PO is achieved. Group discussions, seminars, presentations and soft skills training programmes to be organized to enhance the aspects of communication/skills. Students to be motivated to take related Novel Engaging Courses to groom themselves.
PO11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage	2.75	2.06	**2.61**	**2.6**	**-0.01**	PO is achieved. Awareness to be generated in students regarding managerial principles and projects through some core courses related to management, economics and organization of

	projects and in multidisciplinary environments.						process industries. Industrial Internships to be encouraged
PO12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2.77	1.99	**2.62**	**2.6**	**-0.02**	PO is achieved. Use of ICT facilities like PPT's, live demonstrations, NPTEL lectures to be encouraged. Course delivery to be oriented towards linking the fundamental concepts to practical usage.
PSO1	Apply computational and simulation tools to design, solve & optimize chemical processes.	2.77	2.03	**2.64**	**2.6**	**-0.04**	PO is achieved. Lab to be developed equipped with software such as ANSYS, ASPEN, PRO2, etc
PSO2	Design unit operations & unit processes to solve engineering problems using basic principles and methods & exhibit proficiency in applying technology to industry, society & environmental concerns.	2.68	2.08	**2.58**	**2.6**	**0.02**	PO is not achieved. Course delivery to be focused on extension of concepts to real world applications. Students to be motivated to take design projects & internships.

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ITEM -21

To review and finalize the CO-PO mapping matrix for all the courses to be taught in July-Dec 2024.

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

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Department of Chemical Engineering

CO - PO Mapping Matrix for courses to be taught during July - Dec 2024

				CO-PO Matrix													
			Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
Semester III	3170311: Fluid Mechanics	CO1	Explain the basic fundamentals of fluid statics & fluid flow.	3	3	2	1	2					3		2		1
		CO2	Estimate pressure drops, forces acting on bodies & power and head requirements of pumps.	3	3	3	1		1		1	1	2	1	2	2	2
		CO3	Apply equations of change to various fluid flow systems.	3	2	2	2	2	1	1		1	2	1	2	2	2
		CO4	Formulate the inter-dependency of various parameters using dimensional analysis.	3	2	2	2	2	1	1			1	1	1	1	2
		CO5	Determine the flow rate through different flow measuring devices.	3	3	2	1	1	1				1	1	2	1	
		CO6	Examine the losses due to friction in pipes and other fluid machinery.	3	3	1	2	2				1	2	1	2	1	1
	3170311: Fluid Mechanics Lab	CO1	Analyze the effects of flow measurement by flow measuring devices.	3	3												2
		CO2	Calculate the degree of error in discharge rate of rotameter.	3	3	3	3										2
		CO3	Calculate the coefficient of discharge for venturimeter and orifice meter.	3	3	3	3										2
		CO4	Calculate the coefficient of discharge for rectangular notch.		3		3										2
		CO5	Calculate the coefficient of discharge for triangular notch.		3	3	3										2
		CO6	Calibrate the flow measuring instruments.	3	3	2	3										2
	3170312 (Organic Process Technology)	CO1	Explain the processing of natural products	3	1	2	1	1	1	2	1	1	2		2		1
		CO2	Describe about microbial processes and edible oil refining process	2	2	2	1		1	2	2	2	1	1	2		1
		CO3	Elaborate the processes for producing petrochemicals	2	2	2	2		2	3	1		2		2		
		CO4	Characterize polymers and elaborate its production processes.	3	3	2	1		1	1			2		2	1	2
		CO5	Describe the production processes of fibers	3	2	1	1			2		2	2		2		1
		CO6	Evaluate the different processes from economical aspects	3	2	1	1			2		2	2		2		1
	3170313 (Chemical Engineering Thermodynamics.)	CO1	Infer the fundamental concepts of thermodynamics to chemical engineering applications.	3	2	2	2	2					2		2	1	1
		CO2	Explain the first and second laws of thermodynamics with their practical implications.	2	2	1	2					1	2		2		
		CO3	Analyze the processes involving refrigeration and compression.	3	2	2	2	1		1			2		2	1	2
		CO4	Classify the thermodynamic properties of solutions with their relationships.	3	3	2	2	1					1		1	2	1
		CO5	Infer the detail of vapour liquid equilibria and its use in practical situations.	3	3	3	2	2		1		1	1	1	2	2	2
		CO6	Analyze the chemical equilibrium with thermodynamics for predicting behavior of reacting systems.	3	2	2	2	1					1		1	1	1
	3170314 (HeatTransfer)	CO1	**Apply** the principles of different modes of heat transfer and heat transfer equipments.	2	3	2	2	2	2	2	1	1	2		2	2	2
		CO2	**Analyze** the heat transfer problems involving phase change.	1	2	2	1	1					2		2	2	2
		CO3	**Illustrate** the use of dimensionless numbers and various theoretical concepts.	3	3	2	2	2		1			2		2	3	3
		CO4	**Interpret** the physical systems involving heat transfer.	2	1	2	1			1		1	2		2	1	1
		CO5	**Solve** practical heat transfer problems.	3	1	2	2	2	1	1	1	2	2	1	2	2	2
		CO6	**Estimate** the design parameters of various heat transfer equipments.	3	1	2	2	2	1	1	1	2	2	1	2	2	2
		CO1	Analyze the various modes of heat transfer in chemical industries				2			3		2	2	2			

	3170314 (HeatTransfer Lab)	CO2	Analyze the application of various experimental heat transfer correlations in engineering applications				2			3	2	2	2	2		3	
		CO3	Evaluate the thermal analysis and sizing of heat exchanger														
		CO4	Evaluate the emissivity of materials				2			2	3	2	2	2		3	
		CO5	Study the thermal conduction in metal rod				2				2	3	3	2		3	
		CO6	Analyze the application of heat exchanging equipment in chemical process industries				2				2	3	3	2		3	
	3170315 (Chemical Synthesis Lab)	CO1	Research a specific compound, or a family of compounds, to propose a synthetic route for isolation of this compound.				2			3		2	2	2			
		CO2	Perform advanced manipulations of apparatus relevant to a synthetic chemistry laboratory, use a Schlenk line to synthesize oxygen- and moisture-sensitive products.				2			3	2	2	2	2		3	
		CO3	Characterize chemical compounds using modern spectroscopic techniques.														
		CO4	Maintain a laboratory notebook following scientific best practices.				2			2	3	2	2	2		3	
		CO5	Communicate findings in a format consistent with the scholarly standards of the chemical sciences.				2				2	3	3	2		3	
		CO6	Articulate and follow ethical principles in a scientific context, including professional standards of laboratory practice, the communication of literature research without plagiarism,and the crediting of collaborators				2				2	3	3	2		3	
	2170511 (Data Science)	CO1	Define different Data Science techniques.	3	3	2		3	1	1					2	2	
		CO2	Illustrate various tools used for Data Science technique.	2	2	2	2	3							2	3	
		CO3	Apply data visualization techniques to solve real world problems.	2	2	2		3								2	
		CO4	Build exploratory data analysis for Data Science methods.	3	2	2	2								2	2	
		CO5	Apply Data Science techniques for solving real world problems.	3	3	2	2	3							3	2	2
		CO6	Evaluate the performance of algorithms in data science.	2	3	2	2	2							2	2	
	2170512 (Mass Transfer - II)	CO1	Explain the basics of adsorption, leaching, distillation, liquid-liquid extraction & the principle of diffusion underlying them.	3	1	2	2	2	1	2	1	2	2		2		1
		CO2	Infer the necessary information useful in design of mass transfer equipment.	2	2	2	1		1	2	2	2	1	1	2		1
		CO3	Analyze the different contacting patterns & Analogies in transfer process.	2	2	2	2		2	3	1		2		2		
		CO4	Apply the theoretical concepts to practical problems.	3	3	2	1		2	2			2		2	1	2
		CO5	Interpret the equilibrium data obtained in various mass transfer operations..	3	3	2	2			2		2	2		2		1
		CO6	Propose favourable conditions for a separation to be carried out.	3	2	1	1			2		2	2		2		1
	2170512 (Mass Transfer - II Lab)	CO1	Design calculation of distillation column	3	3	2	2	2	1	2	1	2	2		2	3	3
		CO2	Estimation of number of theoretical stages and composition of each plate	2	2	2	2	2				2	2	1	2	2	2
		CO3	Analyze the separation by adsorption and design of adsorber	3	3	2	2	2					2		2	2	2
		CO4	Design the spray and packed tower separation by liquid liquid extraction	3	3	3	2	2	1	2	1	2	2		2	3	3
		CO5	Analyze the separation by leaching	3	3	2	2	2				2	2		2	3	2
		CO6	Analyze the industrial application of separation equipments in process plant	3	2	2	2	2	2	2	2	2	2	2	2	2	2
		CO1	Explain the basic concepts in the analysis of	3	3	3								2	3	3	
		CO2	Explain the different steps in reaction	3	3	3								2	3	3	

Semester V																		
	2170513 (Chemical Reaction Engineering - I)	CO3	Develop Batch, CSTR, and PFR performance equations from general material balances.	3	2	3	2						2		3		3
		CO4	Analyze Non-Isothermal operation in industrial Reactors	3		3		2	2	3		2			2		2
		CO5	Determine conversion, selectivity & yield for Multiple chemical reactions.	2		3	2	2		3		2			2		
		CO6	Discuss the Non-Ideal Behaviour for any flow reactor.	2	3	3						2			2		3
	2170513 (Chemical Reaction Engineering - I Lab)	CO1	Analyze the chemical reactors and reaction systems	3	3	2	2	2	1	1			2		2	2	3
		CO2	Examine the designing experiments involving chemical reactors, and analyzing and interpreting data	3	2	2	2	2					2		2	1	1
		CO3	Analyze the problems solving ability to mass transfer with reaction in solid catalyzed reactions	3	3	2	2	3				2	2		2	3	3
		CO4	Examine the experimental analysis of batch reactor, plug flow reactor and CSTR	3	3	2	2	2	1	1			2		2	2	3
		CO5	Examine the design and sizing of industrial scale reactor on the basis of kinetic data obtained at lab scale	3	2	2	2	2					2		2		1
		CO6	Analyze the design of the bioreactor, functions of the different part of bioreactor and its application in industry.	3	2	2	2	3					2		2	2	2
	2170514 (Computational Methods in Chemical Engineering)	CO1	Explain mathematical problems as applied to Chemical Engineering.	3	3	2	2	2	1	1			2		2	2	3
		CO2	Interpret the engineering data & the features of different numerical methods.	3	2	2	2	2					2		2	1	1
		CO3	Illustrate the use of numerical methods in Chemical Engineering scenario.	3	3	2	2	3				2	2		2	3	3
		CO4	Outline the scope of optimization in chemical processes & use of numerical solution of the ODEs.	3	3	2	2	2	1	1			2		2	2	3
		CO5	Simplify the solution of engineering problems using PDEs & ODEs.	3	2	2	2	2					2		2		1
		CO6	Solve PDEs & ODEs in various physico-chemical systems.	3	2	2	2	3					2		2	2	2
	2170514 (Computational Methods in Chemical Engineering Lab)	CO1	Choose between various computational methods to solve a process problem.	3	3	2	2	3	1	1	1	2	2	1	2	1	2
		CO2	Present a contrast between analytical & numerical solutions.	3	3	2		2				2			2	2	2
		CO3	Construct functions & codes for different numerical methods.	3	2	2		2					2		2	1	1
		CO4	Solve ordinary & partial differential equations using the solvers in MATLAB.	2	3	2	2	2					2		2	2	1
		CO5	Analyze the solution of engineering problems using ordinary differential equations.	3	3	2	2	2					2		2	2	2
		CO6	Make use of numerical integration & interpolation while solving chemical engineering problems	3	3	1	1	2					2		2	2	2
	2170514 (Computational Methods in Chemical Engineering Lab)	CO1	Choose between various computational methods to solve a process problem.	3	3	2	2	3	1	1	1	2	2	1	2	1	2
		CO2	Present a contrast between analytical & numerical solutions.	3	3	2		2				2			2	2	2
		CO3	Construct functions & codes for different numerical methods.	3	2	2		2					2		2	1	1
		CO4	Solve ordinary & partial differential equations using the solvers in MATLAB.	2	3	2	2	2					2		2	2	1
		CO5	Analyze the solution of engineering problems using ordinary differential equations.	3	3	2	2	2					2		2	2	2
		CO6	Make use of numerical integration & interpolation while solving chemical engineering problems	3	3	1	1	2					2		2	2	2
	2170515 (Process	CO1	**Explain** the flowsheet and synthesis of process.	2	3	3	2	1	1					2	2		2
		CO2	**Compare** the alternate methods of investments.	3	2	2		2						2	2		2
		CO3	**Illustrate** the methods of depreciation and its impact.	3		2		2						2	2		

