माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर
MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
Deemed University
(Declared under Distinct Category by Ministry of Education, Government of India)
NAAC ACCREDITED WITH A++ Grade
Gola Ka Mandir, Gwalior (M.P.)- 474005, INDIA
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BoS Meeting

Chemical Engg. Department

6 December 2024

Item CM 1	To confirm the minutes of previous BoS meeting held in the month of May-June 2024.

The minutes of the previous Board of studies (BoS) meeting held on27/05/2024 (Through Google Meet) were confirmed.

Item CM 2	**To propose the scheme structure of VIII Semester with the provision of ONE DE & ONE OC course to be offered in online mode with credit transfer for the batch admitted in academic year 2021-22. (The total credits from I-VIII semester should not be less than 160 for this batch).**

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Department of Chemical Engineering

Scheme of Evaluation

B. Tech. VIII Semester *(for batch 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			
				End Sem. Exam.	$Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment		Lab work & Sessional	Skill Based Mini Project									
1.	DE	DE	Departmental Elective* (DE-5)	-	-	-	-	-	-	-	25	75	100	3	-	-	3	**Online**	MCQ
2.	OC	OC	Open Category* (OC-3)	-	-	-	-	-	-	-	25	75	100	3	-	-	3	**Online**	MCQ
3.	170811	DLC	Internship/Research Project/ Innovation & Start-up	-	-	-	-	250	150	-	-	-	400	-	-	18	9	**Blended**	SO
4.	170812	-	Professional Development#	-	-	-	-	50	-	-	-	-	50	-	-	4	2		
Total				-	-	-	-	**300**	**150**	-	**50**	**150**	**650**	**6**	-	**22**	**17**	-	-
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 **PP:** Pen Paper **SO:** Submission + Oral

*All of these courses will run through SWAYAM/NPTEL/ MOOC with credit transfer

Evaluation will be based on participation/laurels brought by the students to the institution in national/state level technical and other events during the complete tenure of the UG programme (participation in professional chapter activities, club activities, cultural events, sports, personality development activities, collaborative events, MOOCs, technical events, institute/department)

*DE-5 (SWAYAM/NPTEL/ MOOC platform)		*Open Category (OC-3) (SWAYAM/NPTEL/ MOOC platform) (For students of other branches)	
170861	Chemical Reaction Engineering -II	**910323**	Environmental Quality Monitoring & Analysis
170862	Biomass Conversion and Biorefinery	**910324**	Electrochemical Technology in Pollution Control
170863	Chemical Process Utilities		

Mode of Teaching				Mode of Examination				Total Credits
Theory			Lab	Theory			Lab	
Offline	Online	Blended	Offline	PP	AO	MCQ	SO	
-	06	-	11	-	-	06	11	17
–	35.29%	-	64.71%	-	-	35.29%	64.71%	Credits %

Item CM3	To propose the list of courses which the students can opt from SWAYAM/NPTEL/ other MOOC Platforms/ Institution (MITS) MOOC, to be offered in online mode under **Departmental Elective (DE) category courses (DE-5) and open category (OC3)** for credit transfer in the **VIII Semester** under the flexible curriculum (**Batch admitted in academic year 2021-22)**

The list of courses which the students can opt from SWAYAM/NPTEL/ other MOOC Platforms/ Institution (MITS) MOOC, to be offered in online mode under **Departmental Elective (DE) category courses (DE-5) and open category (OC3)** for credit transfer in the **VIII Semester** under the flexible curriculum (**Batch admitted in academic year 2021-22)**

***DE-5 (SWAYAM/NPTEL/ MOOC platform)**		***Open Category (OC-3) (SWAYAM/NPTEL/ MOOC platform) (For students of other branches)**	
170861	Chemical Reaction Engineering -II	**910323**	Environmental Quality Monitoring & Analysis
170862	Biomass Conversion and Biorefinery	**910324**	Electrochemical Technology in Pollution Control
170863	Chemical Process Utilities	-	

Item CM 4	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. VIII semester students (for the batch admitted in 2021-22)] and for B.Tech. VI semester (for the batch admitted in 2022-23)]**

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. VIII semester students (for the batch admitted in 2021-22)] and for B.Tech. VI semester (for the batch admitted in 2022-23)]

S.No.	Purpose	Name of Course
1.	For Minor Specialization (Others Department) (VIII Semester)	Inorganic Chemical Technology
		Chemical Engineering Thermodynamics
		Momentum Transfer in Fluids
2.	For Minor Specialization (Others Department) (VI Semester)	Chemical Process Technology
		Membrane Technology
		Basic Principles and Calculations in Chemical Engineering

ChemicalEngineering (6TH Semester)

Tracks	Energy Engineering	Separation Processes	Unit Operations	Polymer Technology	Environmental Engineering
S.No.	**Courses**	**Courses**	**Courses**	**Courses**	**Courses**
1	Renewable Energy Engineering: Solar, Wind And Biomass Energy Systems (12 weeks)	Biological process design for waste water treatment (8 Weeks)	Chemical Engineering Fluid Dynamics and Heat Transfer (12 weeks)	Polymer Reaction Engineering (12 weeks)	Industrial Wastewater Treatment (12 weeks)
2	Waste to Energy Conversion (8 Weeks)	Physico-chemical processes for wastewater treatment (12 weeks)	Thermodynamicmics of Fluid Phase Equilibria (8 Weeks)	Characterization n of Polymers, Elastomers and Composites (12 weeks)	Environmental Quality Monitoring & Analysis (12 weeks)

Chemical Engineering (8TH Semester)

Tracks	Energy Engineering	Separation Processes	Unit Operations	Polymer Technology	Environmental Engineering
S.No.	Courses	Courses	Courses	Courses	Courses
1	Carbon Materials and Manufacturing (12 Weeks)	Bioreactor Design and Analysis (8Weeks)	Cooling Technology: Why and How utilized in Food Processing and allied Industries (12 Weeks)	Plastic Waste Management (8 Weeks)	Air Pollution and Control (12 Weeks)
2	Clean Coal Technology (12 Weeks)	Soft Nano Technology (8 Weeks)	Food Science and Technology (12 Weeks)	Processing of Polymers and Polymer Composites (8 Weeks)	Environmental Chemistry and Microbiology (12 Weeks)
3.	Cryogenic Hydrogen Technology (8 Weeks)	-	-	-	-

Item 5	To review and finalize the **scheme structure of B.Tech VI Semester under** the flexible curriculum **(Batch admitted in 2022-23)**

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Department of Chemical Engineering Scheme of Evaluation

B.Tech. VI Semester *(for batch 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	$^{\$\$}$Mode Of Exam.
				Theory Slot				Practical Slot			MOOCs			L	T	P			
				End Term Evaluation		Continuous Evaluation		End Sem .Exam.	Continuous Evaluation		Assignment	Exam							
				End Sem. Exam.	$^{\$}$Proficiency In subject /course	Mid Sem .Exam.	Quiz/Assignment		Lab work & Sessional	Skill Based Mini Project									
1.	2170615	DC	Process Modeling& Simulation	50	10	20	20	60	20	20	-	-	200	2	-	2	3	Blended	PP
2.	2170616	DC	Process Equipment Design	50	10	20	20	-	-	-	-	-	100	3	-	-	3	Blended	AO
3.	DE	DE	Departmental Elective* (DE-1)	-	-	-	-	-	-	-	25	75	100	3	-	-	3	Online	MCQ
4.	OC	OC	Open Category (OC1)**	50	10	20	20	-	-	-	-	-	100	3	-	-	3	Blended	MCQ
5.	2170617	MC	Artificial Intelligence & Machine Learning	50	10	20	20	60	20	20	-	-	200	3	-	2	4	Blended	MCQ
6.	2170618	DLC	Minor Project-II**	-	-	-	-	60	40	-	-	-	100	-	-	4	2	Offline	SO
7.	200XXX	CLC	Novel Engaging Course (Informal Learning)	-	-	-	-	50	-	-	-	-	50	-	-	2	1	Blended	SO
8.		NSS	*Natural Sciences & Skills	200	40	80	80	120	40	40	-	-	600	1	-	2	2*	-	-
Total				400	40	80	80	350	120	80	25	75	1450	16	-	12	21	-	-
8.	1000007	MAC	Intellectual Property Rights (IPR)	50	10	20	20	-	-	-	-	-	100	2	-	-	GRADE	Online	MCQ
Summer Internship-III (On Job Training) for Four weeks duration: Evaluation in VII Semester																			
Additional Course for Honours or minor Specialization				Permitted to opt for maximum two additional courses for the award of Honours or Minors pecialization															

***Natural Sciences& Skills: Engineering Physics / Engineering Chemistry / Environmental Science/ Language**

("Natural Sciences & Skills" treated as Mandatory Audit Courses from first to fourth semester and cumulative marks converted as a cluster of credits and awarded in the VI semester)

$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

***CourserunthroughSWAYAM/NPTEL/MOOCLearningBasedPlatformwithcredittransfer**

****The minor project-II may be evaluated by an internal committee for awarding sessional marks.**

*DE-1(SWAYAM/NPTEL/MOOC platform)		**Open Category (OC-1)(For students of other branches)	
2170661	Multiphase Flow		Fuels & Combustion (PP)
2170662	Membrane Technology		
2170663	Physical and Electrochemical Characterizations in Chemical Engineering		

Mode of Teaching				Mode of Examination				Total Credits
Theory			Lab	Theory			Lab	
Offline	Online	Blended	Offline	PP	AO	MCQ	SO	
-	03	12	06	03	03	09	05	21
-	14.28	57.14	28.57	14.28	14.28	42.85	23.80	Credits %

Item 6	To review & finalize the **syllabi for all Departmental Core Courses (DC)** of **B. Tech VI Semester (for batch admitted in 2022-23)** under the flexible curriculum along with their COs.

To review & finalize the syllabi for all Departmental Core Courses (DC) and Mandatory Course (MC) of B. Tech VI Semester (for batch admitted in 2022-23) under the flexible curriculum along with their COs.

Departmental Core (DC) Courses of VI Semester

2170615: PROCESS MODELING AND SIMULATION

Category	Title	Code	Credit-3			Theory Paper
Departmental Core	PROCESS MODELING AND SIMULATION	2170615	L	T	P	Max.Marks-50 Duration-2hrs.
			3	-	-	

Course Objectives: To provide an adequate knowledge of modeling in chemical engineering process system and to develop solutions for these models.

Syllabus

Unit I Modelling Role & Analysis: Chemical Engineering Problems, Basic concepts of analysis, the analysis process, a simple example of estimating an order, Source of the model equations, Conservation equations, Constitutive equations, Control volumes, Dimensional analysis, System of units, Dimensional consistency in mathematical descriptions, Dimensional analysis and constitutive relationships, Final observations.

Unit II Non-Reacting and Reacting Liquid Systems: Introduction, Equation of continuity, Simple mass balance, Application of the model equations, Component mass balances, Model behavior, Steady state and unsteady state behavior, density assumptions, Numerical integration methods of ordinary differential equation. **Reacting Liquid Systems:** Introduction, basic model equations for a Tank-Type reactor, the reaction rate, the batch reactor, Pseudo First-order reactions, Reversible reactions, **Multiple reactions:** consecutive reactions, parallel reactions, complex reactions, constant density assumption, order and stoichiometry.

Unit III Treatment of Experimental Data: Introduction, Criteria for Best Fit, Best Slope-I, Best Slope-II, Best straight line, Physical property correlations, Fitting a quadratic, Simulation examples of gravity fluid flow, heat and mass transfer, Monte-Carlo simulation.

Unit IV Dynamic Modeling of Simple Processes: Sequential, Simultaneous modular and equation oriented approaches, Partitioning and tearing.

Unit V Computer Programming of Various Processes: Iterative convergence methods such as Newton- Raphson, False position, Wegstein, Muller methods.

Course Outcomes:

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

CO1: **Explain** the basic concepts involved in process analysis & simulation.
CO2: **Formulate** a chemical engineering problem as a mathematical model from basic engineering principles.
CO3: **Apply** the conservation equations in various physico – chemical systems.
CO4: **Analyze** the experimental data for further processing.
CO5: **Compare** iterative convergence methods and numerical solution of ODEs.
CO6: **Analyze** different approaches involved in dynamic modeling of process systems.

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

Text Books

1. W.L. Luyben, “Process Modeling Simulation and Control for Chemical Engineers”, McGraw Hill
2. T.W.F. Russell, “Introduction to Chemical Engineering Analysis”, John Wiley & Sons New-York
3.

Reference Books

1. Ismail Tosun, “Modeling in Transport Phenomena-A Conceptual Approach”, Elsevier Publications
2. A.K. Jana,“Chemical Process Modeling & Computer Simulation”, PHI learning PrivateLtd
3. M.E. Davis, “Numerical Methods and Modeling for Chemical Engineers”, Wiley, NewYork

2170616: PROCESS EQUIPMENT DESIGN

Category	Title	Code	Credit-3			Theory Paper
Departmental Core	PROCESS EQUIPMENT DESIGN	2170616	L	T	P	Max.Marks-50 Duration-2hrs.
			3	-	-	

Course Objective:

The objective of this course is to acquire basic understanding of design parameter, complete knowledge of design procedures for commonly used process equipment.(e.g. evaporator, flash drum, cooling tower, etc.).

Syllabus

Unit I Scale up and scale down of chemical process equipment. Process design calculations for heat exchanges equipment shell and tube heat exchangers general description, heat transfer coefficients and pressure drop by Kern's & Bells methods rating on existing unit.

Unit II Design of a new system having one or more units in series: single effect evaporation, Multiple effect evaporator with boiling point elevation.

Unit III Process design calculations for mass exchange equipment plate (tray) and packed column for distillation and absorption including column diameter and height.

Unit IV Detailed process and mechanical design, Flash drum, Kettle reboiler, Condenser, cooling tower, rotary drier.

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

CO1: **Discuss** the aspects of design, flowsheets and scaleup in chemical plant design
CO2: **Design** heat exchangers by selecting a suitable method
CO3: **Determine** the property values at various process conditions.
CO4: **Analyze** the final design parameters in any process design.
CO5: **Choose** between different methods employed in design calculations & designs available for specific equipment.
CO6: **Formulate** rules of thumb to decide parameters encountered in process design.

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

Suggested Reading:

1. Dawande, S.D., “Process Design of Equipments”, Central Techno Publications, Nagpur, 2000
2. R. H. Perry, "Chemical Engineers' Handbook", 7th Edn., McGraw Hill , NewYork, 1998.
3. R. K. Sinnott, "Chemical Engineering Design", Coulson and Richardson’s Chemical Engineering Series, Volume-6, Fourth Edition, Butterwoth-Heinemann, Elsevier, NewDelhi,2005.
4. D.Q. Kern “Process Heat Transfer”, Tata McGraw Hill Edn.,2004.
5. Chemical Engg. Vol-6 By Coulson J. M. Richardson

2170617 ARTIFICIAL INTELLIGENCE & MACHINELEARNING

COURSE OBJECTIVES:

1. To provide the fundamental knowledge of Artificial Intelligence, Neural Network and Machine Learning.
2. To present the basic representation and reasoning paradigms used in AI &ML.
3. To understand the working of techniques used in AI &ML.

Unit – I:

Introducing Artificial Intelligence: Definition,Goals of AI, Task of AI, Computation, Psychology and Cognitive Science. Perception, Understanding, and Action. Artificial intelligence vs machine learning vs deep learning and other related fields. Applications of Artificial intelligence and Machine Learning in the real world.

Unit – II:

Problem, Problem Space and Search:

Production System, Blind Search: BFS & DFS, Heuristic Search, Hill Climbing, Best First Search

Introduction to Neural Networks:

History, Biological Neuron, Artificial Neural Network, Neural Network Architectures, Classification, & Clustering

Unit – III:

Introduction to Machine Learning: Traditional Programming vs Machine learning. Key Elements of Machine Learning: Representation, process (Data Collection, Data Preparation, Model selection, Model Training, Model Evaluation and Prediction), Evaluation and Optimization. Typesof Learning: Supervised, Unsupervised and reinforcement learning. Regression vs classification problems.

Unit – IV:

Supervised Machine Learning: Linear regression: implementation, applications & performance parameters. Decision tree classifier, terminology, classification vs regression trees, tree creation with Gini index and information gain, IDE3 algorithms, applications and performance parameters.Random forest classifier.Case study on regression and classification for solving real world problems.

Unit –V:

Unsupervised Machine Learning: Introduction, types: Partitioning, density based, DBSCAN, distribution model-based, hierarchical, Agglomerative and Divisive, Common Distance measures, K-means clustering algorithm. Case study on clustering for solving real world problems.

COURSE OUTCOMES: After completing the course, the student will be able to:
CO1: **Explain** basics of Artificial Intelligence & Machine Learning.
CO2: **Discuss** techniques for search and processing.
CO3: **Describe** types of machine learning problems and techniques.
CO4: **Analyze** various techniques in Artificial Intelligence & Machine Learning.
CO5: **Apply** AI and ML techniques to solve real world problems.
CO6: **Build** AI enabled intelligent systems for solving real world problems.

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

RECOMMENDED BOOKS:

1. Artificial Intelligence: A Modern Approach by Stuart J. Russell and Peter Norvig, PrenticeHall.
2. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-GrawHill.
3. Introduction to AI & Expert System: Dan W. Patterson,PHI.
4. Pattern Recognition and Machine Learning, Christopher M.Bishop
5. Introduction to Machine Learning using Python: Sarah Guido
6. Machine Learning in Action: Peter Harringto

1000007 INTELLECTUAL PROPERTY RIGHTS

(Offered by Humanities Department: MC)

1000007	Intellectual Property Rights	Theory	Midterm	Quiz/Assignment	TOTAL	L	T	P	C
		70	20	10	100	2	-	-	02

COURSE OBJECTIVES

- To acquaint the learners with the basic concepts of Intellectual Property Rights.
- To develop expertise in the learners in IPR related issues and sensitize the learners with emerging issues in IPR and the rationale for the protection of IPR.

UNIT – I: Introduction

Introduction to IPRs, Basic concepts and need for Intellectual Property – Meaning and practical aspects of Patents, Copyrights, Geographical Indications, IPR in India and Abroad. Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT – II: Intellectual Property Rights

The IPR tool kit, Patents, the patenting process, Patent cooperation treaties: International Treaties and conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT – III: Intellectual Property Protections

IPR of Living Species, protecting inventions in biotechnology, protections of traditional knowledge, biopiracy and documenting traditional knowledge, Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection. **Case studies: The basmati rice issue, revocations of turmeric patent, revocation of neem patent.**

UNIT – IV: Exercising and Enforcing of Intellectual Property Rights

Rights of an IPR owner, licensing agreements, criteria for patent infringement. Case studies of patent infringement, IPR – a contract, unfair competitions and control, provisions in TRIPs,

UNIT- V: Role of Patents in Product Development & Commercialization

Recent changes in IPR laws impacting patents and copy rights, intellectual cooperation in the science and allied industry. Patentable and non-patentable research. Case studies

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

1. Imbibe the knowledge of Intellectual Property and its protection through various laws
2. apply the knowledge of IPR for professional development
3. develop a platform for protection and compliance of Intellectual Property Rights & knowledge
4. create awareness amidst academia and industry of IPR and Copyright compliance
5. deliver the purpose and function of IPR and patenting.

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

References

1. P.B. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy. Tata Mc Graw Hill, 2001. Steve Smith, The Quality Revolution.1st ed., Jaico Publishing House, 2002.
2. Kompal Bansal and Praishit Bansal. Fundamentals of IPR for Engineers, 1st Edition, BS Publications, 2012. Prabhuddha Ganguli. Intellectual Property Rights. 1st Edition, TMH, 2012.
3. R Radha Krishnan & S Balasubramanian. Intellectual Property Rights. 1st Edition, Excel Books, 2012. M Ashok Kumar & Mohd. Iqbal Ali. Intellectual Property Rights. 2nd Edition, Serial Publications, 2011. VinodV. Scople, Managing Intellectual Property. Prentice Hall of India PvtLtd, 2012.
4. Deborah E. Bouchoux. Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets. Cengage Learning, 3rd ed. Edition, 2012.

5. Prabuddha Ganguli. Intellectual Property Rights: Unleashing the Knowledge Economy. McGraw Hill Education, 2011. Edited by Derek Bosworth and Elizabeth Webster.The Management of Intellectual Property. Edward Elgar Publishing Ltd.,2013.

6. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House

Item 7	To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered for batches admitted in 2022-23 **in online mode under Departmental Elective (DE) Course** with credit transfer, **in the VI Semester.**

***DE-1(SWAYAM/NPTEL/MOOC platform)**	
2170661	Multiphase Flow
2170662	Membrane Technology
2170663	Physical and Electrochemical Characterizations in Chemical Engineering

Item 8	To review and finalize the courses & syllabi to be offered (for batch admitted in 2022-23) under the **Open Category (OC) Courses to be offered in traditional mode for B Tech VI semester** of other departments along with their COs.

: Fuels & Combustion

Category	Title	Code	Credit-3			Theory Paper
Open Course I – OC(i)	**Fuels & Combustion**		L	T	P	Max.Marks-50 Duration-2 hrs.
			3	0	0	

Course Objectives:

To understand processing and limitations of fossil fuels (coal, petroleum and natural gas) and necessity of harnessing alternate energy resources such as solar, wind, nuclear, geothermal, tidal and biomass. Also, to understand and practice various characterization techniques for fuels.

Unit-I Solid Fuels: Coal and lignite reserves in India, Classification of coal, washing of coal, analysis of coal, proximate and ultimate analysis**.**

Unit-II Coal Carbonization, Mechanism of low temperature carbonization and high temperature carbonization, by- product recovery from coke oven, properties of coke, coal, grinding, pulverization, briquetting of solid fuels.

Unit-III Liquid Fuels: Origin of Petroleum production, Indian petroleum resources and their nature, Petroleum processing, distillation, cracking- thermal and catalytic, coking, reforming, Isomerization, crude Oil Classification, Reserves of Hydrocarbon in India, Introduction to petroleum refining and processing, atmospheric and vacuum crystallization.

Unit-IV Petroleum product and their utilization, blending of petrol for octane number boosting, Transport fuels: Diesel, Petrol, AVL (Aviation Liquid Fuel), Kerosene, fuel and furnace oil, Testing of petroleum product: Flash Point, pore point, fire point, Octane number, cetane number, viscosity and viscosity index, API.

Unit-V Gaseous fuels: Natural gas, synthetic gases, their composition & properties, producer gas, water gas, coal gas, LPG.

Course Outcomes:

After completion of this course, the student will be
able to CO 1. Explain the origin of fossil fuels

CO 2. Classify fossil fuels and their reserves in India

CO 3. Analyze various alternate energy options available in earth

CO 4. Explain various fuel-processing techniques used in solid, liquid and gaseous fuels

CO5 Assess characterization techniques for fuels

CO6 Compare quality of fuels based on its properties and possible utilization

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

Suggested Reading:

Sarkar S. –FUEL AND COMBUSTION- 2nd ed. ORIENT Longmen, Mumbai, 1996.

Gupta O.P. FUEL & COMBUSTION-3rd ed. Khanna Publishers, New Delhi, 1996.

Francis W. & Peters M. C. – Fuel & Fuel Technology – 2nd Edn., Pergamon, 1980.

Item 9	To review and finalize the **Experiment list/ Lab manual/Skill based mini-project** for all the Laboratory Courses to be offered in **B.Tech.VI semester *(*for batch admitted in 2022-23).**

2170615:ProcessModeling&Simulation Lab

ListofExperiments

1. Process dynamics experiments like flow of incompressible fluids at a variable flow rate.
2. Dynamics of a tank draining through an orifice in the bottom. Differential equation formulation and verification with the experimental data.
3. Mass balance in a tank filling at certain rate and emptying at another rate. Rectangular and wedge-shaped tank and incompressible fluid
4. Modeling a batch reactor-verification of 1st and 2nd order ratekinetics.
5. Counter current double pipe heat exchanger modeling-data analysis by iterative methods.
6. Simulation of a distillation column-binary systems, equimolal overflow, constant relative, volatility.
7. Input-Output response study in non-ideal flow reactors.
8. Simulation of a perfectly mixed reactor with heat transfer. Derivation of a mathematical model and solving for steady state heat transfer
9. Simulation of False Position method.
10. Simulation of Newton-Raphson method.
11. Simulation of Muller method.
12. Simulation of Euler's & R-K methods.