	Engineering & Costing)	CO4	**Analyze** the rate of return, venture profit, payout time, break even point for any investment.	3				2						2	2		
		CO5	**Describe** the capital cost and manufacturing cost estimation methods.	2										2	2		
		CO6	**Analyze** R&D investment and technological forecasting for the process industries.		2		2										
	1000006 (Disaster Management)	CO1	**Identify** disaster prevention and mitigation approaches.	3	2		2		2	2	1		2		2		
		CO2	**Classify** global and national disasters, their trends and profiles.	3	2		2						2		2		
		CO3	**Determine** the impacts of various disasters	2	2	2	1						2		2		1
		CO4	management	3	3	1	1			2			2		2		
		CO5	**Infer** the linkage between disasters, environment and development	3	3	2	1	2					2		2	1	2
		CO6	**Identify** Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders	2	2	1	1		2	2			2		2		
Semester VII	170721 (Transport Phenomena)	CO1	**Explain** the basic terminology of Transport phenomena.	3	2	2	1								2		
		CO2	**Apply** shell balance to mass, momentum and heat transfer.	3	3	2									2		2
		CO3	**Solve** the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration	3	3	3									2		2
		CO4	**Analyze** industrial problems along with appropriate boundary conditions.	2	2	3									2		
		CO5	**Apply** analogies among momentum, heat and mass transfer.	3	2	2									2		
		CO6	**Describe** mechanisms of transport phenomena, present in given isothermal and non- isothermal, laminar and turbulent flow systems.	3	3	3									2		
	170722 (Equilibrium Staged Operations)	CO1	**Describe the fundamentals of separation operation**.	3	2	2									2		
		CO2	**Describe the approximation technique and its algorithms for multicomponent multistage separations**	3	3	2									2		2
		CO3	**Analyze the equilibrium data obtained in the various separation operation**	3	3	3									2		2
		CO4	**Analyze industrial problems along with appropriate boundary conditions.**	2	2	3									2		
		CO5	**Apply the knowledge of kinetics and transport.**	3	2	2									2		
		CO6	**Apply the mechanisms of industrial equilibrium separation operation**	3	3	3									2		2
	170723 (Heterogeneous Reaction Systems)	CO1	**Analyze the heterogeneous processes**.	3	2	2									2		
		CO2	**Examine the various catalytic processes and catalytic poisoning**	3	2	2									2		2
		CO3	**Examine the effect of various parameters like yield selectivity etc. on catalytic reaction**	3	3	2									2		2
		CO4	**Design the multiple phase reactors**	2	2	3									2		3
		CO5	**Design the model for solid fluid non catalytic reaction**	3	2	2									2		3
		CO6	**Describe the models for fluid-fluid catalytic reaction**	3	3	3									2		2
	170724 (Multi-Component Distillation)	CO1	**Select key component**	3	2	2									2		
		CO2	**Solve number of theoretical and actual stages required for multi component distillation by using various methods.**	3	2	2									2		2
		CO3	**Examine how to break azeotrope using azeotropic and extractive distillation.**	3	3	2									2		2
		CO4	**Estimate reflux ratio required for the distillation operation.**	2	2	3									2		3
		CO5	**Estimate tower diameter and operating pressure for multi distillation column.**	3	2	2									2		3

		CO6	**Analyze various design options for energy conservation in the distillation column.**	3	3	3									2		2
	910215 (Industrial Safety and Hazards)	CO1	**Analyze** the origin of hazards and fundamental principles of safety	3	3	2	1	2		1		1	2		2	2	2
		CO2	**Analyze** the issues related to toxicants and minimize the toxicants dose	3	3	3	2	3				2	2		2	3	3
		CO3	**Explain** the fire & explosion hazard and the controlling measurement techniques used in chemical industries	3	2	2	1	2					2		2	2	2
		CO4	**Evaluate** the professional obligations related to the plant management and maintenance to reduce energy hazard	2	2	1	1	1	1	1			1		2	1	2
		CO5	**Analyze** the risk analysis and plant reliability to reduce the hazard	3	2	2	1	2					2		2	2	2
		CO6	**Formulate** the HAZOP study, event tree analysis and fault tree analysis	2	3	2	1	2	1	2			2		2	2	2
	170715 (Process Computation Lab)	CO1	**Operate** and program in MS Excel	3	2					2		3				3	3
		CO2	**Construct** the flowsheets of chemical process unit.	3	3										3	3	3
		CO3	**Apply** mass balance for a process situation using excel.	3	3										3		3
		CO4	**Apply** energy balance for a process situation using excel.	2	3		2									2	3
		CO5	**Construct** various time changing plots for parameters involved in a process.	3	3	2							3		3	3	3
		CO6	**Carry out** data validation and consolidation in excel.	3	2				3			3	3		3	2	2
	170716 (Creative Problem Solving)	CO1	**Interpret** about contemporary issues in chemical engineering & its allied areas through literature survey.	3	3	2		3		2			2		3	3	3
		CO2	**Distinguish** state of art & relevance of the topic in national & international arena	2	3	2				2			2		2	2	3
		CO3	**Demonstrate** written communication	3	3	3	2		2	3			3		3	3	3
		CO4	**Practice** in lifelong learning	2	2				2	2			2		2		3
		CO5	**Simplify** complex problems in Chemical Engineering	2		2											2
		CO6	**Summarize** different aspects involved in a particular field of study	3	2								2		2	2	2

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(Deemed to be University)

NAAC Accredited with A++ Grade

ITEM -22

To review curricula feedback from various stakeholders, its analysis and impact

Department of Chemical Engineering

Feedback Analysis & Action Taken Report

ITEM NO. 23 To review curricula feedback from various stakeholders, its analysis and impact	**Feedback**	**Feedback Comments**	**Feedback Action Taken**
	Students Feedback	• The curriculum is up to date • Much theoretical things should be excluded from Thermodynamics • IPT, OPT can be merged as Chemical Technology	• Scope of improvement is being explored • Same will be put up before concerned authorities • Same will be put up before concerned authorities
	Faculty Feedback	• Yes, the environment allows for a free exchange of ideas, thoughts and skills among the facilitators and learners	• We commit to maintain the consistency
	Parents Feedback	• There will be some more concern about student's future job opportunities	• It has been informed to placement cell.
	Alumni Feedback	• Revision of syllabus is required • Need to particularly focus on practical application rather than teaching theories. • Availability of Books in Library • Department should have a regular industrial visits.	• Already discussed and changed in BoS accordingly • All the faculty members have been instructed to discuss the theory with some practical applications in their respective courses. • The Library officer has been informed about the situation and also shared

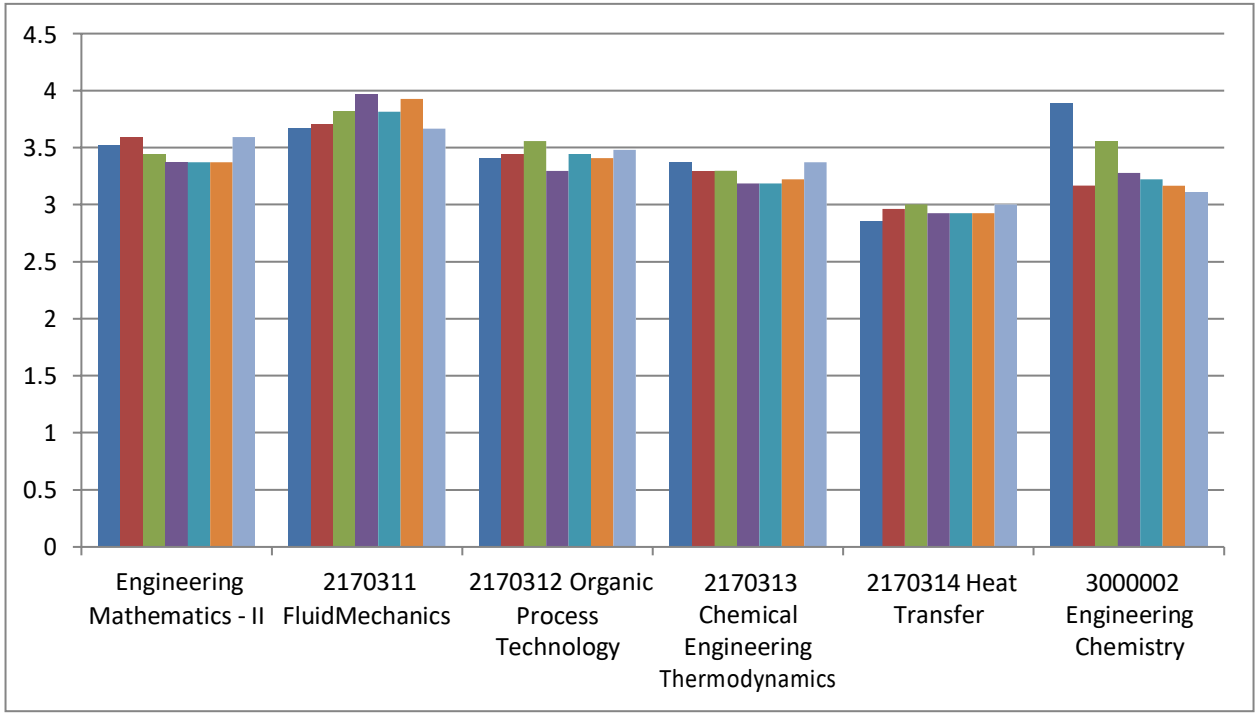
			the list of Books. • Department is exploring opportunity related to conduction of industrial visit.