Note: ***All the lab classes mentioned above are software based and will be conducted on MATLAB platform***

Course Outcomes: Process Modeling & Simulation Lab

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

CO1: Develop fundamental understanding of chemical engineering problems.

CO2: Develop dynamic model equations of chemical engineering systems.

CO3: Solve the differential equations by using different convergence methods.

CO4: Develop MATLAB code to solve dynamic model equations.

CO5: Analyze the plotted data generated by MATLAB code.

CO6: Analyze the variation of state variable with respect to time.

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

2170615: Process Modeling & Simulation Lab

Skill Based Mini Project

List of Experiments

1. Consider a stirred tank heater where the tank inlet stream is received from another process unit. The objective is to raise the temperature of the inlet stream to a desired value. A heat transfer fluid is circulated through a jacket to heat the fluid in the tank. Develop model equations for the system by taking suitable assumptions & perform simulations using MATLAB.

2. Consider a perfectly mixed tank where a liquid phase chemical reaction is taking place. The reaction is assumed to be irreversible and of first order. The feed enters the reactor with volumetric rate $F_f(m^3/sec)$, density $\rho_f(kg/m^3)$and concentration $C_{Af}(mol/m^3)$. The output comes out of the reactor at volumetric rate $F_0(m^3/sec)$, density $\rho_O(kg/m^3)$ and concentrations $C_{A0}(mol/m^3)$ and $C_{B0}(mol/m^3)$. Develop model equations for the system by taking suitable assumptions & perform simulations using MATLAB.

3. Consider the catalytic hydrogenation of ethylene : A+B ----------->P,where A represents hydrogen, B represents ethylene and P is the product (ethane). The reaction is taking place in a CSTR. Two streams are feeding the reactor. One concentrated feed with flow rate $F1(m^3/sec)$and concentration $CB1(mol/m^3)$and another dilute stream with flow rate $F2(m^3/sec$ concentration $CB2(mol/m^3)$.The effluent has flow rate $F0(m^3/sec)$and concentration $CB(mol/m^3)$. The reactant A is assumed to be in excess. Develop modelequations for the system by taking suitable assumptions & perform simulations using MATLAB.

4. A perfectly mixed, isothermal CSTR has an outlet weir. The flow rate over the weir is proportional to the height of liquid over the weir to the 1.5^{th} power. The weir height is h_W. The cross-sectional area of the tank is A. Assume constant density. A first orderreaction takes place in the tank. Develop model equations for the system by taking suitable assumptions & perform simulations using MATLAB.

5. Consider the following elementary gas phase reversible reaction taking place in a perfectly mixed vessel: A←------>2B.The influent to the vessel has volumetric rate $F_f(m^3/sec)$, density (kg/m^3) and mole fraction y_f. Product comes out of the reactor with

volumetric rate F0, density ρ_0 and mole fraction y_0.The temperature and pressure inside the vessel are constant. The reactor effluent passes through a control valve whichregulates the gas pressure at constant pressure PS. Develop model equations for the system by taking suitable assumptions & perform simulations using MATLAB.

6. A fluid stream is continuously fed to the mixed reactor and another fluid stream is continuously removed from the reactor. Since the reactor is perfectly mixed, the exit stream has the same concentration and temperature as the reactor fluid. A jacket surrounding the reactor also has feed and exit stream. The jacket is assumed to be perfectly mixed and at lower temperature, then passes through the reactor walls into the jacket, removing the heat generated by reaction. Develop model equations for the system by taking suitable assumptions & perform simulations using MATLAB.

7. An exothermic reaction : A ---------->B takes place in a CSTR and the heat generated in the reactor is removed by a cooling coil. The effluent temperature is different from the inlet temperature due to heat generation by the exothermic reaction. Develop model equations for the system by taking suitable assumptions & perform simulations using MATLAB.

8. Develop model equations for non-isothermal jacketed CSTR system by taking suitable assumptions& perform simulations using MATLAB.

9. Consider a batch reactor. Reactant is charged into the vessel. Steam is fed into the jacket to bring the reaction temperature up to the desired level. Then afterwards cooling water must be added to the jacket to remove the exothermic heat of reaction and to make the reactor temperature follow the prescribed temperature profile. First order consecutive reactions with rate constants k1and k2:A---------->B-->C takes place in the reactor. Assume that the density of the reacting liquid is constant. Develop model equations for the system by taking suitable assumptions & perform simulations using MATLAB.

10. A semi-batch reactor is run at constant temperature by varying the rate of addition of one of the reactants, A. The irreversible exothermic is first order in reactants A and B. A+B----------> C. The tank is initially filled to its 40 % level with pure reactant B at a concentration C_{B0} maximum. Cooling water flow is begun and reactant A is slowly added to the perfectly stirred vessel. Develop model equations for the system by taking suitable assumptions & perform simulations using MATLAB.

Item 10	To review and finalize the **scheme structure of B. Tech. IV Semester** under the flexible curriculum (**for batch admitted in 2023-24**)

माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर
MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
Deemed University
(Declared under Distinct Category by Ministry of Education, Government of India)
NAAC ACCREDITED WITH A++ Grade
Gola Ka Mandir, Gwalior (M.P.)- 474005, INDIA
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Department of Chemical Engineering

B. Tech. IV 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	$$Mode of Exam.
				Theory Slot				Practical Slot				L	T	P			
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation								
				End Sem. Exam.	$Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project							
1.	3100028	BSC	Engineering Mathematics-III	50	10	20	20	-	-	-	100	3	1	-	4	Blended	PP
2.	3170411	DC	Instrumentation & Process Control	50	10	20	20	-	-	-	100	3	-	-	3	Blended	PP
3.	3170412	DC	Mass Transfer –I	50	10	20	20	60	20	20	200	3	-	2	4	Blended	PP
4.	3170413	DC	Mechanical Design of Process Equipment	50	10	20	20	-	-	-	100	3	-	-	3	Blended	AO
5.	3170414	DC	Inorganic Process Technology	50	10	20	20	-	-	-	100	3	-	-	3	Blended	PP
6.	3100009	MC	Cyber Security	50	10	20	20	-	-	-	100	2	-	-	2	Blended	MCQ
7.	3170415	DLC	Process Control Lab	-	-	-	-	60	20	20	100	-	-	2	1	Offline	SO
8.	200XXX	CLC	Novel Engaging Course (Informal Learning)	-	-	-	-	50	-	-	50	-	-	2	1	Interactive	SO
Total				**250**	**50**	**100**	**100**	**230**	**60**	**60**	**850**	**16**	**01**	**8**	**21**	-	-
9.	3000002	Natural Sciences & Skills	Engineering Physics	50	10	20	20	-	-	-	100	2	-	-	Grade	Online	MCQ
10.	1000005	MAC	Project Management & Financing	50	10	20	20	-	-	-	100	2	-	-	Grade	Online	MCQ
Summer Internship Project-II (Soft skills Based) for two weeks duration: Evaluation in V Semester																	

$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

Theory			Lab	Theory			Lab	
Offline	Online	Blended	Offline	PP	AO	MCQ	SO	
-	-	18	03	13	03	02	03	21
-	-	85.71%	14.29%	61.90%	14.29%	9.52%	14.29%	Credits %

Item 11	To review and finalize the syllabi for all Departmental Core (DC) Courses of ***B. Tech. IV Semester*** (for **batch admitted in 2023-24**) under the flexible curriculum along with their Cos

3170411: INSTRUMENTATION AND PROCESS CONTROL

Category	Title	Code	Credits-4			Theory Paper
			L	T	P	
Departmental Core-DC	Instrumentation& Process Control	3170411	3	-	-	Max.Marks-50 Duration-2hrs.

Course Objectives: To gain the knowledge of different process instruments, To understand dynamic modeling of a physical process using first principles, To convert the model to a form amenable to solution and analysis, To design various control schemes, and To apply the control system in various processes.

Syllabus:

Unit – I: Introduction of process variables, static and dynamic characteristics of instruments and classification of instruments. Temperature measuring instruments- Principle, construction and operation, Pressure measuring instruments –Bourdon, diaphragm and bellow pressure gauge.

Unit –II: Construction and Characteristics of final control elements such as Proportional, Integral, PD, PID, controllers, pneumatic control value, principal and construction of pneumatic and electronic controllers.

Unit- III: Process instrumentation diagrams and symbols, process instrumentation for process equipment's such as – Distillation column, Heat exchanger, fluid storage vessel.

Unit – IV: Laplace Transform, Linear open system, first and second order system and their transient response, Interacting and non-interacting system, Transportation lag and linear closed loop systems block diagram of closed loop transfer function, controllers, transient response of closed loop system.

Unit-V: Stability concept, Routh stability criterion, relative stability, Hurwitz stability criterion, Nyquist's stability criterion. Root locus technique, introduction to frequency response, Bode diagram, Bode stability criterion, gain and margins, Ziegler Nichols controller setting.

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

CO1: **Explain** the importance of process control in industrial process plants.
CO5: **Compare** the Linear open loop and Closed loop system.
CO2: **Develop** block diagrams & the mathematical model for control systems.
CO3: **Identify** controller for specific problems in chemical industry.
CO4: **Analyze** the transient and frequency response of systems.
CO6: **Test** the stability of a given system.

CourseArticulationMatrix

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

1-Slightly; 2-Moderately; 3 – Substantially

Text Books:

1. Process system Analysis and Control ByCoughnower and Koppel (Mc- Graw Hill, NewYork)

Reference Books

Automatic Process Control by D. P. Eckman (Mc-Graw Hill, New York)

Process Control by Peter Harriot (Mc- Graw Hill, New York)

Control System Engineering by J. J. Nagrath and M. Gop

3170412: MASS TRANSFER–I

Category	Title	Code	Credits-4			Theory Paper
			L	T	P	
Departmental Core-DC	Mass Transfer– I	3170412	2	1	2	Max.Marks-50 Duration-2hrs.

Course Objective: The purpose of this course is to introduce the undergraduate students with the most important separation equipments in the process industry, and provide proper understanding of unit operations.

Syllabus:

Unit-I: Diffusion Phenomenon: Molecular and eddy diffusion in gases, liquid and solids, interface mass transfer, Mass transfer theories; film theory, penetration theory and surface renewal theory, Concept of mass transfer coefficient: Individual and film coefficients, overall mass transfer coefficient and their inter relationship. Continuous contact and differential contact.

Unit –II: Absorption: Absorption in continuous contact columns, co- current, counter current and cross current contacting of fluids, Absorption in packed column, calculation ofNTU and HTU, concept of HETP.

Unit –III: Humidification: Humidification: general theory , psychometric chart, fundamental concepts in humidification and dehumidification, wet bulb temperature adiabatic saturation temperature, measurement of humidification calculation of humidification operation, cooling tower and related equipments.

UNIT- IV: Drying: Equilibrium mechanism, theory of drying, drying rate curve, batch and continuous drying for tray dryers, drum dryers , spray and tunnel dryers.

Unit-V: Crystallization: Factor governing nucleation and crystal growth rate, controlled-growth of crystals, super saturation curve, principal and design of batch and continuous type equipment.

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

CO1: **Explain** the basics of absorption, humidification, drying, crystallization & diffusion.
CO2: **Identify** the necessary information required in design of mass transfer equipment.
CO3: **Analyze** the different cases of diffusion phenomena.
CO4: **Compute** the parameters for mass transfer operations
CO5: **Solve** drying and humidification problems using psychometric charts & equilibrium data.
CO6: **Analyze** favorable conditions for a separation to be carried out.