	Employer Feedback	• They must focus on the core rather making aware about other subjects • The courses offered are only relevant upto a certain level there should be a proper commencement of newly technologies introduced in the industries then only we can make graduates ready for an industry. They must taught about the ethics and principles which one should follow while working inside the chemical industries. • Must include an optional course on chemical/industrial operations which are practiced in different process industries. • Need some courses on finance as well. Data science is an emerging field an exposure of that will be beneficial. • If possible, addition of 2-3 months of internship or practising of students in multiple industries to get contemporary knowledge in industrial operations.	• Courses are offered according NEP • New Technology and Industry related course already offered in flexible curriculum. • Some Such courses are offered on NPTEL platform under DE • Regarding this Provision is there in open category courses. • Students get industrial (1 month) visit after 6^{th} sem and during 8^{th} sem most of the students are engaged with industrial internship (4-6months)

Students Feedback on Course Curriculum

Comments	Action Taken
• The curriculum is up to date • Much theoretical things should be excluded from Thermodynamics • IPT, OPT can be merged as Chemical Technology	• Scope of improvement is being explored • Same will be put up before concerned authorities • Same will be put up before concerned authorities

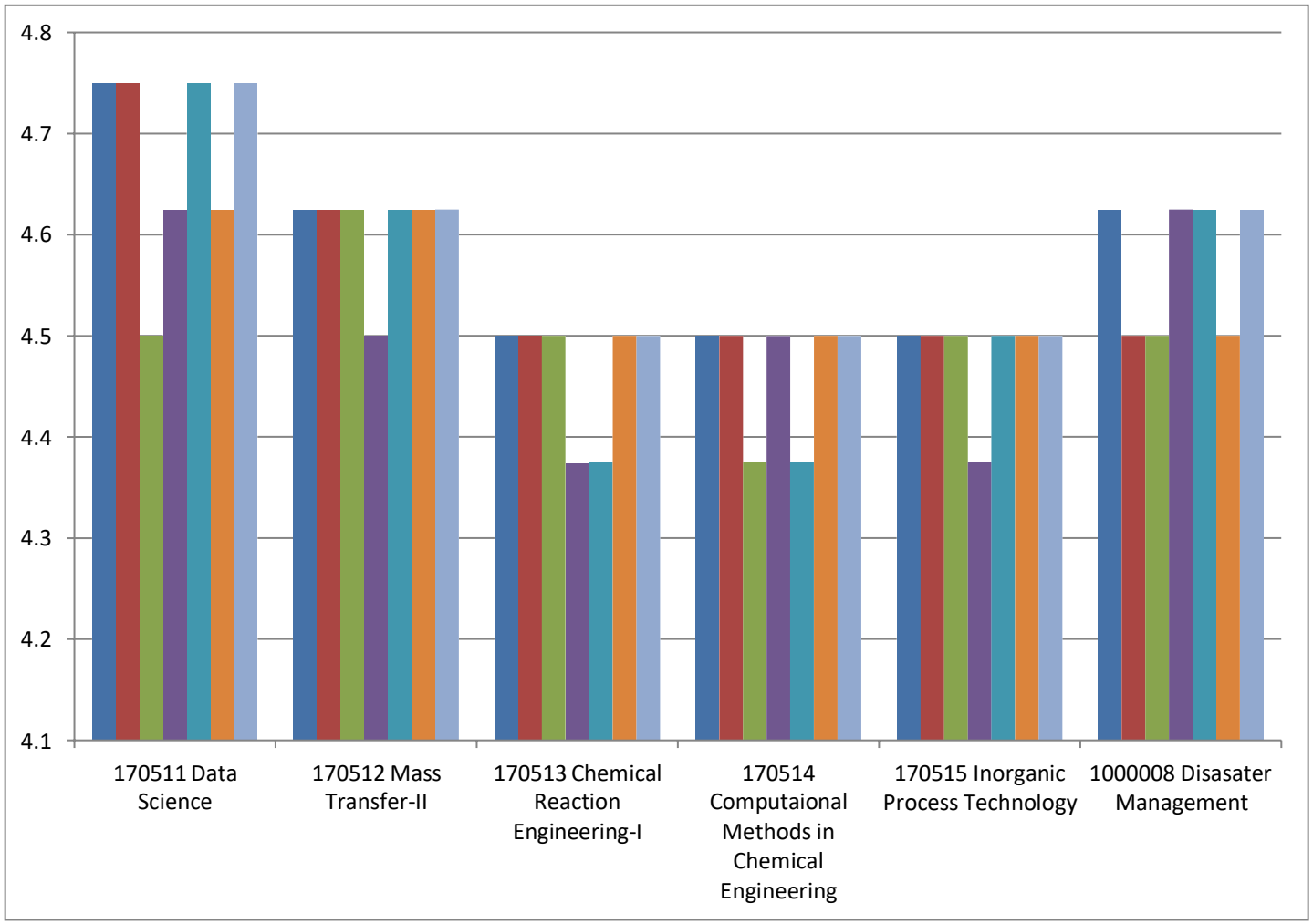
Course Curriculum Feedback (by students on MOODLE): (July – Dec 2023) III Semester, Sample Size: 6



SUMMARY SHEET (Course Curriculum Feedback by Students on MOODLE) III Semester, Sample Size: 6

Parameter (Average Grading)	1. The course is well designed	2. The syllabus units are balanced	3. The course will be useful for you in future	4. The learning material was available to you	5. The content was clear and easy to understand	6. The course meets your expectations	7. The course was relevant and updated for present needs	CSI
Engineering Mathematics - II	3.51	3.59	3.44	3.370	3.370	3.37	3.59	3.5
2170311 Fluid Mechanics	3.66	3.70	3.81	3.96	3.81	3.92	3.66	3.79
2170312 Organic Process Technology	3.40	3.44	3.55	3.29	3.44	3.40	3.48	3.434
2170313 Chemical Engineering Thermodynamics	3.37	3.29	3.29	3.18	3.185	3.22	3.370	3.23
2170314 Heat Transfer	2.85	2.96	3	2.92	2.92	2.92	3	2.989
3000002 Engineering Chemistry	3.88	3.16	3.55	3.27	3.22	3.16	3.11	3.38

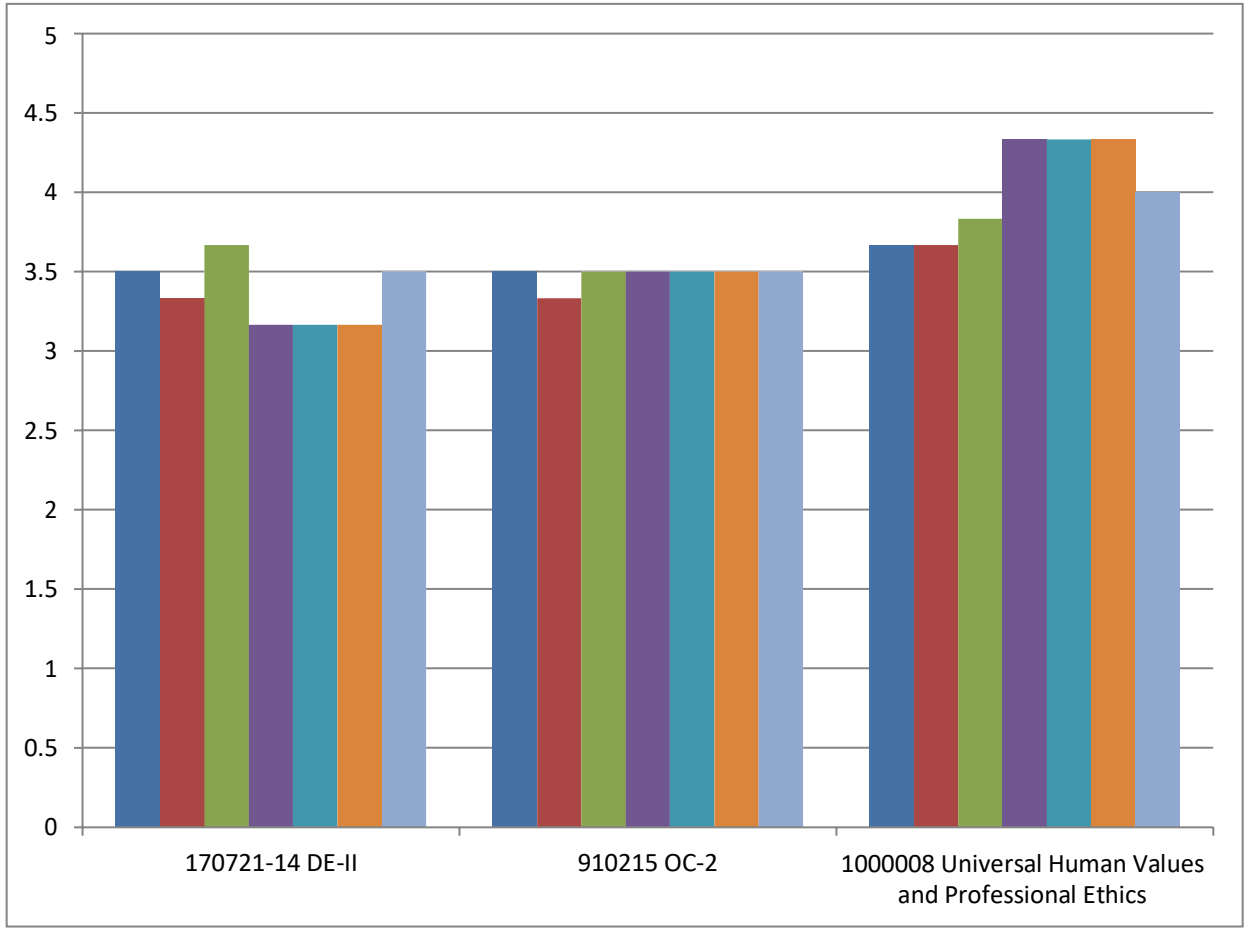
Course Curriculum Feedback (by students on MOODLE): (Jul – Dec 2023) V Semester, Sample Size: 10



SUMMARY SHEET (Course Curriculum Feedback by Students on MOODLE) V Semester, Sample Size: 10

Parameter (Average Grading)	1 .The course is well designed	2. The syllabus units are balanced	3. The course will be useful for you in future	4. The learning material was available to you	5. The content was clear and easy to understand	6. The course meets your expectations	7. The course was relevant and updated for present needs	CSI
170511 Data Science	4.75	4.75	4.5	4.625	4.75	4.625	4.75	4.67
170512 Mass Transfer-II	4.625	4.625	4.625	4.5	4.625	4.625	4.625	4.60
170513 Chemical Reaction Engineering-I	4.5	4.5	4.5	4.374	4.375	4.5	4.5	4.46
170514 Computaional Methods in Chemical Engineering	4.5	4.5	4.375	4.5	4.375	4.5	4.5	4.47
170515 Inorganic Process Technology	4.5	4.5	4.5	4.375	4.5	4.5	4.5	4.49
1000008 Disasater Management	4.625	4.5	4.5	4.625	4.625	4.5	4.625	4.57

Course Curriculum Feedback (by students on MOODLE): (Jul – Dec 2023) VII Semester, Sample Size: 9



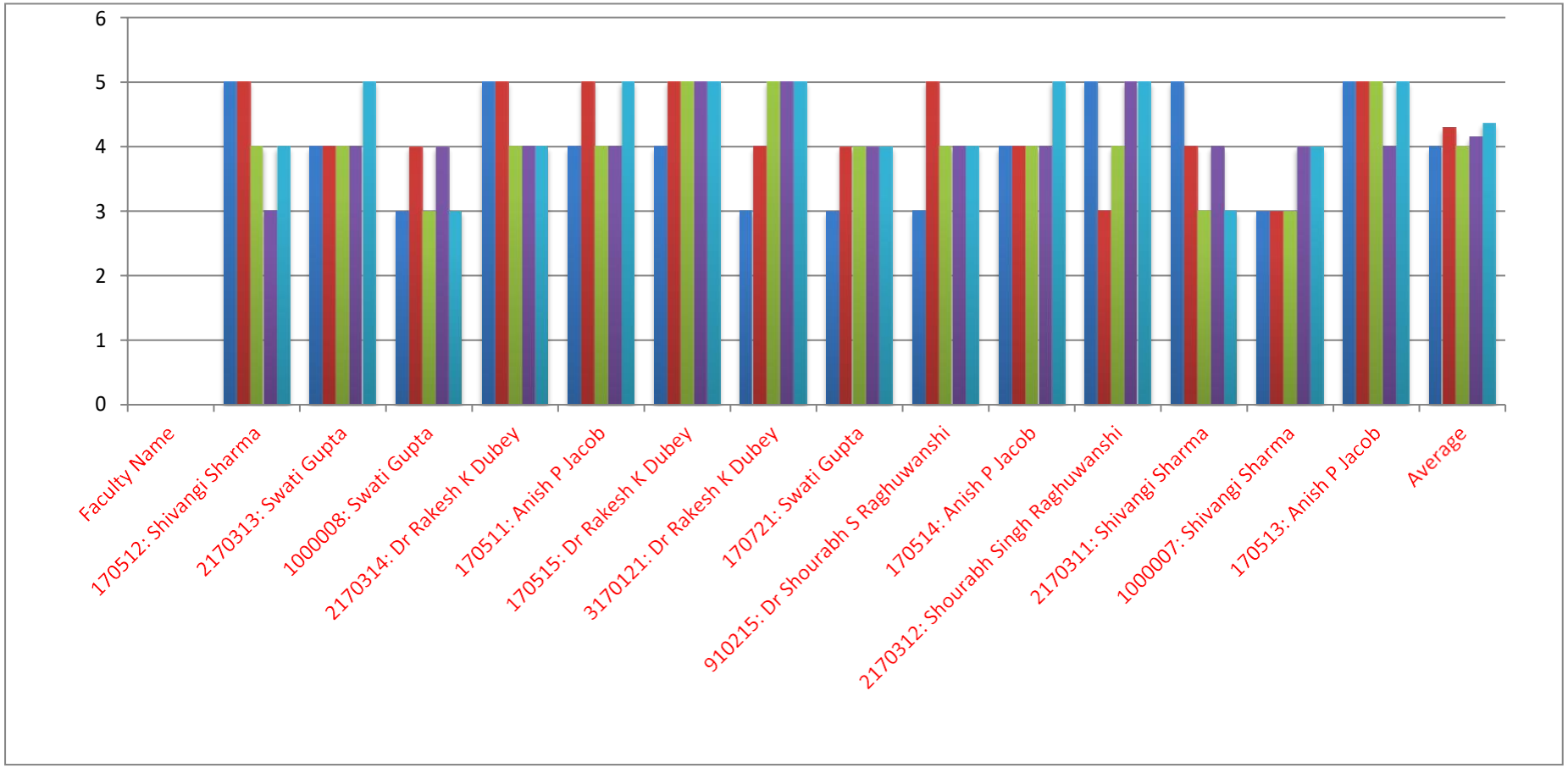
SUMMARY SHEET (Course Curriculum Feedback by Students on MOODLE) VII Semester, Sample Size: 9