CourseArticulationMatrix

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

1-Slightly; 2-Moderately; 3 – Substantially

Text Books

1. TreybalR.E.–MassTransferOperation–3rdEdition, Mc- Graw Hill.

Reference Books

1. Mc- Cabe, W.L, Smith J.M. - Unit Operation in Chemical Engineering 5thedition TataMc Graw Hill, New Delhi.
2. Coulson J.M. & Richardson J.F. – Chemical Engineering–Vol.2, 2nd Edition, Oxford, New Delhi

List of Experiments:

1. To determine the diffusion coefficient of liquid vapor in air by Stefan's tube.
2. To study the rate of dissolution of rotating cylinder and then to calculate the mass transfer coefficient.
3. To investigate the mass transfer characteristics of a wetted surface column unit.
4. To investigate the characteristics of a cooling tower.
5. To study the drying characteristics of wet granular material using natural and forced circulation in a tray dryer.
6. To prepare the drying rate curve for fluidized dryer.
7. To study the characteristics of spray dryer.
8. To study the characteristics of drum and tunnel dryer.
9. To find out the crystal yield with and without seeds.
10. To draw the tie lines and plot equilibrium curve for given ternary system.

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: Determine the mass transfer coefficient from wetted wall column.

CO2: Demonstrate the mechanism of diffusion through Stefan's tube.

CO3: Make use of the theoretical concepts in humidification to operate a cooling tower.

CO4: Prepare effective technical report

3170413: MECHANICAL DESIGN OF PROCESS EQUIPMENT

Category	Title	Code	Credits-4			Theory Paper
Departmental Core-DC	Mechanical Design of Process Equipment	3170413	L	T	P	Max.Marks-50 Duration-2hrs.
			3	1	-	

Course Objective: The objective of this course is to acquire basic understanding of design parameter, complete knowledge of design procedures for commonly used process equipment and their attachments (e.g. internal and external pressure vessels, tall vessels, high pressure vessels, supports etc.), and different types of equipment testing methods.

Syllabus:

Unit-I: Mechanics of materials: Stress – strain relationship of elastic materials: Thermal stress, membrane stresses and stress concentrations, Theories of failures. Design stress, Welded joints, efficiencies, Corrosion allowances.

Unit-II: General Design Consideration: Design of storage tanks for liquids and gases -classification, design of shell, bottom and roofs and other accessories.

Unit-III: Unfired Pressure Vessel: Pressure codes, classification of pressure vessels, design of cylindrical and spherical shells under internal and external pressures; Selection and design of flat plate, ellipsoidal, torispherical and conical closures, compensation of openings.

High pressure vessel: stress analysis of thick walled cylinder shell, Design of monoblic and multilayer vessels.

Unit-IV: Tall Vertical & Horizontal Vessels: pressure, deadweight, wind, earthquake and eccentric loads and induced stress; combined stresses, shell design of skirt supported vessels. **Vessel Supports:** Design of skirt, lug and saddle supports.

Unit-V: Bolted Flanges: Types of flanges, and selection, Gasket, Design of non standard flanges, Specification of standard flanges, fabrication of equipment: Major fabrication steps; welding, non destructive tests of welded joints, inspection and testing, vessel lining, material used in fabrication of some selected chemical industries.

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

CO1: **Evaluate** the important parameters of process equipment design.
CO2: **Design** internal and external pressure vessels.
CO3: **Evaluate** stress distribution in process vessels.
CO4: **Design** tall vessels and columns.
CO5: **Design** various parts of equipments such as supports, closure and heads.
CO6**: Analyze** the equipment fabrication and testing methods.

CourseArticulationMatrix

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

1-Slightly; 2-Moderately; 3 – Substantially

Text Books:

1. Process equipment design by Brownell, N.E. and Young, H.E. (John Wiley1959).

2. Introduction of chemical equipment design by Bhattacharaya, B.C. (CBS Publishers)

Reference Books

1. Code for unfired vessels by I.S.:2825-1969

2. Code of practice for Design, Fabrication by I.S.803-19 Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks

3. Process Equipment Design by Joshi, M.V

3170414: Inorganic Process Technology

Category	Title	Code	Credit-2			Theory Paper
Departmental Core-DC	Inorganic Process Technology	3170414	L	T	P	Max.Marks-50 Duration-2 hrs.
			3	-	-	

Course Objectives: To impart the basic concepts of Inorganic process technology. To develop concepts of unit process and unit operations in various industries. To learn manufacturing processes and flow sheets of Inorganic chemicals, its applications and major engineering problems encountered in the processes.

Syllabus

Unit I Alkalies: Chlor - alkali Industries: Manufacture of Soda ash, Manufacture of caustic soda and
Chlorine - common salt.

Unit II Acids: Sulphur and Sulphuric acid: Mining of sulphur and manufacture of sulphuric acid, Manufacture of hydrochloric acid, Phosphoric acid.

Unit III Fertilizers: Nitrogen Fertilizers: Synthetic ammonia, nitric acid, Urea, Ammonium Chloride,
Ammonium Sulphate; Phosphorus Fertilizers: Phosphate rock, phosphoric acid, Super phosphate and
Triple Super phosphate, MAP, DAP; Potassium Fertilizers: Potassium chloride, Potassium sulphate and Bio-fertilizers.

Unit IV: Cement, Glass and Industrial Gases: Cement: Types and Manufacture of Portland cement,
Glass: Manufacture of glasses and special glasses, Industrial gases: manufacture of Nitrogen, Oxygen, Hydrogen, Helium and Argon**.**

Unit V: Inorganic Chemicals: Manufacture of Bromine, Iodine and Fluorine, Alumina and Aluminum chloride, Inorganic pigments**.**

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

CO1: **Explain** the basics of heavy and inorganic chemical industry.
CO2: **Discuss** the importance of different unit operation and unit processes involved in heavy and inorganic chemical industry.
CO3: **Draw** process flow diagram.
CO4: **Analyze** the major engineering problems involved in the process.
CO5: **Evaluate** types of processes based on the conversion and yield of desirable products.
CO6: **Explain** the importance of fertilizer and cement technology.

CourseArticulationMatrix

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

CO3	2	3	3		2	2				2				
CO4	2	3	3		2	2				2				
CO5	2	3	3		2	2				2				
CO6	3	2	3		2	2				2				

1-Slightly; 2-Moderately; 3 – Substantially

TextBooks:

1. G.T. Austin, N. Shreves, "Chemical Process Industries", 5th Edition, Mc Graw Hill, NewYork, 1984.
2. W.V. Mark, S.C. Bhatia, "Chemical Process Industries volume I and II", 2nd Edition 2007.

References:

1. R. Gopal and M. Sittig, "Dryden's Outlines of Chemical Technology: For the 21st Century", Third Edition, Affiliated East-West Publishers, 1997.
2. S.D. Shukla and G. N. Pandey, "Textbook of Chemical Technology" Vol2,1984

Item 12	To review and finalize the Experiment list/ Lab manual/Skill based mini-project for all the Laboratory Courses to be offered in Batch IV semester **(for batch admitted in 2022-23)**

170412 Mass Transfer –I

List of Experiments:

1.To determine the diffusion coefficient of liquid vapor in air by Stefan's tube.
2. To study the rate of dissolution of rotating cylinder and then to calculate the mass transfer coefficient.
3. To investigate the mass transfer characteristics of a wetted surface columnunit.
4. To investigate the characteristics of a coolingtower.
5. To study the drying characteristics of wet granular material using natural and forced circulation in a traydryer.
6. To prepare the drying rate curve for fluidizeddryer.
7. To study the characteristics of spraydryer.
8. To study the characteristics of drum and tunneldryer.
9. To find out the crystal yield with and withoutseeds.
10. Todrawthetielinesandplotequilibriumcurvefor giventernarysystem.

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

Lab Course Outcomes

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

CO1: **Determine** the mass transfer coefficient from wetted wall column.

CO2: **Demonstrate** the mechanism of diffusion through Stefan's tube.

CO3: **Interpret** the mass transfer characteristics in turbulent flows.

CO4: **Make use of** the theoretical concepts in humidification to operate a cooling tower.

CO5: **Compare** the drying operation in tray dryer, rotary dryer & fluidized bed dryer.

CO6: **Decide** on various factors governing crystal yield in both batch as well as continuous crystallization.

2170415 Process Control Lab

List of Experiments:

1. To study the Characteristics of control valves (linear, quick opening,etc.)
2. To Study the dynamics of liquid level control systems of non - interacting and interacting types.
3. To study the response of mercury in glass thermometer with and without a thermowell.
4. To study the characteristics of an electronic PIDController.
5. To study the characteristics of a current to pneumaticconverter.
6. To study the effectiveness of computer control of a distillationcolumn.
7. To study the effectiveness of computer control of a heatexchanger.
8. To study the effectiveness of computer control of a chemicalreactor.
9. To study the dynamics of pressuretanks.
10. To calibrate an air purged liquid levelindicator.

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: Inculcate the importance of process control in industrial process plants.
CO2: Demonstrate the working of a level control trainer and its applications.
CO3: Demonstrate the working of a flow control trainer and its applications.
CO4: Select the controller that can be used for specific problems in chemical industry.
CO5: Visualize the Dynamic behavior of first and second order control system.
CO6: Differentiate between interaction and non-interacting systems.

List of Skill Based Mini Projects

Mass Transfer-I (3170412)

1. Compare the various mass transfer theories with appropriate examples where needed.
2. Demonstrate any mass transfer process experimentally at your home and interpret the operation.
3. List out the some mass transfer operation happening around you.
4. Differentiate between humidification and dehumidification with real time examples.
5. Explain the role of mass transfer in drying process and demonstrate experimentally at your home.
6. Compare the various types of industrial driers with their limitations.
7. Explain any Crystallization unit in details with flow diagram.
8. Demonstrate the crystallization process experimentally at your home.
9. Analyze the Phase Equilibrium diagram of different components.
10. Design of simple solar dryer system using household waste material.
11. Design of diffusion of coke and milk binary system.
12. Design of simple lab model for distillation column using household waste material.
13. Predict and optimize of Extraction of Nicotine from tobacco.
14. Design of simple prototype of Gas Absorption column.
15. Explain the working principle of a cooling tower with application area & limitation.

Process Control Lab (3170415)

1.Design and study of Characteristics of various type of control valves
2.Design and study of characteristics of control valve with and without positioner
3.Design of ON/OFF, PI and PID controller for the pressure process
4.Design of ON/OFF, PI and PID controller for the level process
5.Design of ON/OFF, PI and PID controller for the flow process
6.Design of ON/OFF, PI and PID controller for the temperature process
7.Design and Study for Tuning of controllers
8.Design and Study of complex control system
9.Study for Responses of different order processes with transportation lag
10.Study for Responses of different order processes without transportation lag

Item 13	To finalize the **Skill Internship Project** (SIP) module to be offered **in Dec 2024.**

माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर
MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
Deemed University
(Declared under Distinct Category by Ministry of Education, Government of India)
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Chemical Engineering

Name of Module	Energy Generation from Waste
Name of Module Coordinator	Anish P. Jacob
Email and Contact details of Module Coordinator	anishjaco@mitsgwalior.in 9993370276
Objectives	To equip the students with the knowledge of production of energy from different types of wastes through thermal, biological and chemical routes and get familiarize with utilization of different types of wastes for energy production
Content	Introduction, characterization of wastes, Methods of energy generation from wastes: Incineration, Gasification, Pyrolysis, Anaerobic digestion, Fermentation & Trans-esterification, Syngas utilization, Energy generation from waste plastics
Mode of Delivery (online/offline/blended)	Blended
Outcomes	Students will 1) understand & differentiate various methods of waste utilization, 2) be updated & become aware of the waste being a potential source for energy generation
Drive link of Module information video (1~2 min)	https://drive.google.com/file/d/1KR1mPCaOP12I0NlbyGaPbkJVO_tVGkLM/view?usp=sharing

Item 14	**To propose the content of the courses identified for MITS-MOOC development** to be offered **in blended mode** for VII Semester DE/OC courses for the batch admitted in 2022-23.

List of VII Semester DE/OC courses for MITS-MOOC development

S. No.	Name of the Course	Course Code	Category
1.	Transport Phenomena	2170721	DE
2.	Industrial Safety & Hazards	910215	OC

1. Transport Phenomena

Category	Title	Code	Credits-3			Theory Paper
			L	T	P	
Departmental Elective	Transport Phenomena	2170721	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, Heatand 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 insolids 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 andconcentration

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 HillBook 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 and masstransfer, 5th edition, John Wiley & sons, New York 2007.