Parameter (Average Grading)	1 .The course is well designed	2. The syllabus units are balanced	3. The course will be useful for you in future	4. The learning material was available to you	5. The content was clear and easy to understand	6. The course meets your expectations	7. The course was relevant and updated for present needs	CSI
170721-14 DE-II	3.5	3.33	3.67	3.17	3.16	3.16	3.5	3.35
910215 OC-2	3.5	3.33	3.5	3.5	3.5	3.5	3.5	3.47
1000008 Universal Human Values and Professional Ethics	3.67	3.67	3.83	4.33	4.33	4.33	4	4.02

FACULTY FEEDBACK ON COURSE CURRICULUM

S.No	Comments	Action Taken
1.	Yes, the environment allows for a free exchange of ideas, thoughts and skills among the facilitators and learners	Team work is appreciated, department will try to maintain the consistency

TEACHERS' COURSE CURRICULUM FEEDBACK (by teacher on MOODLE): (Jul – Dec 2023)



SUMMARY SHEET (Teachers Course Curriculum Feedback by Teacher on MOODLE)

Parameter (Average Grading)	1. The availability of books & E-learning material in the institute is good. (Please give your opinion)	2. The Courses and content are up to date. Please suggest if you feel any new course(s) need to be introduced to meet current needs & technological changes?	3. The course curriculum/syllabi are helpful in meeting the higher studies/placement requirements according to present global trends. (Please give suggestions if any)	4. The course / contents in your domain/area are well designed and frequently updated, hence need no changes at present.[If you feel some changes (new content to be added or outdated content to be removed) are needed, please suggest]	5. The curriculum is capable of inculcating life-long learning abilities in students. (Any suggestions, please give below)
170512: Mass Transfer-II	5	5	4	3	4
2170313: Chemical Engineering Thermodynamics	4	4	4	4	5
1000008: Universal Human Values and Professional Ethics	3	4	3	4	3
2170314: Heat Transfer	5	5	4	4	4
170511: Data Science	4	5	4	4	5
170515: Inorganic Process Technology	4	5	5	5	5

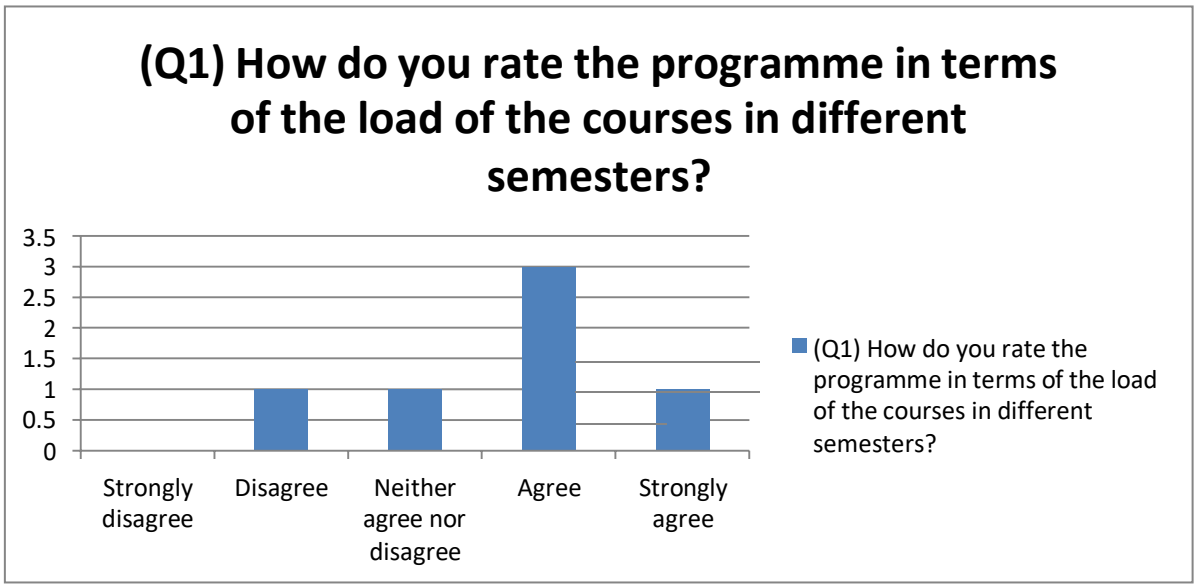
3170121: Fuel Technology	3	4	5	5	5
170721: Transport Phenomena	3	4	4	4	4
910215: Industrial Safety and Hazards	3	5	4	4	4
170514: Computational Methods in Chemical Engineering	4	4	4	4	5
2170312: Organic Process Technology	5	3	4	5	5
2170311: Fluid Mechanics	5	4	3	4	3
1000007: Disaster Management	3	3	3	4	4
170513: Chemical Reaction Engineering - I	5	5	5	4	5
Average	4	4.29	4	4.14	4.36
	Satisfactory	**Good**	**Good**	**Good**	**Good**

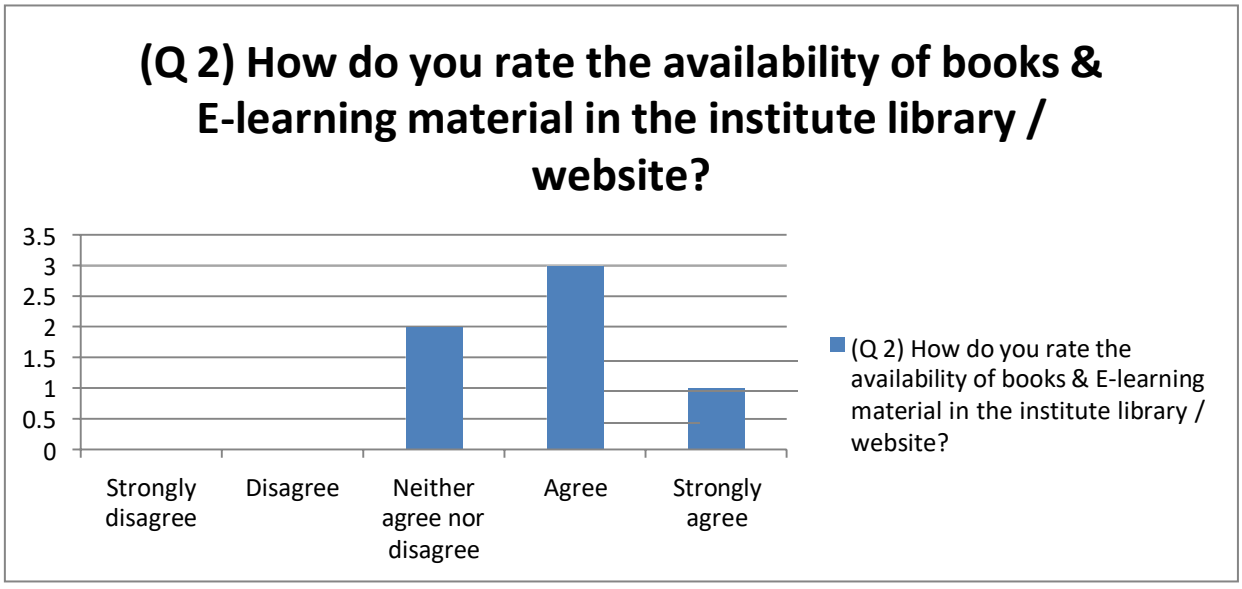
Teacher Course Satisfaction Index (TSI) (on a scale of 5) (5: Excellent, 4: Very Good, 3: Good, 2: Average, 1: Below Average)

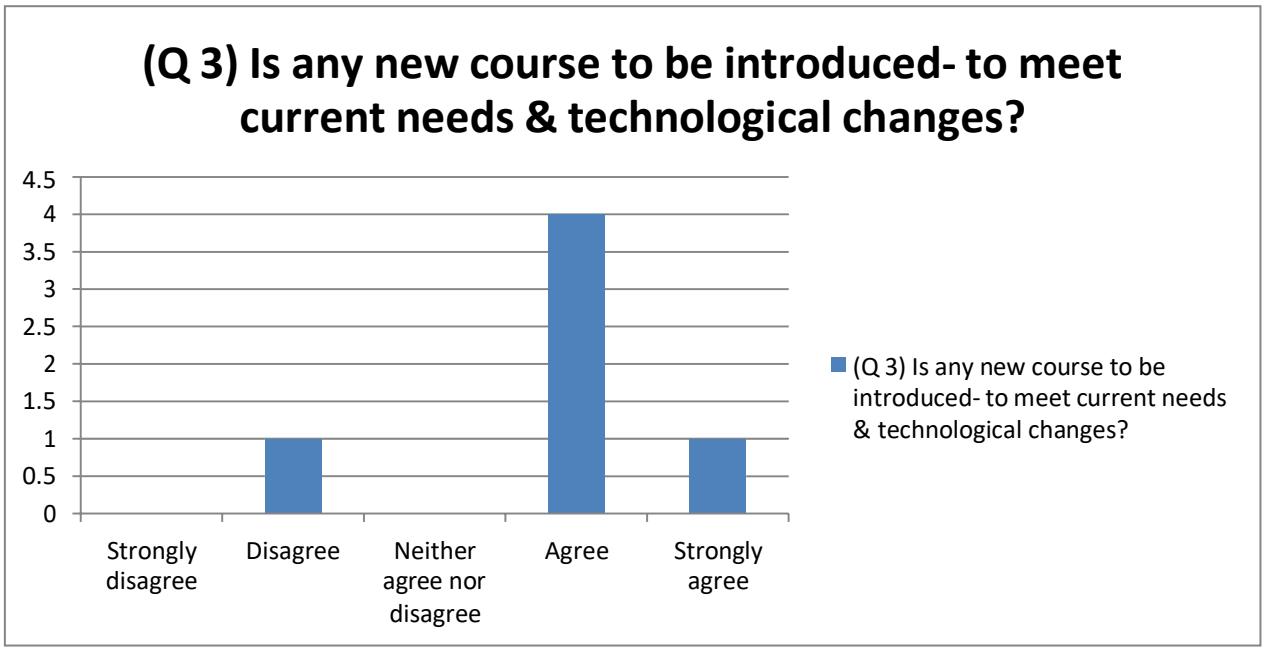
Parent Feedback

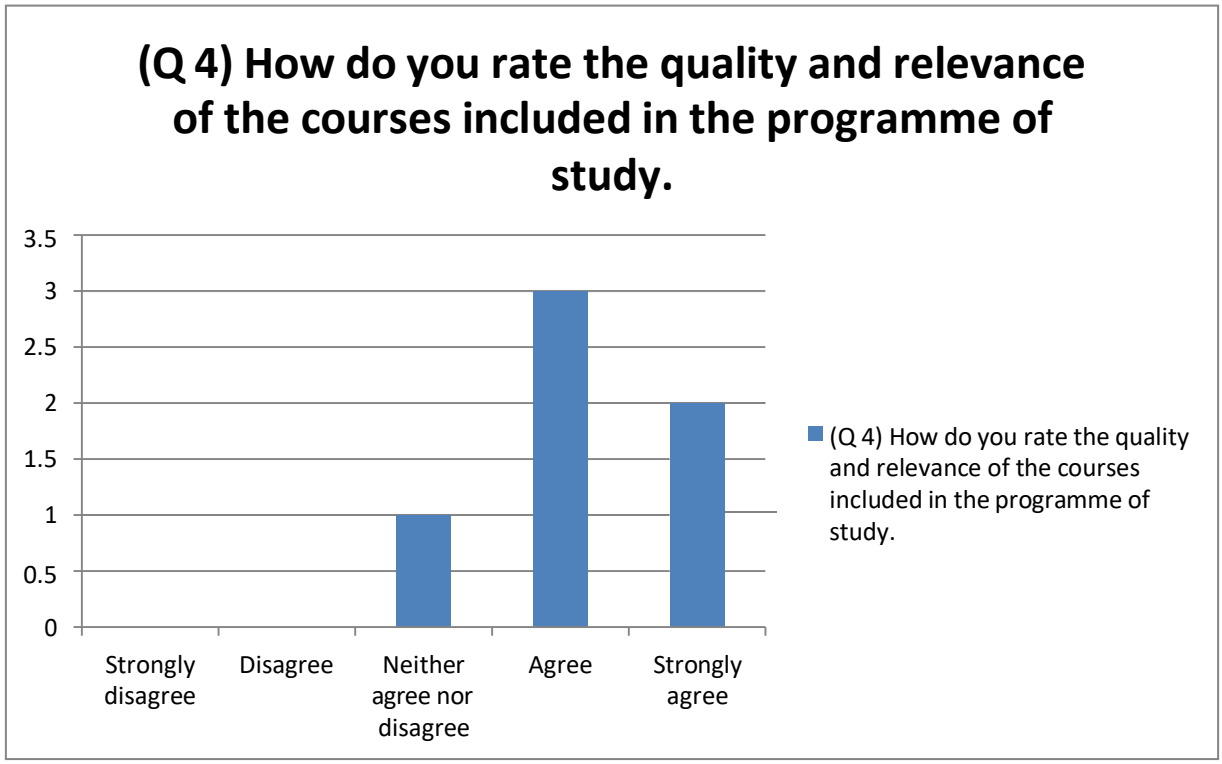
S. No.	Comments	Action Taken
1.	• There will be some more concern about student's future job opportunities	It has been informed to placement cell.

Parent Satisfaction Survey 2nd year 2023 – 24) Sample Size: 06

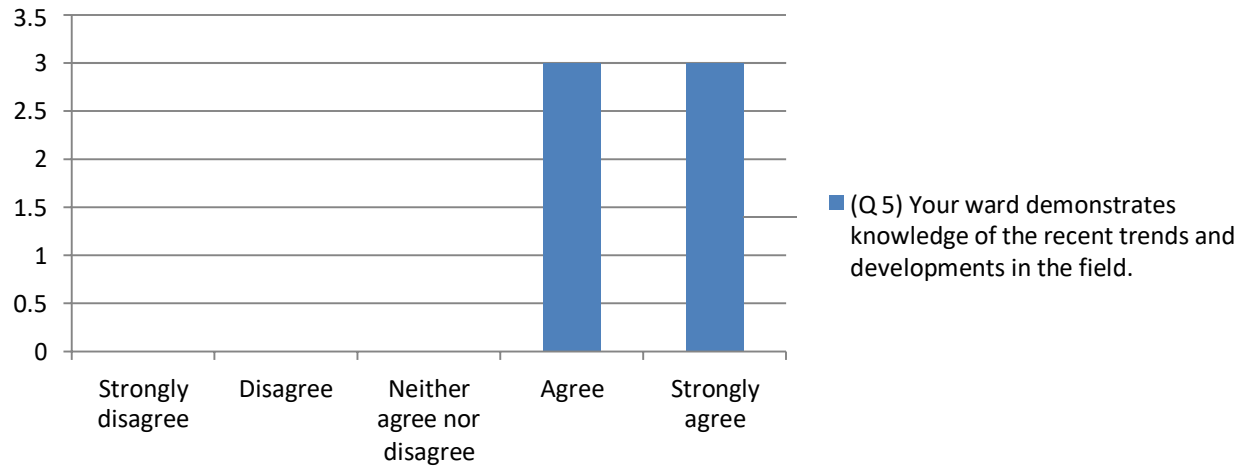




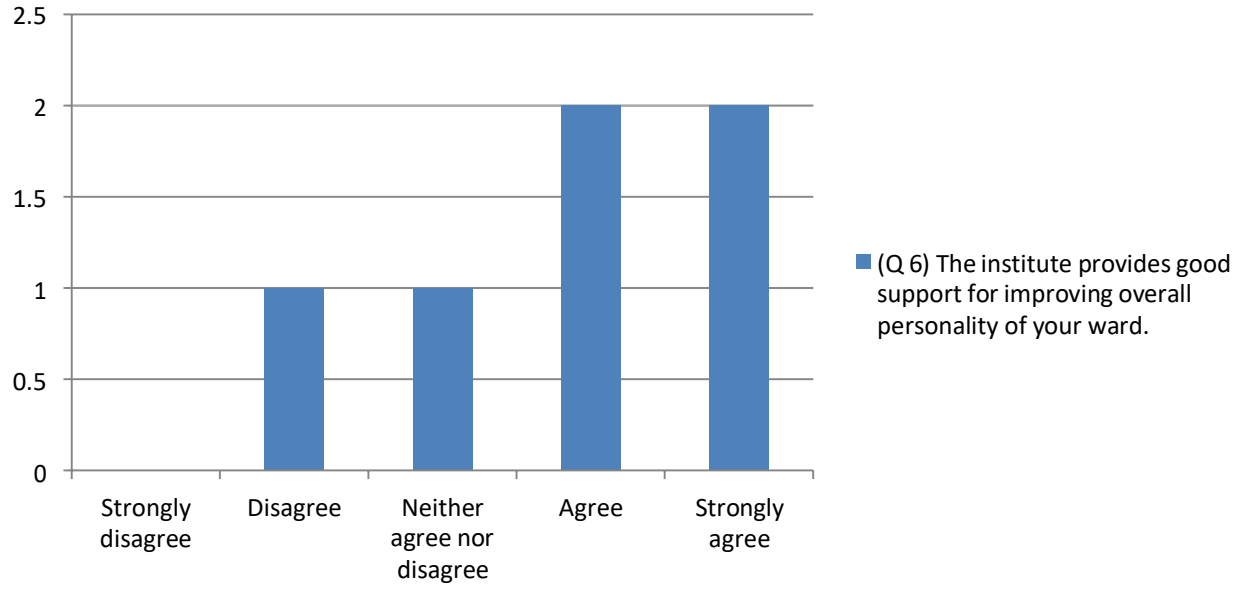

(Q 3) Is any new course to be introduced- to meet current needs & technological changes?
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree
(Q 3) Is any new course to be introduced- to meet current needs & technological changes?

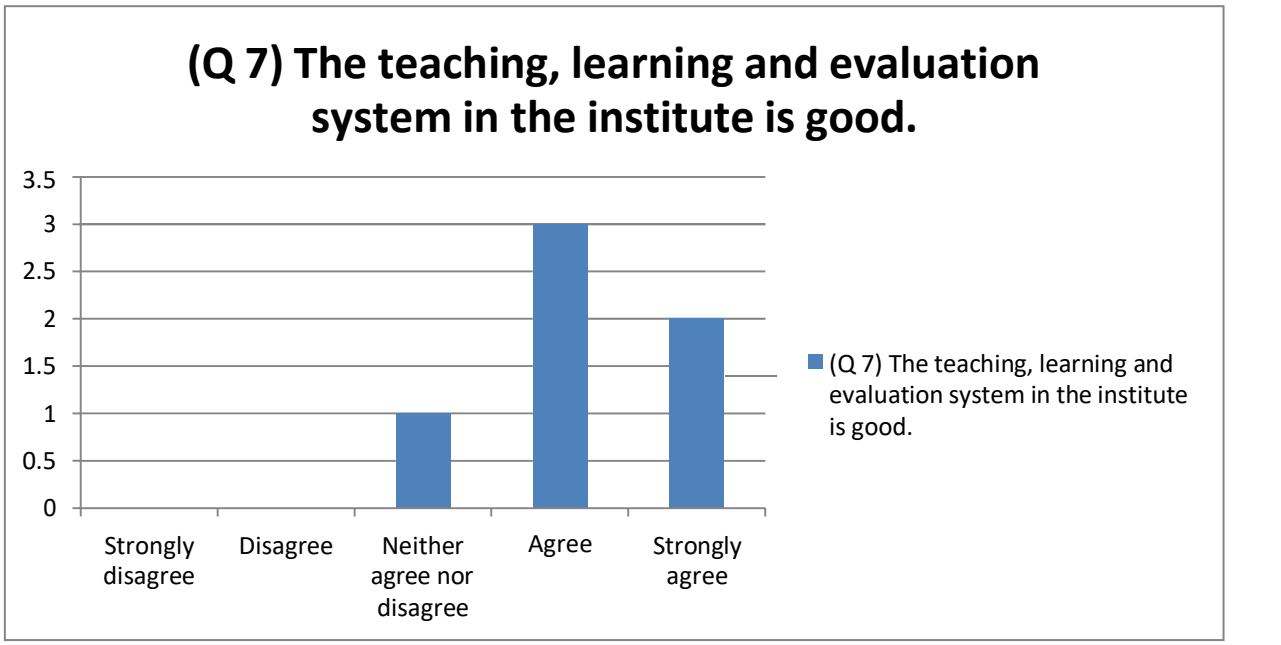

(Q 4) How do you rate the quality and relevance of the courses included in the programme of study.
3.5
3
2.5
2
1.5
1
0.5
0
Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree
(Q 4) How do you rate the quality and relevance of the courses included in the programme of study.