Industrial Safety & Hazards (OC-2)

Category	Title	Code	Credits-4			Theory Paper
Departmental OC	Industrial Safety & Hazards	**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 techniquesused 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:

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 (2nd Edition 2001, Mc Graw Hill) -Safety, Health and Environmental Protection
2. B. D. Smith (4th Edition 2003, Mc Graw Hill) –Design of Equilibrium State Process

Item 15	To review the CO attainments, identify gaps and suggest corrective measures for the improvement in the CO attainment levels for the courses taught in **Jan-June 2024 Session**.

Madhav Institute of Technology & Science, Gwalior

(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV, Bhopal)

NAAC Accredited with A++ Grade (DEEMED UNIVERSITY)

Chemical Engineering

Course Outcome Attainment & Gap Analysis of Jan - June 2024 Semester

Semester	S. No.	Name of the Course & Code	Course Outcomes		CO Attainment						Corrective Actions
					Direct attainment	Indirect attainment	Overall	Target	Gap	Status	
II Semester	1	Chemical Process Calculations (3170221)	CO1	**Explain** different unit system, basic mass volume relationship, conversion of units	2.6	3	**2.68**	2.6	**-0.08**	**Attained**	Questions with more difficulty level to be Included
			CO2	**Classify** ideal and non –ideal gases	2.7	2.9	**2.74**	2.6	**-0.14**	**Attained**	Questions with more difficulty level to be Included
			CO3	**Solve** energy balance problems	2.6	2.7	**2.62**	2.6	**-0.02**	**Attained**	Explanation should be correlated with industry
			CO4	**Analyze** the recycle, bypass, and purge calculations	2.7	2.6	**2.68**	2.6	**-0.08**	**Attained**	Explanation should be given with more illustrations
			CO5	**Estimate** the raw material requirement for synthesis of a chemical product based on stoichiometry	2.6	3	**2.68**	2.6	**-0.08**	**Attained**	Explanation should be given with more illustrations
			CO6	**Estimate** the performance of chemical equipment using material and energy balance	2.7	2.5	**2.66**	2.6	**-0.06**	**Attained**	Tutorial to be given along with practice problems
	2	Fluid Particle Mechanics (3170223)	CO1	**Rephrase** the application of Screen Analysis in Industry.	2.6	3	**2.68**	2.6	**-0.16**	**Attained**	Explanation should be correlated with industry
			CO2	**Describe** the various methods of size reduction and to list the various principles.	2.6	2.9	**2.66**	2.6	0.02	Not **Attained**	Tutorial to be given along with practice problems
			CO3	**Explain** the separation techniques and equipments.	2.7	2.8	**2.72**	2.6	**-0.02**	**Attained**	Seminar presentation to be included
			CO4	**Illustrate** the various process like sedimentation, filtration etc.	2.6	2.7	**2.62**	2.6	**-0.16**	**Attained**	Teaching along with experimentation
			CO5	**Compare** the various conveying devices.	2.6	3	**2.68**	2.6	**-0.08**	**Attained**	Mini project work to be given
			CO6	**Illustrate** the fluidization and fluid catalytic process.	2.6	3	**2.68**	2.6	**-0.08**	**Attained**	Analysis based questions to be given
	3	Fluid Particle Mechanics Lab (3170223)	CO1	**Analyze** the effectiveness of a given screen.	2.9	2.5	**2.82**	2.6	**-0.22**	**Attained**	More sessions on virtual labs to be conducted
			CO2	**Apply** separation technique (sedimentation) to separate a mixture.	2.8	2.4	**2.72**	2.6	**-0.12**	**Attained**	More sessions on virtual labs to be conducted

			CO3	**Design** size reduction ratio, grindability index using ball mill and jaw crusher.	2.6	2	**2.48**	2.6	**0.12**	**Not Attained**	More sessions on virtual labs to be conducted
			CO4	**Compute** Bond crushing laws using hammer mill.	2.7	2.6	**2.68**	2.6	**-0.08**	**Attained**	More sessions on virtual labs to be conducted
			CO5	**Design** the plate and frame filter press, and thickener.	2.8	2.3	**2.7**	2.6	**-0.1**	**Attained**	More sessions on virtual labs to be conducted
			CO6	**Solve** mathematical descriptions of mixing processes.	2.8	2.3	**2.70**	2.6	**-0.1**	**Attained**	More sessions on virtual labs to be conducted
IV Semester	1.	**Inorganic Process Technology (2170414)**	CO1	Explain the basics of heavy and inorganic chemical industry	2.7	2.8	**2.72**	2.5	**-0.22**	**Attained**	Seminar Presentation to be taken
			CO2	Relate the importance of different unit operation and different unit processes involved in heavy and inorganic chemical industry	2.7	2.4	**2.72**	2.5	**-0.22**	**Attained**	Assignments to be included
			CO3	Develop process flow diagram	2.7	2.5	**2.62**	2.5	**-0.12**	**Attained**	Mini project to be
			CO4	Analyze the major engineering problems involved in the process	2.6	2.3	**2.54**	2.5	**-0.04**	**Attained**	Questions with more difficulty level to be
			CO5	Evaluate different types of processes based on the conversion and yield of desirable products	2.7	2.5	**2.66**	2.5	**-0.16**	**Attained**	Quiz to be included
			CO6	Analyze the importance of Fertilizer and cement technology	2.8	2	**2.64**	2.5	**-0.14**	**Attained**	Case study can be given
	2	**Instrumentation & Process Control (2170411)**	CO1	**Explain** the basic principles & importance of process control in industrial process plants.	2.6	2	**2.48**	2.4	**-0.08**	**Attained**	Explanation should be given with more illustrations
			CO2	**Explain** the use of block diagrams & the mathematical basis for the design of control systems.	2.8	2.7	**2.78**	2.4	**-0.38**	**Attained**	Tutorial to be given along with practice problems
			CO3	**Identify** controller that can be used for specific problems in chemical industry.	2.5	2.3	**2.46**	2.4	**-0.06**	**Attained**	Explanation should be correlated with industry
			CO4	**Analyze** the Dynamic behavior of first and second order control system.	2.8	2.9	**2.82**	2.4	**-0.42**	**Attained**	Tutorial to be given along with practice problems

			CO5	**Compare** the Linear open loop and Closed loop system.	2.4	2.2	**2.36**	2.4	**0.04**	Not **Attained**	Explanation should be given with more illustrations
			CO6	**Test** the stability of a given system & Analyze the transient and frequency response of systems.	2.1	1.9	**2.06**	2.4	**0.34**	Not **Attained**	Tutorial to be given along with practice problems
	3	**Mechanical Design of Process Equipment (2170413)**	CO1	**Recall** basics of Mechanical Design in the industrial problems	2.8	3	**2.84**	2.6	**-0.24**	**Attained**	Weekly quizzes to be conducted
			CO2	**Experiment** with different heads, closures and other accessories involved during design.	2.6	3	**2.68**	2.6	**-0.08**	**Attained**	Application based tutorial to be given
			CO3	**Decide** on general design considerations	2.5	2.7	**2.54**	2.6	**0.06**	**Not Attained**	Practice problems to be given
			CO4	**Make use of** IS Codes in design of Pressure vessel	2.6	2.8	**2.64**	2.6	**-0.04**	**Attained**	Tutorial to be given along with practice problems
			CO5	**Distinguish** between design procedures for Tall Vertical & Horizontal Vessels	2.7	2.3	**2.62**	2.6	**-0.02**	**Attained**	Analysis based questions to be given
			CO6	**Outline** the design of bolted flanges for determining suitable material of construction for specific service.	2.8	2.4	**2.72**	2.6	**-0.12**	**Attained**	Analysis based questions to be given
	4	**Mass Transfer - I (2170412)**	CO1	**Apply** the basics of absorption, humidification, drying, crystallization & the principle of diffusion underlying them.	2.7	3	**2.76**	2.7	**-0.06**	**Attained**	Tutorial to be given along with practice problems
			CO2	**Choose** the necessary information useful in design of mass transfer equipment.	2.5	2.9	**2.58**	2.7	**0.12**	**Not Attained**	Case study can be given
			CO3	**Analyze** the different cases of diffusion phenomena.	2.6	2.7	**2.62**	2.7	**0.08**	**Not Attained**	Seminar presentation to be included
			CO4	**Apply** the theoretical concepts for solving practical problems.	2.8	2.6	**2.76**	2.7	**-0.06**	**Attained**	Teaching along with experimentation
			CO5	**Interpret** psychometric charts & equilibrium data.	2.4	3	**2.52**	2.7	**0.18**	**Not Attained**	Mini project work to be given
			CO6	**Propose** favorable conditions for a separation to be carried out.	2.1	3	**2.28**	2.7	**0.42**	**Not Attained**	Analysis based questions to be given
	5	**Mass Transfer - I Lab (2170412)**	CO1	**Analyze** the various applications of modern separation technique	3	2.5	**2.9**	2.5	**-0.4**	**Attained**	More sessions on virtual labs to be conducted
			CO2	**Design** novel drying equipments for intended application.	2.9	2.4	**2.8**	2.5	**-0.3**	**Attained**	More sessions on virtual labs to be conducted
			CO3	**Evaluate** the diffusion application in chemical industries	2.5	2	**2.4**	2.5	**-0.1**	**Attained**	More sessions on virtual labs to be conducted
			CO4	**Analyze** the ability to know the application of humidification operation in chemical industry	3	2.6	**2.92**	2.5	**-0.42**	**Attained**	More sessions on virtual labs to be conducted

		CO5	**Evaluate** the appropriate application equipment in a process	2.7	2.3	**2.62**	2.5	**-0.12**	**Attained**	More sessions on virtual labs to be conducted
		CO6	**Analyze t**he design of the mass transfer equipments used in crystallization processes	2.9	2.3	**2.78**	2.5	**-0.28**	**Attained**	More sessions on virtual labs to be conducted
	6	**Cyber Security (2100009)**	CO1	**Tell** the basic terminologies of Cyber Security	2.4	2.2	**2.36**	2.3	**-0.06**	**Attained**	Application based explanation to be given
			CO2	**Explain** the basic concept of networking & Internet	2.6	2.2	**2.52**	2.3	**-0.22**	**Attained**	Explanation should be given with more illustrations
			CO3	**Apply** various methods used to protect data in the internet environment in real world situations	2.7	2.3	**2.62**	2.3	**-0.32**	**Attained**	Assignment to be given
			CO4	**Discover** the concept of IP security & architecture	2.5	2.3	**2.46**	2.3	**-0.16**	**Attained**	Analysis based questions to be given
			CO5	**Compare** various types of Cyber security threats/vulnerabilities	2.6	2.5	**2.58**	2.3	**-0.28**	**Attained**	Seminar presentation to be included
			CO6	**Develop** the understanding of cyber crime investigation and IT ACT 2000	2.6	2.2	**2.52**	2.3	**-0.22**	**Attained**	Case studies to be given
VI Semester	**7.**	**Process Control Lab (2170415)**	CO1	**Tell** the importance of process control in industrial process plants	2.7	3	**2.76**	2.6	**-0.16**	**Attained**	More sessions on virtual labs to be conducted
			CO2	**Explain** the working of a flow control trainer and its applications	2.8	3	**2.84**	2.6	**-0.24**	**Attained**	More sessions on virtual labs to be conducted
			CO3	**Explain** the working of a level control trainer and its applications	2.7	2.7	**2.7**	2.6	**-0.1**	**Attained**	More sessions on virtual labs to be conducted
			CO4	**Identify** controller that can be used for specific problems in chemical industry	2.7	2.9	**2.74**	2.6	**-0.14**	**Attained**	More sessions on virtual labs to be conducted
			CO5	**Analyze** the Dynamic behavior of first and second order control system	2.8	3	**2.84**	2.6	**-0.24**	**Attained**	More sessions on virtual labs to be conducted
			CO6	**Differentiate** between interaction and non-interacting systems	2.7	3	**2.76**	2.6	**-0.16**	**Attained**	More sessions on virtual labs to be conducted
	1	**Process Modeling & Simulation (170615)**	CO1	**Explain** the basic concepts involved in process analysis & simulation.	2.6	2.9	**2.66**	2.6	**-0.06**	**Attained**	Analysis based questions to be given
			CO2	problem as a mathematical model from basic engineering principles.	2.8	2.8	**2.8**		**-0.2**	**Attained**	Mini project to be given