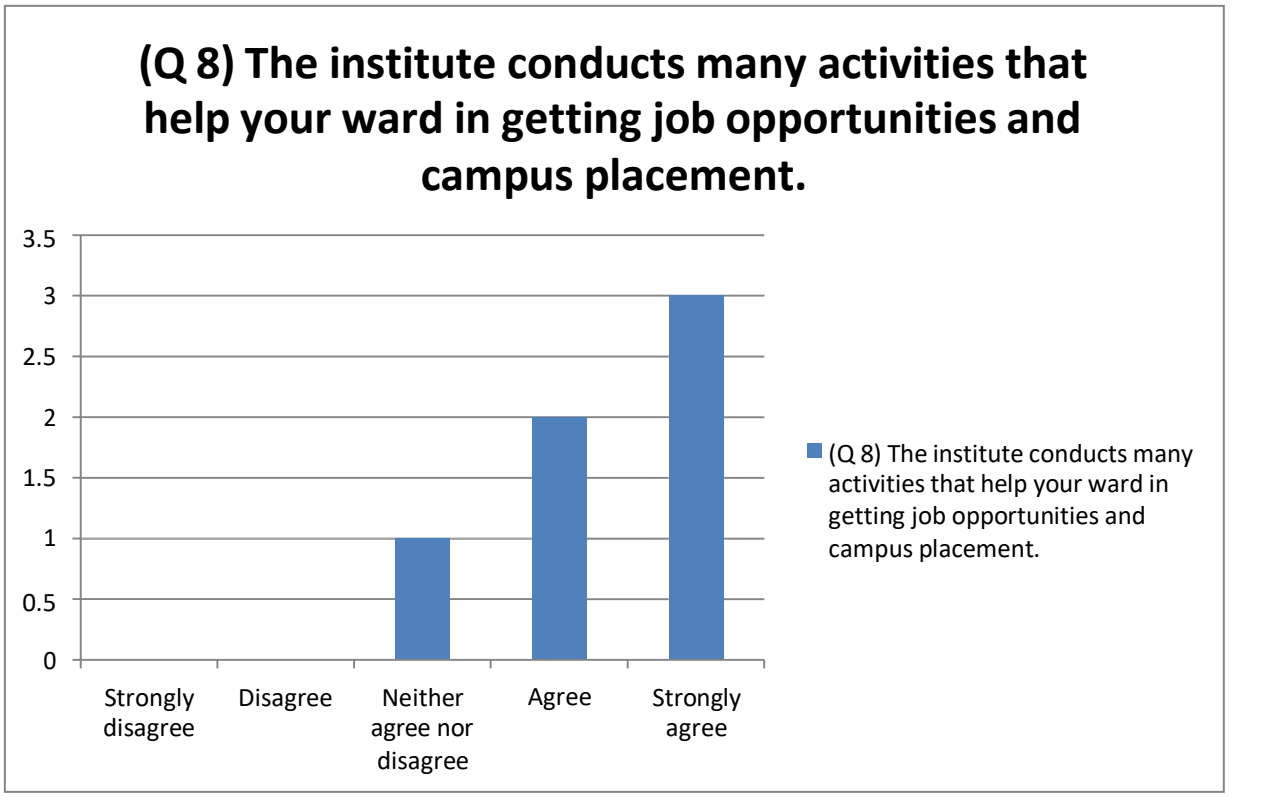
(Q 5) Your ward demonstrates knowledge of the recent trends and developments in the field.

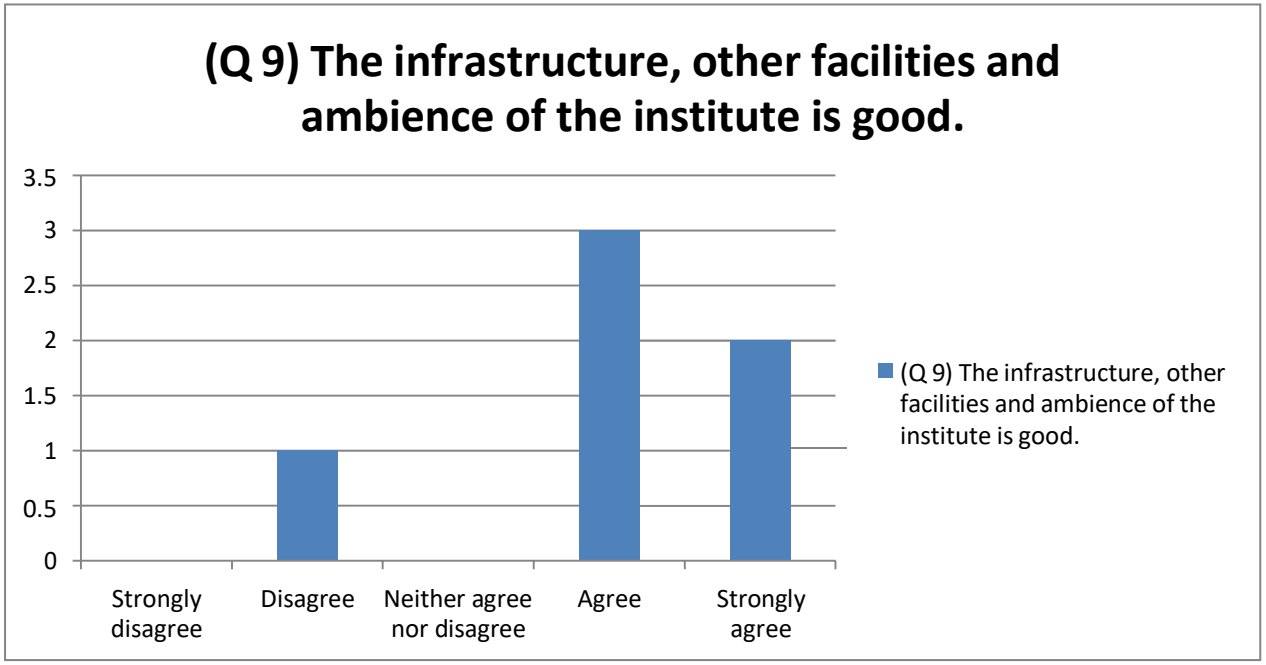


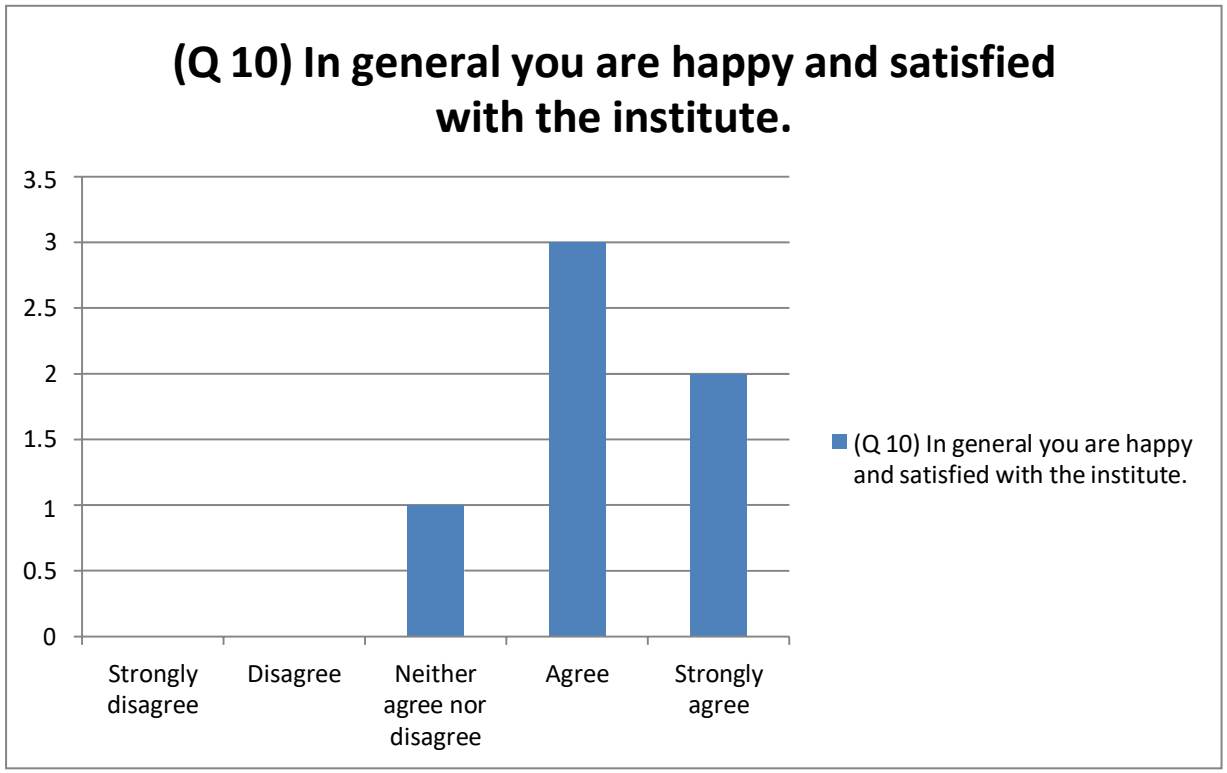
(Q 6) The institute provides good support for improving overall personality of your ward.



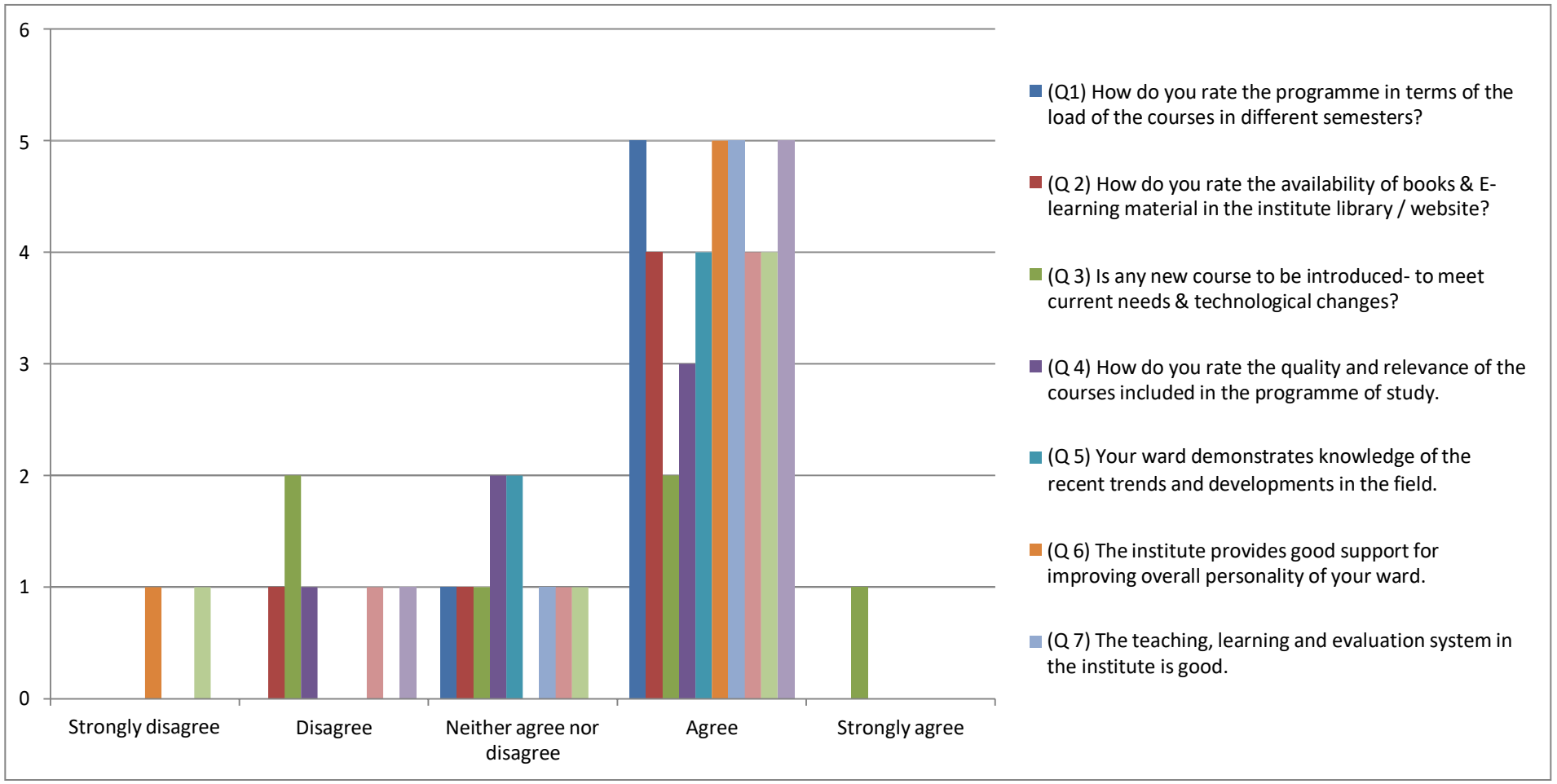

(Q 7) The teaching, learning and evaluation system in the institute is good.
3.5
3
2.5
2
1.5
1
0.5
0
Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree
(Q 7) The teaching, learning and evaluation system in the institute is good.


(Q 8) The institute conducts many activities that help your ward in getting job opportunities and campus placement.
3.5
3
2.5
2
1.5
1
0.5
0
Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree
(Q 8) The institute conducts many activities that help your ward in getting job opportunities and campus placement.


(Q 9) The infrastructure, other facilities and ambience of the institute is good.
3.5
3
2.5
2
1.5
1
0.5
0
Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree
(Q 9) The infrastructure, other facilities and ambience of the institute is good.


(Q 10) In general you are happy and satisfied with the institute.
3.5
3
2.5
2
1.5
1
0.5
0
Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree
(Q 10) In general you are happy and satisfied with the institute.

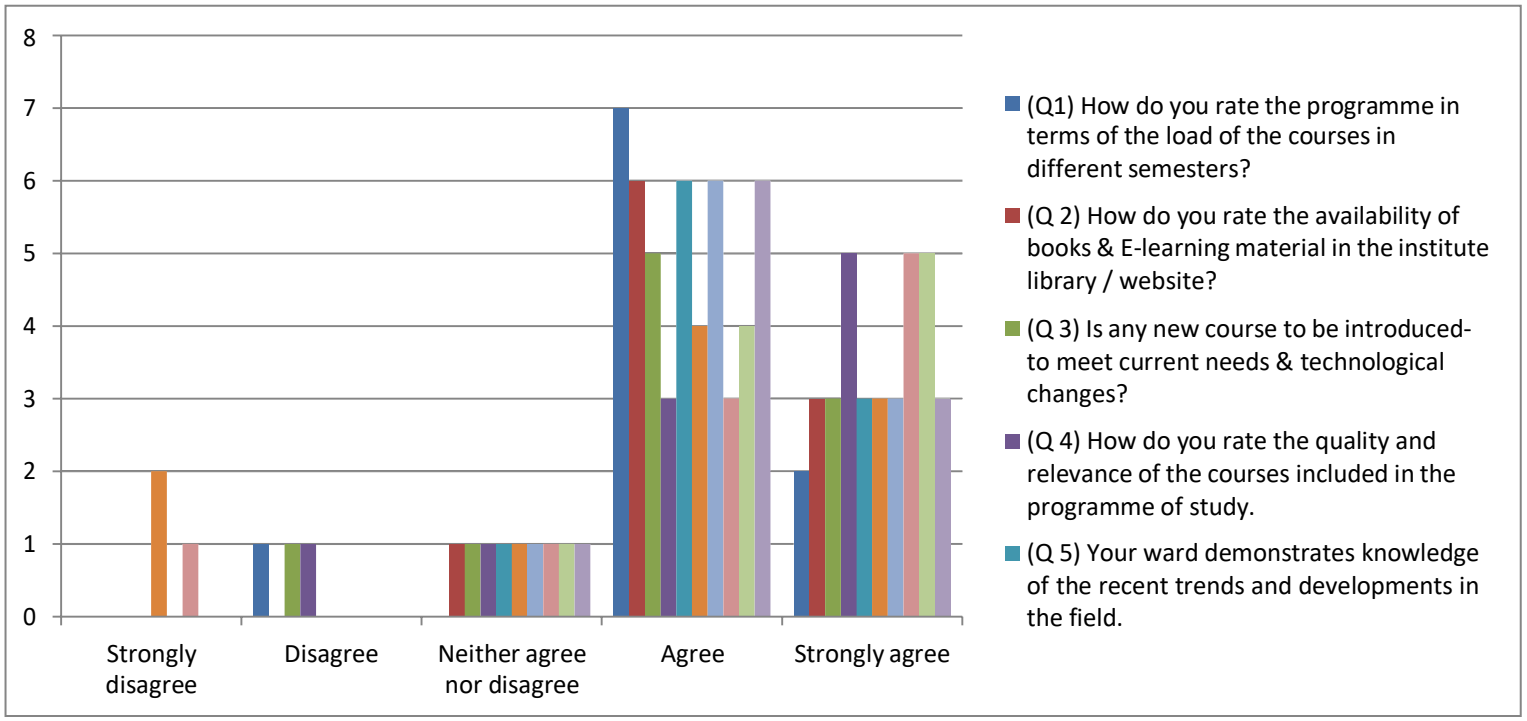
Parent Satisfaction Survey 2nd year 2023 – 24) Sample Size: 06



Summary Sheet Parent Satisfaction survey 2nd year (2023– 24) Sample Size: 6

	(Q1) How do you rate the programme in terms of the load of the courses in different semesters?	(Q 2) How do you rate the availability of books & E-learning material in the institute library / website?	(Q 3) Is any new course to be introduced- to meet current needs & technological changes?	(Q 4) How do you rate the quality and relevance of the courses included in the programme of study.	(Q 5) Your ward demonstrates knowledge of the recent trends and developments in the field.	(Q 6) The institute provides good support for improving overall personality of your ward.	(Q 7) The teaching, learning and evaluation system in the institute is good.	(Q 8) The institute conducts many activities that help your ward in getting job opportunities and campus placement.	(Q 9) The infrastructure, other facilities and ambience of the institute is good.	(Q 10) In general you are happy and satisfied with the institute.
Strongly disagree	0	0	0	0	0	0	0	0	1	0
Disagree	0	0	0	0	0	1	1	0	1	1
Neither agree nor disagree	1	3	3	3	1	2	2	4	1	2
Agree	10	5	7	7	7	6	3	6	7	5
Strongly agree	2	5	3	3	5	4	7	3	3	5
Parent Satisfaction Index (PSI)	**4.08**	**4.15**	**4.00**	**4.00**	**4.31**	**4.00**	**4.23**	**3.92**	**3.77**	**4.08**

Parent Satisfaction Survey 3rd year 2023 – 24) Sample Size: 10



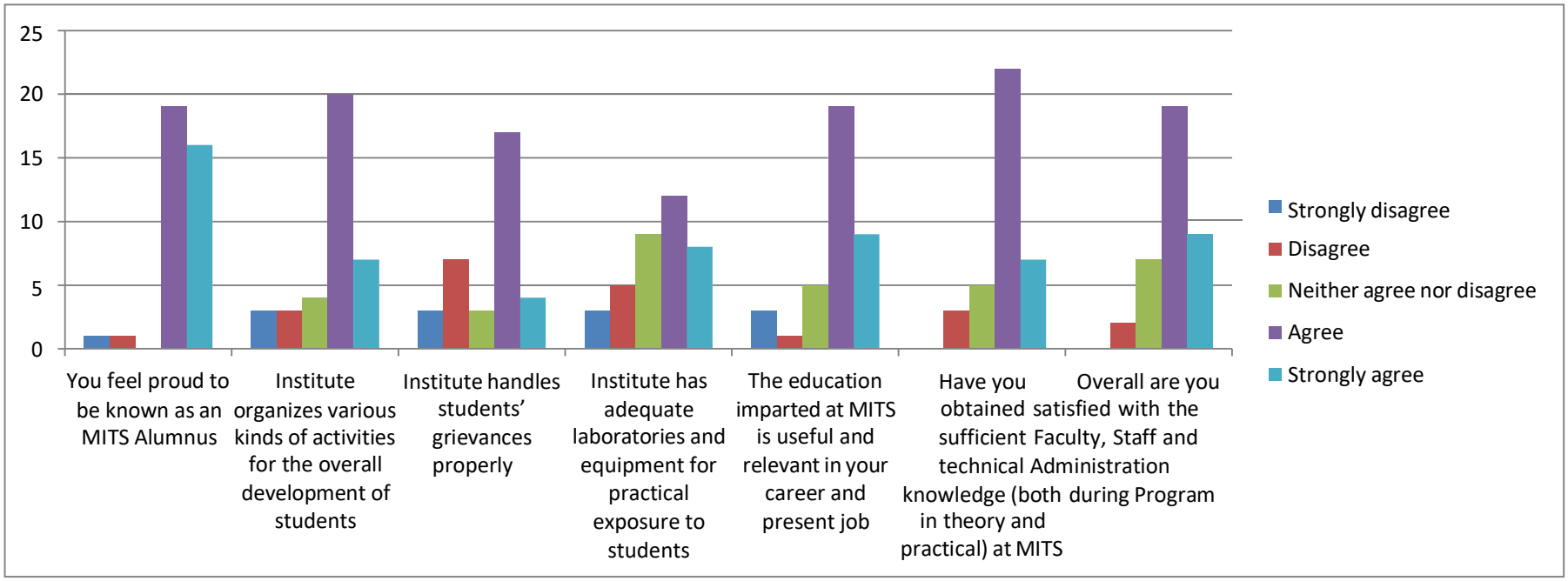
Summary Sheet Parent Satisfaction survey 3rd year (2023 – 24) Sample Size: 10

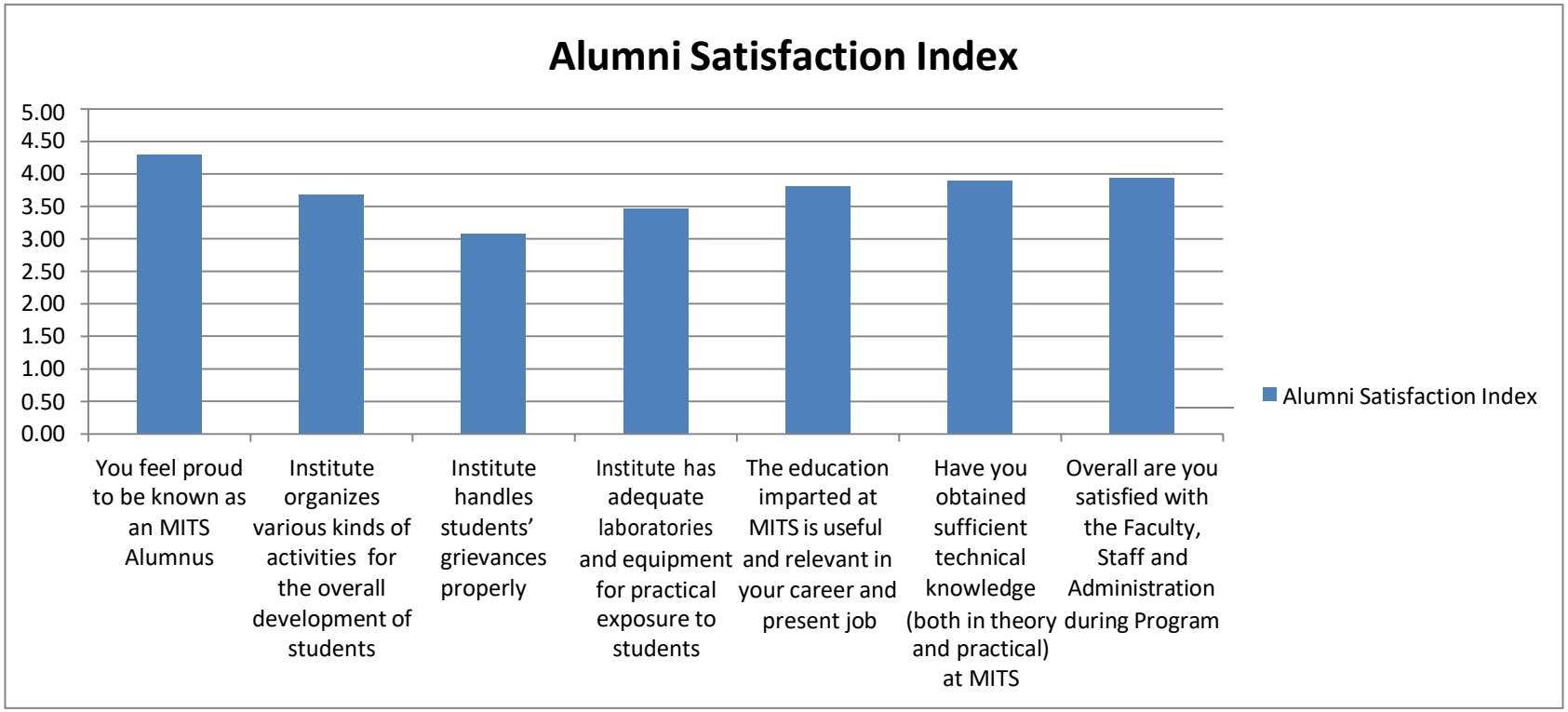
	(Q1) How do you rate the programme in terms of the load of the courses in different semesters?	(Q 2) How do you rate the availability of books & E-learning material in the institute library / website?	(Q 3) Is any new course to be introduced- to meet current needs & technological changes?	(Q 4) How do you rate the quality and relevance of the courses included in the programme of study.	(Q 5) Your ward demonstrates knowledge of the recent trends and developments in the field.	(Q 6) The institute provides good support for improving overall personality of your ward.	(Q 7) The teaching, learning and evaluation system in the institute is good.	(Q 8) The institute conducts many activities that help your ward in getting job opportunities and campus placement.	(Q 9) The infrastructure, other facilities and ambience of the institute is good.	(Q 10) In general you are happy and satisfied with the institute.
Strongly disagree	0	0	0	0	0	2	0	1	0	0
Disagree	1	0	1	1	0	0	0	0	0	0
Neither agree nor disagree	0	1	1	1	1	1	1	1	1	1
Agree	7	6	5	3	6	4	6	3	4	6
Strongly agree	2	3	3	5	3	3	3	5	5	3
Parent Satisfaction Index (PSI)	**4.00**	**4.20**	**4.00**	**4.20**	**4.20**	**3.60**	**4.20**	**4.10**	**4.40**	**4.20**