		CO3	**Apply** the conservation equations in various physio – chemical systems.	2.7	2.9	**2.74**	2.6	**-0.14**	**Attained**	Analysis based questions to be given
		CO4	**Examine** the experimental data for further processing.	2.6	3	**2.68**	2.6	**-0.08**	**Attained**	Analysis based questions to be given
		CO5	**Compare** various iterative convergence methods and numerical solution of ODEs.	2.6	3	**2.68**	2.6	**-0.08**	**Attained**	Analysis based questions to be given
		CO6	**Analyze** different approaches involved in dynamic modelling of process systems.	2.7	2.7	**2.7**	2.6	**-0.01**	**Attained**	Application based tutorial to be given
2	**Process Modeling & Simulation Lab (170615)**	CO1	**Develop** fundamental understanding of chemical engineering problems	2.6	2.9	**2.66**	2.7	**0.04**	**Not Attained**	Practical problems to be given
		CO2	**Develop** dynamic model equations of chemical engineering systems	2.7	3	**2.76**	2.7	**-0.06**	**Attained**	Practical problems to be given
		CO3	**Solve** the differential equations by using different convergence methods	2.8	3	**2.84**	2.7	**-0.14**	**Attained**	Practical problems to be given
		CO4	**Develop** MATLAB code to solve dynamic model equations	3	2.4	**2.88**	2.7	**-0.18**	**Attained**	Practical problems to be given
		CO5	**Analyze** the plotted data generated by MATLAB code	2.9	2.6	**2.84**	2.7	**-0.14**	**Attained**	Practical problems to be given
		CO6	**Analyze** the variation of state variable with respect to time	2.5	2.3	**2.46**	2.7	**0.23**	**Not Attained**	Practical problems to be given
3	**Process Equipment Design (170616)**	CO1	**Explain** the basics of process equipment design and important parameters of equipment design	2.4	2.7	**2.46**	2.3	**-0.16**	**Attained**	Analysis based questions to be given
		CO2	**Describe** the scale up criteria	2.6	2.5	**2.58**	2.3	**-0.28**	**Attained**	Tutorial to be given along with practice problems
		CO3	**Explain** the various supports and closures and their appropriate selections for given process equipment	2.4	2.2	**2.36**	2.3	**-0.06**	**Attained**	Analysis based questions to be given
		CO4	**Analyze** the concept of internal and external pressure conditions (Tube and Shell side)	2.2	2.3	**2.22**	2.3	**0.08**	**Not Attained**	Practical problems to be given
		CO5	**Develop** the designing concept and flow-sheeting (for given process)	2.5	2.4	**2.48**	2.3	**-0.18**	**Attained**	Practical problems to be given
		CO6	**Design** the various process equipments	2.7	2.6	**2.68**	2.3	**-0.38**	**Attained**	Practical problems to be given
4	**Artificial Intelligence and Machine**	CO1	**Define** basic concepts of Artificial Intelligence & Machine Learning	2.5	2.7	**2.54**	2.5	**-0.04**	**Attained**	Assignment to be given

		Learning (170617)									
			CO2	**Illustrate** various techniques for search and processing.	2.7	2.5	**2.66**	2..5	**-0.16**	**Attained**	Explanation should be given with more illustrations
			CO3	**Identify** various types of machine learning problems and techniques.	2.8	2.7	**2.78**	2.5	**-0.28**	**Attained**	Application based tutorial to be given
			CO4	**Analyze** various techniques in Artificial Intelligence, ANN& Machine Learning.	2.5	2.6	**2.52**	2.5	**-0.02**	**Attained**	Explanation should be given with more illustrations
			CO5	**Apply** AI and ML techniques to solve real world problems.	2.6	2.9	**2.66**	2.5	**-0.16**	**Attained**	More practice numerical problems to be given
			CO6	**Build** AI enabled intelligent systems for solving real world problems.	2.5	2.6	**2.52**	2.5	**-0.02**	**Attained**	Explanation should be given with more illustrations
	5	**Artificial Intelligence and Machine Learning Lab (170617)**	CO1	**Demonstrate** different AI techniques.	2.5	2.7	**2.54**	2.3	**-0.24**	**Attained**	Practical problems to be given
			CO2	**Apply** the machine learning algorithms to real life problems	2.2	2.5	**2.26**	2.3	**0.04**	**Attained**	Practical problems to be given
			CO3	**Implement** machine learning through Python Programming	2.4	2.1	**2.34**	2.3	**-0.04**	**Attained**	Practical problems to be given
			CO4	**Apply** blind search and heuristic search approaches.	2.6	2.5	**2.58**	2.3	**-0.28**	**Attained**	Practical problems to be given
			CO5	**Develop** neural network models.	2.5	2.4	**2.48**	2.3	**-0.18**	**Attained**	Practical problems to be given
			CO6	**Demonstrate** various unsupervised machine learning methods.	2.3	2.2	**2.28**	2.3	**0.02**	**Attained**	Practical problems to be given
	6	**OC 1: Fuels & Combustion (910115)**	CO1	**Explain** the origin of fossil fuels	2.6	2.9	**2.66**	2.5	**-0.16**	**Attained**	Analysis based questions to be given
			CO2	**Classify** fossil fuels	2.4	2.4	**2.4**	2.5	**-0.1**	**Attained**	Tutorial to be given along with practice problems
			CO3	**Analyze** the various alternate energy options available in earth	2.8	3	**2.84**	2.5	**-0.34**	**Attained**	Practical problems to be given
			CO4	**Explain** various fuel-processing techniques used in solid, liquid and gaseous fuels	2.7	2.8	**2.72**	2.5	**-0.22**	**Attained**	Mini project work to be given.
			CO5	**Explain** the characterization techniques of fuels	2.3	2.3	**2.3**	2.5	**0.2**	**Attained**	Tutorial to be given along with practice problems

		CO6	**Examine** quality of fuels based on its properties and possible utilization	2.5	2.6	**2.52**	2.5	**-0.02**	**Attained**	Tutorial to be given along with practice problems
7	**Minor Project - II (170618)**	CO1	**Explain** the basics of various unit operations & unit processes.	2.5	2.4	**2.48**	2.5	**0.02**	**Not Attained**	Topic with practical relevance to be encouraged
		CO2	**Outline** the necessary features to be utilized in undergoing any project work.	2.3	2.3	**2.3**	2.5	**0.2**	**Not Attained**	Outline of the work to be clearly specified
		CO3	**Choose** among experimental work, modeling & a combination of both for any problem statement.	2.8	2.6	**2.76**	2.5	**-0.26**	**Attained**	Proper guidelines to be given
		CO4	**Examine** the literature for useful information regarding the project.	3	2.2	**2.84**	2.5	**-0.34**	**Attained**	Proper guidelines to be given
		CO5	**Justify** the background for selecting a suitable project title.	2.7	2.4	**2.64**	2.5	**-0.14**	**Attained**	Proper guidelines to be given
		CO6	**Plan** the work in phases for accomplishment of the project objective.	2.5	2.6	**2.52**	2.5	**-0.02**	**Attained**	Topic with practical relevance to be encouraged
		CO1	**Imbibe** the knowledge of Intellectual Property and its protection through various laws	2.5	2.6	**2.52**	2.5	**-0.02**	**Attained**	Explanation should be given with more examples
		CO2	**Apply** the knowledge of IPR for professional development	2.6	2.7	**2.62**	2.5	**-0.12**	**Attained**	Explanation should be given with more examples
	8 **Intellectual Property Rights (1000007)**	**CO3**	**Develop** a platform for protection and compliance of Intellectual Property Rights & knowledge	2.3	2.7	**2.38**	2.5	**0.12**	**Not Attained**	Explanation should be given with more examples
		CO4	**Create** awareness amidst academia and industry of IPR and Copyright compliance	2.8	3	**2.84**	2.5	**-0.34**	**Attained**	Practical assignments to be given
		CO5	**Deliver** the purpose and function of IPR and patenting.	3	2.8	**2.96**	2.5	**-0.46**	**Attained**	Explanation should be given with more industrial examples
VIII Semester	1	**Internship/Project (170811)**	CO1	**Identify** the problem after reviewing the Literature or field survey	2.9	2.7	**2.86**	2.6	**-0.26**	**Attained**	Practical Problems to be focussed
			CO2	**Develop** non conventional prototypes for different chemical systems	2.8	2.5	**2.74**	2.6	**-0.14**	**Attained**	Experimental work to be encouraged
			CO3	**Execute** experiments as per the target objectives	2.7	2.4	**2.64**	2.6	**-0.04**	**Attained**	Design of experiment should be well planned

			CO4	**Compose** observations and results by using appropriate statistical tools or	2.8	2.8	**2.8**	2.6	**-0.02**	**Attained**	Application based topics to be chosen
				software							
			CO5	**Develop** leadership and team work ability	2.7	2.6	**2.68**	2.6	**-0.08**	**Attained**	Coordination to work in a team to be emphasized
			CO6	**Communicate** effectively by means of oral, written and graphical presentation	2.8	2.8	**2.8**	2.6	**-0.02**	**Attained**	Reports and presentation should be professional
	2	**Professional Development (170812)**	CO1	**Demonstrate** technical & non technical skills in in-house activities.	2.7	2.7	**2.7**	2.7	**0**	**Not Attained**	Focus on all round development
			CO2	**Demonstrate** good oral & written communication skills	2.8	2.8	**2.8**	2.7	**-0.1**	**Attained**	Focus on all round development
			CO3	**Acquire** knowledge of new areas & emerging fields through MOOCs	2.7	3	**2.76**	2.7	**-0.06**	**Attained**	Focus on all round development
			CO4	**Develop** leadership and team work ability	2.8	2.9	**2.82**	2.7	**-0.12**	**Attained**	Focus on all round development
			CO5	**Take** positions of responsibility in professional organizations	2.9	3	**2.92**	2.7	**-0.22**	**Attained**	Focus on all round development

Item 16	To review the PO attainment, CO-PO mapping matrix and action to be taken to improve PO attainment level.

Chemical Engineering

Program Outcomes (PO) Attainment, Gap Analysis & ATR for 2023 -24

		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.	2.67	2.04	**2.52**	**2.6**	**0.08**	PO is not 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.	2.78	2.08	**2.64**	**2.6**	**-0.04**	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	**2.62**	**2.6**	**-0.02**	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	2.87	2.09	**2.71**	**2.6**	**-0.11**	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.	2.68	1.99	**2.54**	**2.6**	**0.06**	PO is not 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..	2.78	2.03	**2.63**	**2.6**	**-0.03**	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.	2.75	2.12	**2.62**	**2.6**	**-0.02**	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.	2.75	2.16	**2.63**	**2.6**	**-0.03**	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.	2.75	2.10	**2.62**	**2.6**	**-0.02**	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.	2.73	2.14	**2.61**	**2.6**	**-0.01**	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.	2.78	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.	2.79	2.03	**2.63**	**2.6**	**-0.03**	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.	2.78	2.08	**2.64**	**2.6**	**-0.04**	PO is achieved. Course delivery to be focused on extension of concepts to real world Applications. Students to be motivated to take design projects & Internships.