Alumni Feedback

S. No.	Comments	Action Taken
1.	Revision of syllabus is required	Already discussed and changed in BoS accordingly
2.	Need to particularly focus on practical application rather than teaching theories.	All the faculty members have been instructed to discuss the theory with some practical applications in their respective courses.
3.	Availability of Books in Library	The Library officer has been informed about the situation and also shared the list of Books.
4.	Department should have a regular industrial visits.	Department is exploring opportunity related to conduction of industrial visit.

ALUMNI SATISFACTION SURVEY: (2023-2024): Sample Size: 37




Alumni Satisfaction Index
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
You feel proud to be known as an MITS Alumnus
Institute organizes various kinds of activities for the overall development of students
Institute handles students' grievances properly
Institute has adequate laboratories and equipment for practical exposure to students
The education imparted at MITS is useful and relevant in your career and present job
Have you obtained sufficient technical knowledge (both in theory and practical) at MITS
Overall are you satisfied with the Faculty, Staff and Administration during Program
Alumni Satisfaction Index

SUMMARY SHEET (Alumni Satisfaction Survey) Sample Size: 37

Parameter (Average grading)	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Alumni Satisfaction Index
You feel proud to be known as an MITS Alumnus	1	1	0	19	16	**4.30**
Institute organizes various kinds of activities for the overall development of students	3	3	4	20	7	**3.68**
Institute handles students' grievances properly	**3**	7	3	17	4	**3.08**
Institute has adequate laboratories and equipment for practical exposure to students	3	5	9	12	8	**3.46**
The education imparted at MITS is useful and relevant in your career and present job	3	1	5	19	9	**3.81**
Have you obtained sufficient technical knowledge (both in theory and practical) at MITS	0	3	5	22	7	**3.89**
Overall are you satisfied with the Faculty, Staff and Administration during Program	0	2	7	19	9	**3.95**

Alumni Satisfaction Index (ASI) (on a scale of 5) (5: Excellent, 4: Very Good, 3: Good, 2: Fair, 1: Poor)

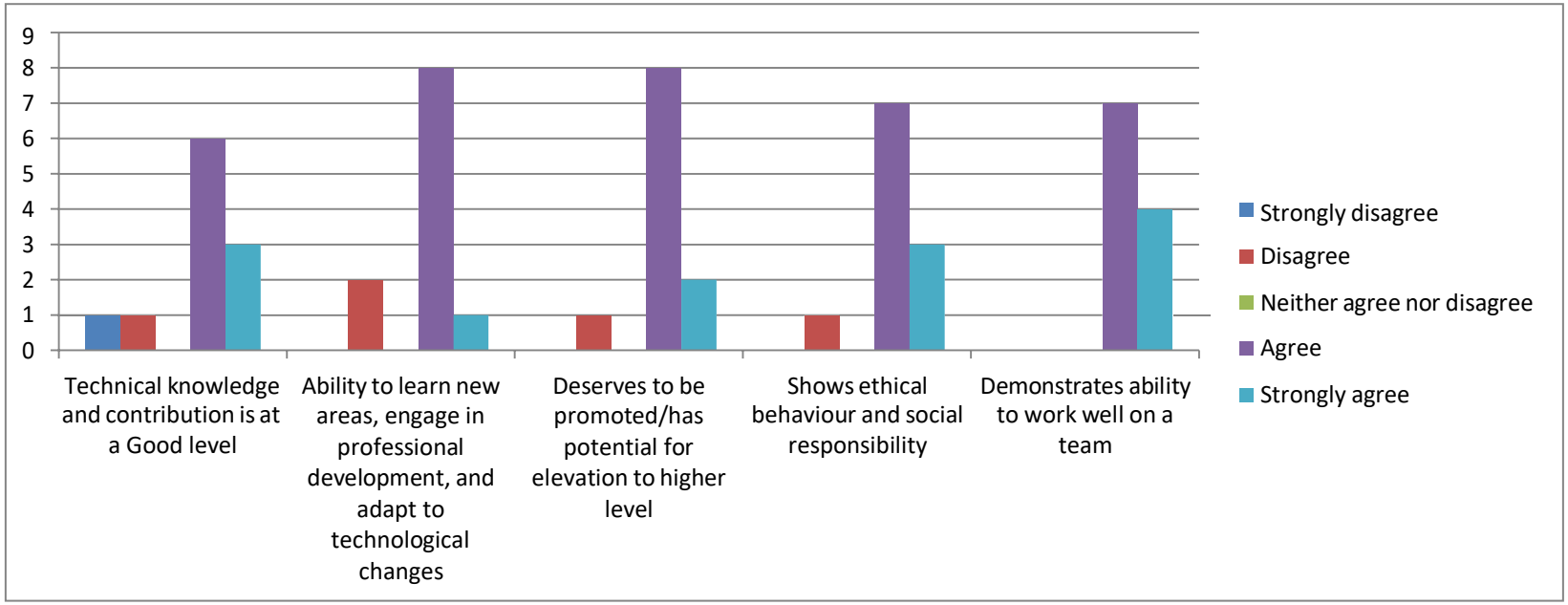
Details of Alumni who gave Feedback

S. No.	Name	Organization	Mail id	Phone No.
1.	Udit Singh Rajput	Pulsus Healthcare Pvt. Ltd.	rajputudit25sep@gmail.com	7999886247
2.	Kakul Joshi	DCM Shriram Rayons	skakul374@gmail.com	8109860434
3.	Vivek Singh	Lupin Limited	Vivek.singh0797@gmail.com	8153043120
4.	Sourabh Kumar Shrivastava	GACL-NALCO Alkalies And Chemicals	subh.mits88@gmail.com	-
5.	Indraneel Nandi	KBR technology	indraneel.nandi@gmail.com	9911345984
6.	Radhika Paliwal	Streamingo.ai	paliwalradhika162@gmail.com	8963914208
7.	Soniya Markam	CSIR-NML jamshedpur	Soniyamarkam397@gmail.com	9425993239
8.	Akshar Pandey	SRF Ltd	aksharpandey88@gmail.com	7814687561
9.	Lokesh Singh kisroliya	Industry	Lokeshsinghkisroliya@gmail.com	7987484361
10.	Kunjbihari Katare	Orient cement limited	kunjkatare@yahoo.co.in	7000310430
11.	Hemang Mahajani	Accenture Solutions	Hemangmahajani09@gmail.com	9039633225
12.	Mukesh Sharma	Ginni International Limited	mukesh9867436784@gmail.com	9920750749
13.	Manish Gupta	Detox India Private Limited (Veolia Water)	Manishgptind@gmail.com	7047292846
14.	Shahid mansoori	Industry	shahidcool7786@gmail.com	7869266446
15.	Rahul Gosavi	Indian Oil Corporation Limited,Panipat Refinery	rahul_goswami5@rediffmail.com	9729397138
16.	Aditya Rao	Great Galleon Ventures Ltd.	adityarao2575@gmail.com	8770262082
17.	Ritu Ranjan	Dishman carbogen amcis ltd	ritu.ranjan.che16@gmail.com	9304162778
18.	Gajendra Kushwah	National fertilizer limited	gd.kushwah03@gmail.com	7772954279
19.	Imrat bihuniya	-	noddyy24@gmail.com	8839907713
20.	Abhishek Gupta	Ion Exchange	abhishek40122@gmail.com	9630882244
21.	Shivangi Sharma	Jiwaji university	shivangi887@gmail.com	8370039690
22.	Tushar Maheshwari	BORL	tshrmaheshwari@gmail.com	8109692396
23.	Himanshu Jain	LUPIN limited	himanshujain046@gmail.com	9770261004

Employer Feedback

S. No.	Comments	Action Taken
1.	They must focus on the core rather making aware about other subjects	Courses are offered according NEP
2.	The courses offered are only relevant upto a certain level there should be a proper commencement of newly technologies introduced in the industries then only we can make graduates ready for an industry. They must taught about the ethics and principles which one should follow while working inside the chemical industries.	New Technology and Industry related course already offered in flexible curriculum.
3.	Must include an optional course on chemical/industrial operations which are practiced in different process industries.	Some Such courses are offered on NPTEL platform under DE
4.	Need some courses on finance as well. Data science is an emerging field an exposure of that will be beneficial.	Regarding this Provision is there in open category courses.
5.	If possible, addition of 2-3 months of internship or practising of students in multiple industries to get contemporary knowledge in industrial operations.	Students get industrial (1 month) visit after 6^{th} sem and during 8^{th} sem most of the students are engaged with industrial internship (4-6months)

EMPLOYER SATISFACTION SURVEY: (2023-2024): Sample Size: 11




Employer Satisfaction Index
4.6
4.4
4.2
4
3.8
3.6
3.4
Technical knowledge and contribution is at a Good level
Ability to learn new areas, engage in professional development, and adapt to technological changes
Deserves to be promoted/has potential for elevation to higher level
Shows ethical behaviour and social responsibility
Demonstrates ability to work well on a team
Employer Satisfaction Index

SUMMARY SHEET (Employer Satisfaction Survey) Sample Size: 11

Parameter (Average grading)	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Employer Satisfaction Index
Technical knowledge and contribution is at a Good level	1	1	0	6	3	3.82
Ability to learn new areas, engage in professional development, and adapt to technological changes	0	2	0	8	1	3.73
Deserves to be promoted/has potential for elevation to higher level	0	1	0	8	2	4.00
Shows ethical behaviour and social responsibility	0	1	0	7	3	4.09
Demonstrates ability to work well on a team	0	0	0	7	4	4.36

Parameter (Average grading)	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Employer Satisfaction Index
Technical knowledge and contribution is at a Good level	1	0	0	6	2	**3.89**
Ability to learn new areas, engage in professional development, and adapt to technological changes	0	1	0	7	1	**3.89**
Deserves to be promoted/has potential for elevation to higher level	0	0	0	7	2	**4.22**
Shows ethical behaviour and social responsibility	0	1	0	5	3	**4.11**
Demonstrates ability to work well on a team	0	0	0	5	4	**4.44**
Employer Satisfaction Index (ESI) (on a scale of 5) (5: Excellent, 4: Very Good, 3: Good, 2: Fair, 1: Poor)						

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(Deemed to be University)

NAAC Accredited with A++ Grade

ITEM -23

Any other matter

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(Deemed to be University)
NAAC Accredited with A++ Grade

As per the instructions received from the Dean (Academics), the SWAYAM-NPTEL course on **"Natural Hazards"** was included as an Open course (OC-3) in the B. Tech. VIII Semester, Chemical Engineering scheme for the 2020 admitted students only for B. Tech Civil Engg students during the Jan – June 2024 semester.