FeedbackAnalysis & ActionTakenReport

ITEM NO.19	Feedback	Feedback Comments	Feedback Action Taken
To review curricula feedback from various stake-holders, its analysis and impact	Students Feedback	• The curriculum is up to date	• Scope of improvement is being explored
	Faculty Feedback	• Advanced Books are not available in the Library • Access to recent research papers (online mode) is not available.	• The Library officer has been informed about the situation and also shared the list of Books. • Digital library officer is informed about the same and is requested to share the login credentials to reachable websites.
	Parents Feedback	• The students should be informed about different upcoming exams for future.	• The class coordinators& faculty have been informed about the same.
	Alumni Feedback	• Revision of syllabus is required • Novel technologies must be included in curriculum • Virtual Labs can be used for experiment visualization	• Already discussed and changed in BoS accordingly • Already discussed and changed in BoS accordingly, extra part is covered via gaps in Teaching-Learning Activities • Already added in extracurricular academic activity

	Employer Feedback	• Electives should be offered related to technological advancement • Curriculum should support training and placement	• Novel electives as per recent trends are added and reported in BoS • Last semester is totally based on internship/in-house project that aids in training and placemet

Students Feedback on Course Curriculum

S. No.	Comments	Action Taken
1.	The curriculum is up to date	Scope of improvement is being explored
2.	Remedial classes should be in MMTLP mode	Subject faculties are informed and trend has started to conduct MMTLP mode remedial classes

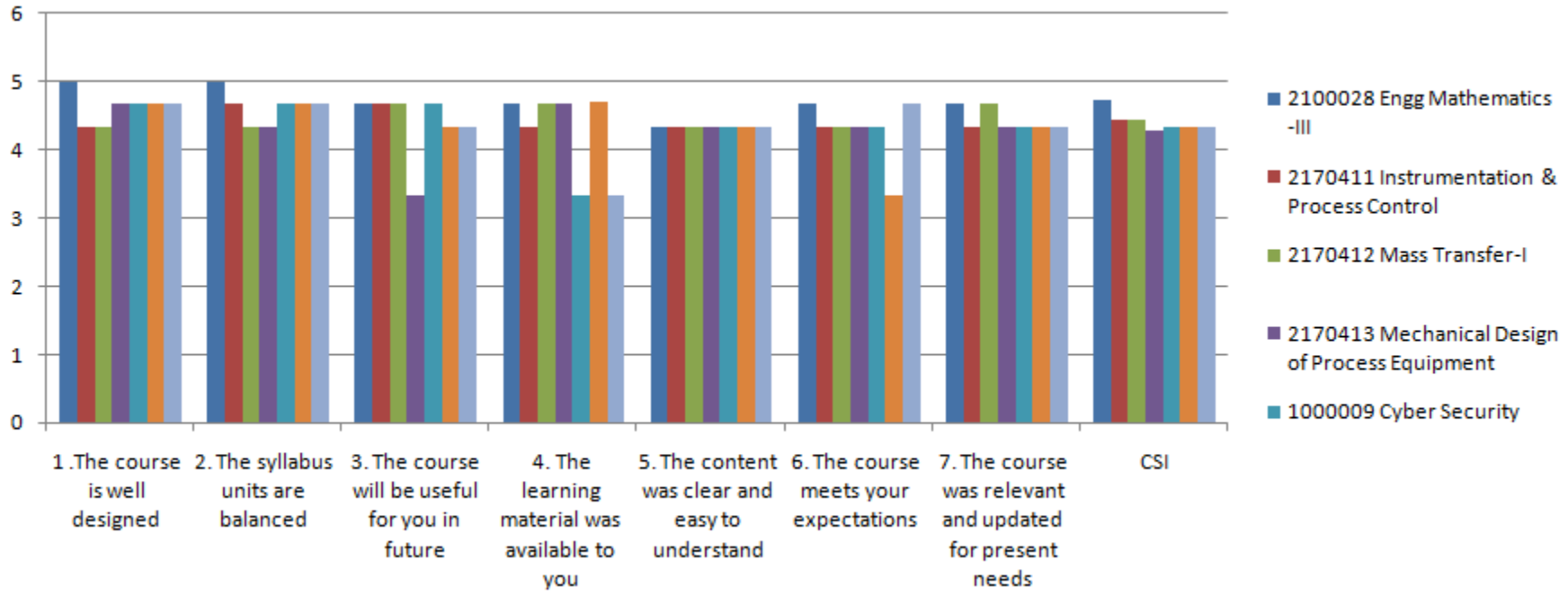
CUURICULA FEEDBACK ANALYSIS

1. Students Feedback Summary Sheet (Course Curriculum Feedback by Students on MOODLE)

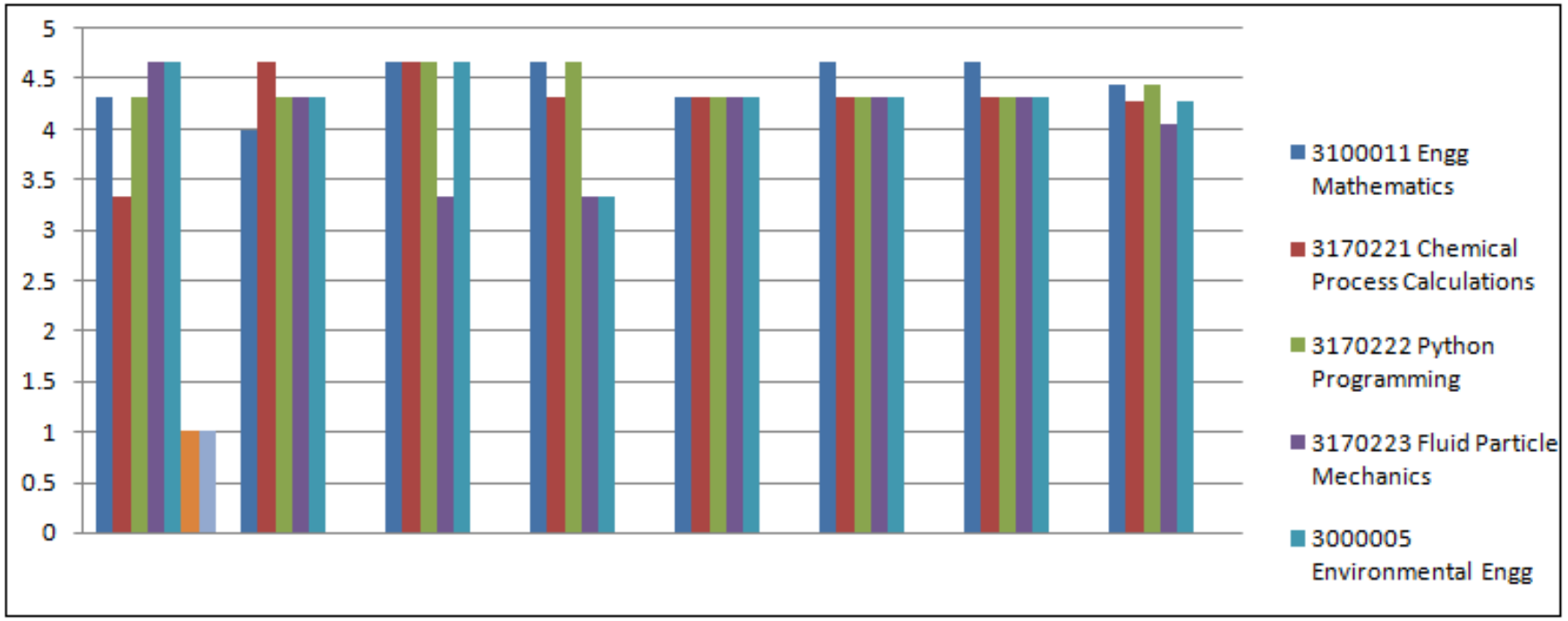
4th Semester, Sample Size: 9

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
2100028 Engg Mathematics -III	5	5	4.67	4.67	4.33	4.67	4.67	4.72
2170411 Instrumentation & Process Control	4.33	4.67	4.67	4.33	4.33	4.33	4.33	4.44
2170412 Mass Transfer-I	4.33	4.33	4.67	4.67	4.33	4.33	4.67	4.44
2170413 Mechanical Design of Process Equipment	4.67	4.33	3.33	4.67	4.33	4.33	4.33	4.28
1000009 Cyber Security	4.67	4.67	4.67	3.33	4.33	4.33	4.33	4.33

1000005 ProjectManagement & Financing	4.67	4.67	4.33	4.7	4.33	3.33	4.33	4.34
3000001 Engineerig Physics	4.67	4.67	4.33	3.33	4.33	4.67	4.33	4.33
Course Satisfaction Index (CSI) (on a scale of 5) (5: Excellent, 4: Very Good, 3: Good, 2: Average, 1: Below Average)								



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
3100011 Engg Mathematics	4.33	4	4.67	4.67	4.33	4.67	4.67	4.45
3170221 Chemical Process Calculations	3.33	4.67	4.67	4.33	4.33	4.33	4.33	4.28
3170222 Python Programming	4.33	4.33	4.67	4.67	4.33	4.33	4.33	4.44
3170223 Fluid Particle Mechanics	4.67	4.33	3.33	3.33	4.33	4.33	4.33	4.05
3000005 Environmental Engg	4.67	4.33	4.67	3.33	4.33	4.33	4.33	4.28
Course Satisfaction Index (CSI) (on a scale of 5) (5: Excellent, 4: Very Good, 3: Good, 2: Average, 1: Below Average)								



2. Faculty Feedback

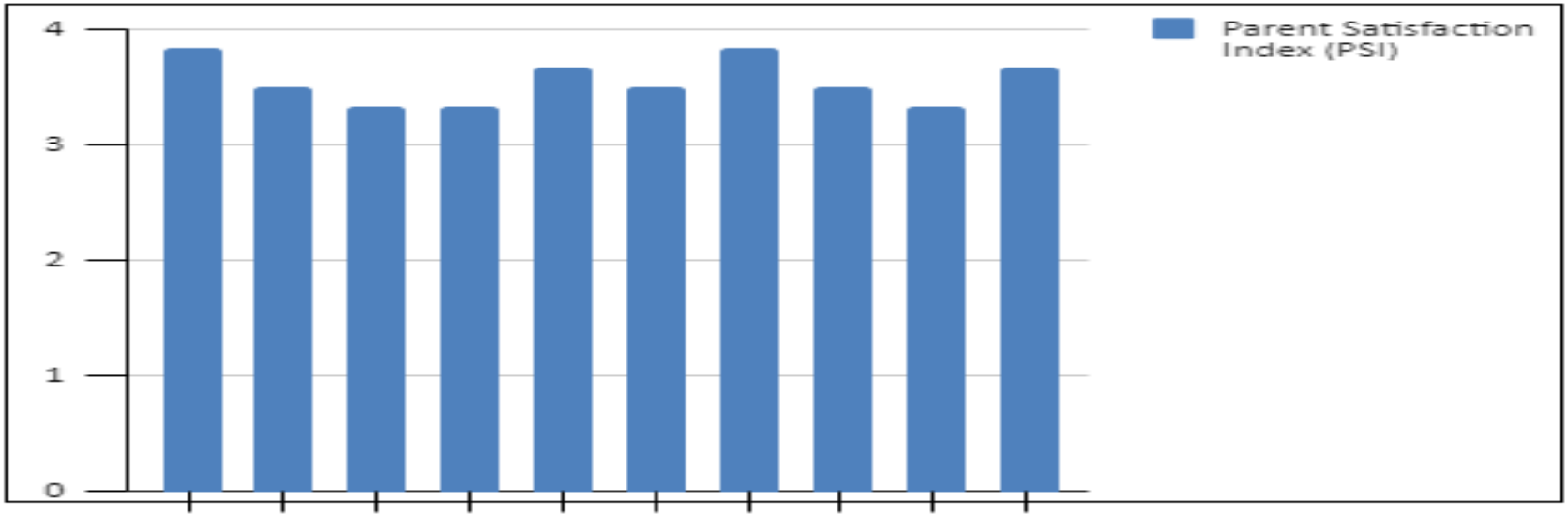
Parameter (Average grading)	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Satisfaction Index
The availability of books & E-learning material in the institute is good.	0	0	1	3	4	**4.375**
The Courses and content are up to date.	0	0	0	4	4	**4.5**
The course curriculum/syllabi are helpful in meeting the higher studies/placement requirements according to present global trends	0	0	0	4	4	**4.5**
The course / contents in your domain/area are well designed and frequently updated, hence need no changes at present.	0	0	0	1	7	**4.85**
The curriculum is capable of inculcating life-long learning abilities in students.	0	3	5	22	7	**3.89**
The environment of department/institute is conducive for innovative teaching and research.	0	2	7	19	9	**3.95**
The institute supports you in your initiatives for updating your knowledge/skills and in achieving career growth	0	0	0	4	4	**4.5**

The institute provides basic infrastructural facilities required for teaching learning.	0	0	0	4	4	**4.5**
You get academic freedom to implement your ideas and conduct your courses without interference from authorities.	0	0	0	4	4	**4.5**
In general you are satisfied with your work environment and institute culture.	0	0	0	4	4	**4.5**

3. PARENTS FEEDBACK I SEM

	(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	1	0	0	1	0
Disagree	0	1	2	1	0	0	0	1	0	1
Neither agree nor disagree	1	1	1	2	2	0	1	1	1	0

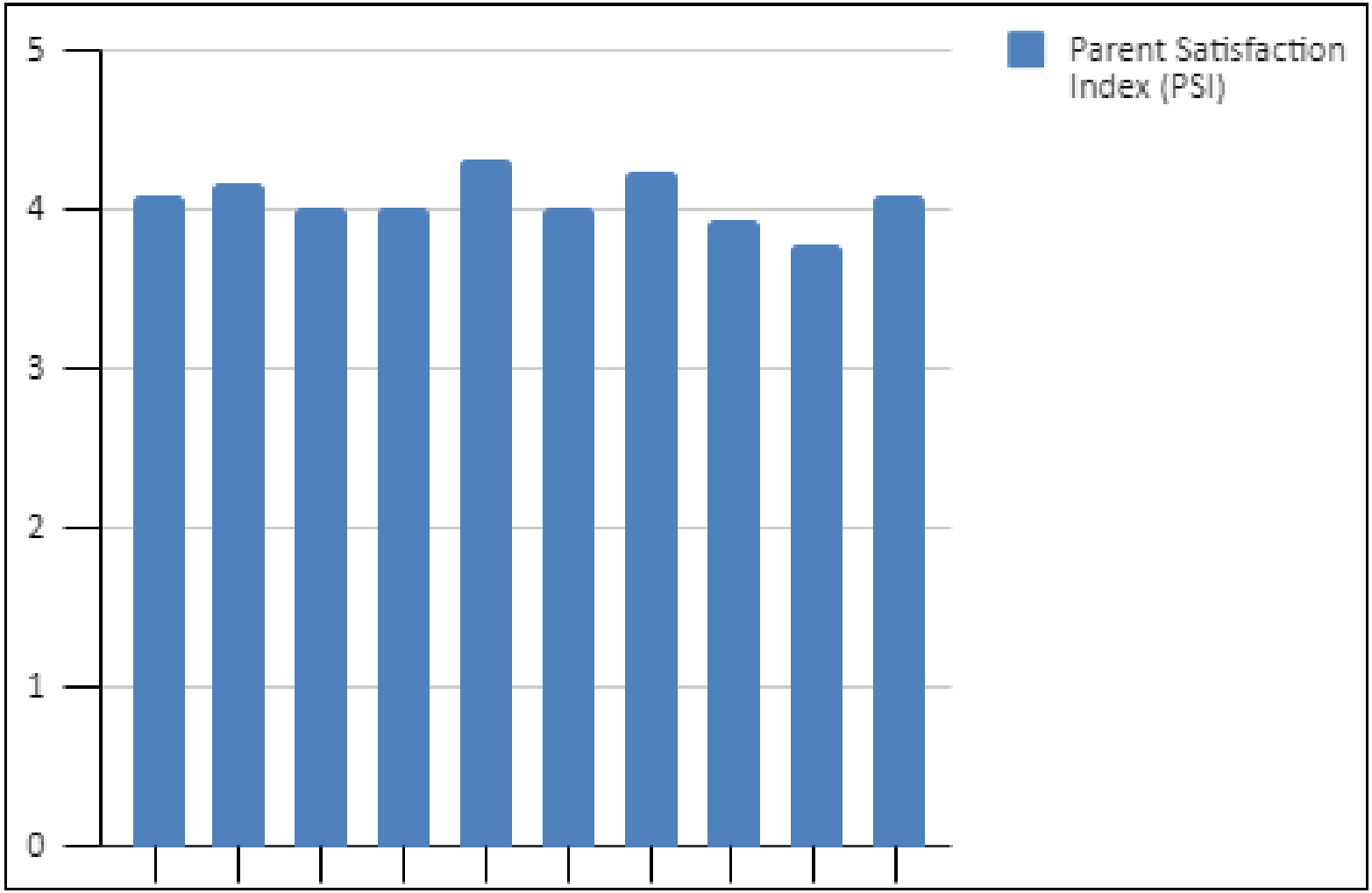
Agree	5	4	2	3	4	5	5	4	4	5
Strongly agree	0	0	1	0	0	0	0	0	0	0
Parent Satisfaction Index (PSI)	**3.83**	**3.50**	**3.33**	**3.33**	**3.67**	**3.50**	**3.83**	**3.50**	**3.33**	**3.67**



4. PARENTS FEEDBACK-III SEM

	(Q1) How	(Q 2) How	(Q 3) Is any	(Q 4) How	(Q 5) Your	(Q 6) The	(Q 7) The	(Q 8) The	(Q 9) The	(Q 10)

	do you rate the programme in terms of the load of the courses in different semesters?	do you rate the availability of books & E-learning material in the institute library / website?	new course to be introduced- to meet current needs & technological changes?	do you rate the quality and relevance of the courses included in the programme of study.	ward demonstrates knowledge of the recent trends and developments in the field.	institute provides good support for improving overall personality of your ward.	teaching, learning and evaluation system in the institute is good.	institute conducts many activities that help your ward in getting job opportunities and campus placement.	infrastructure, other facilities and ambience of the institute is good.	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**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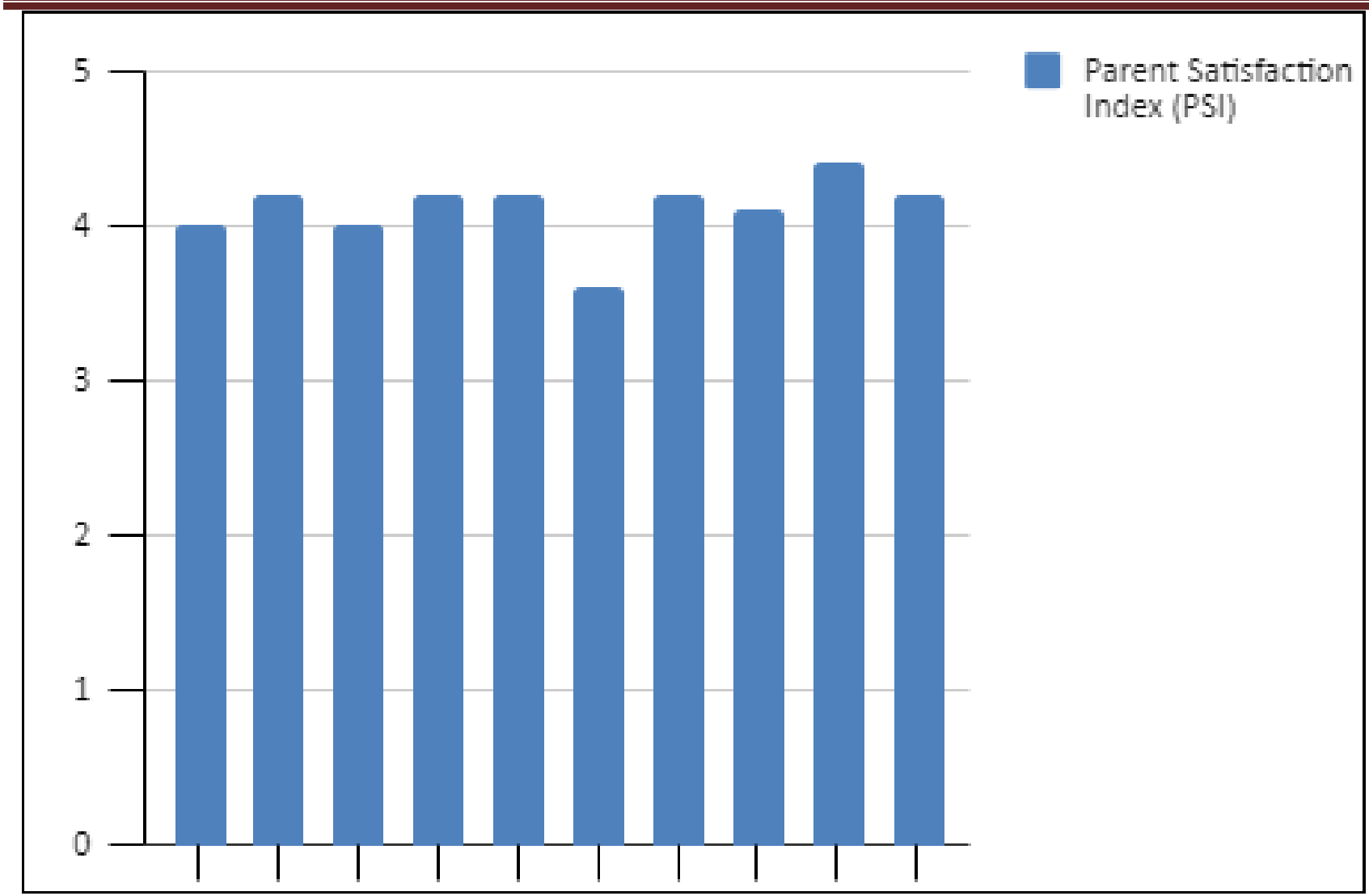
Parent Satisfaction Index (PSI)

5. PARENTS FEEDBACK V SEM

	(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**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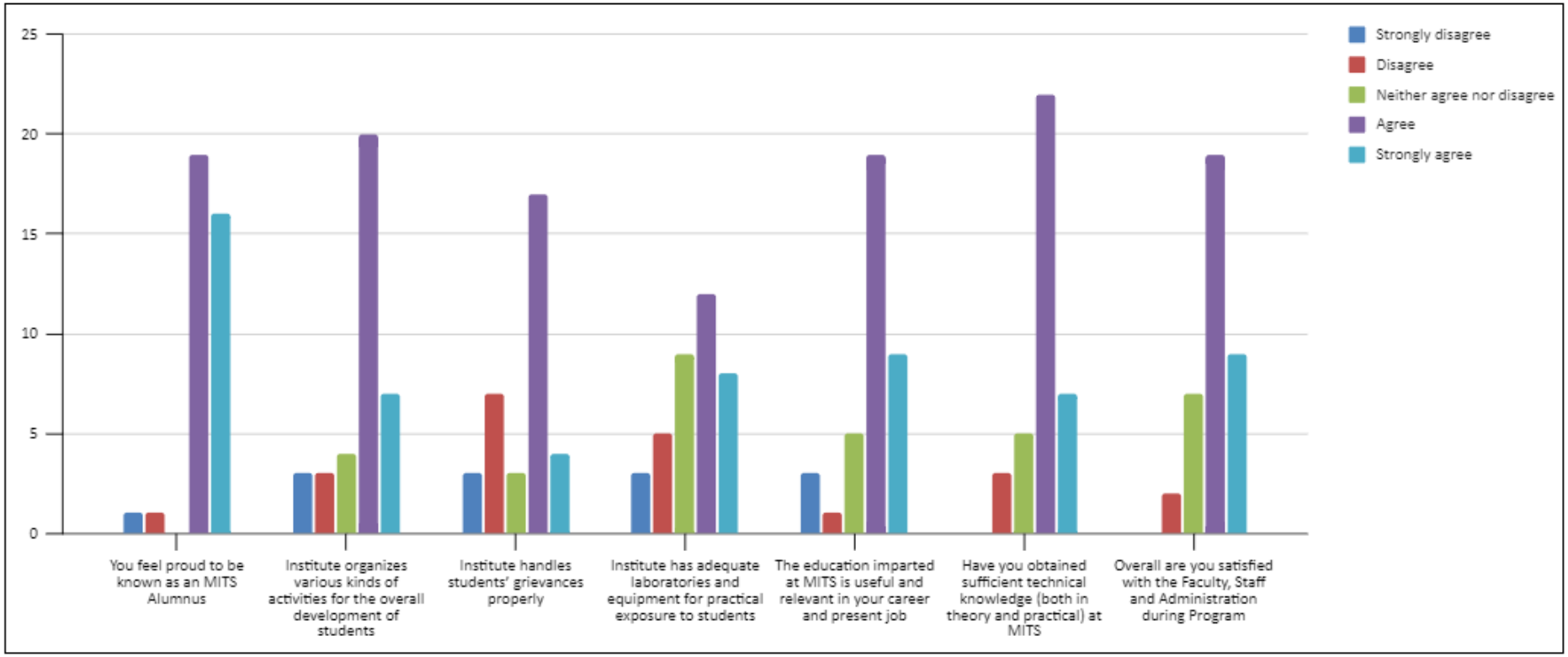
Parent Satisfaction Index (PSI)

6. ALUMINI FEEDBACK

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**


25
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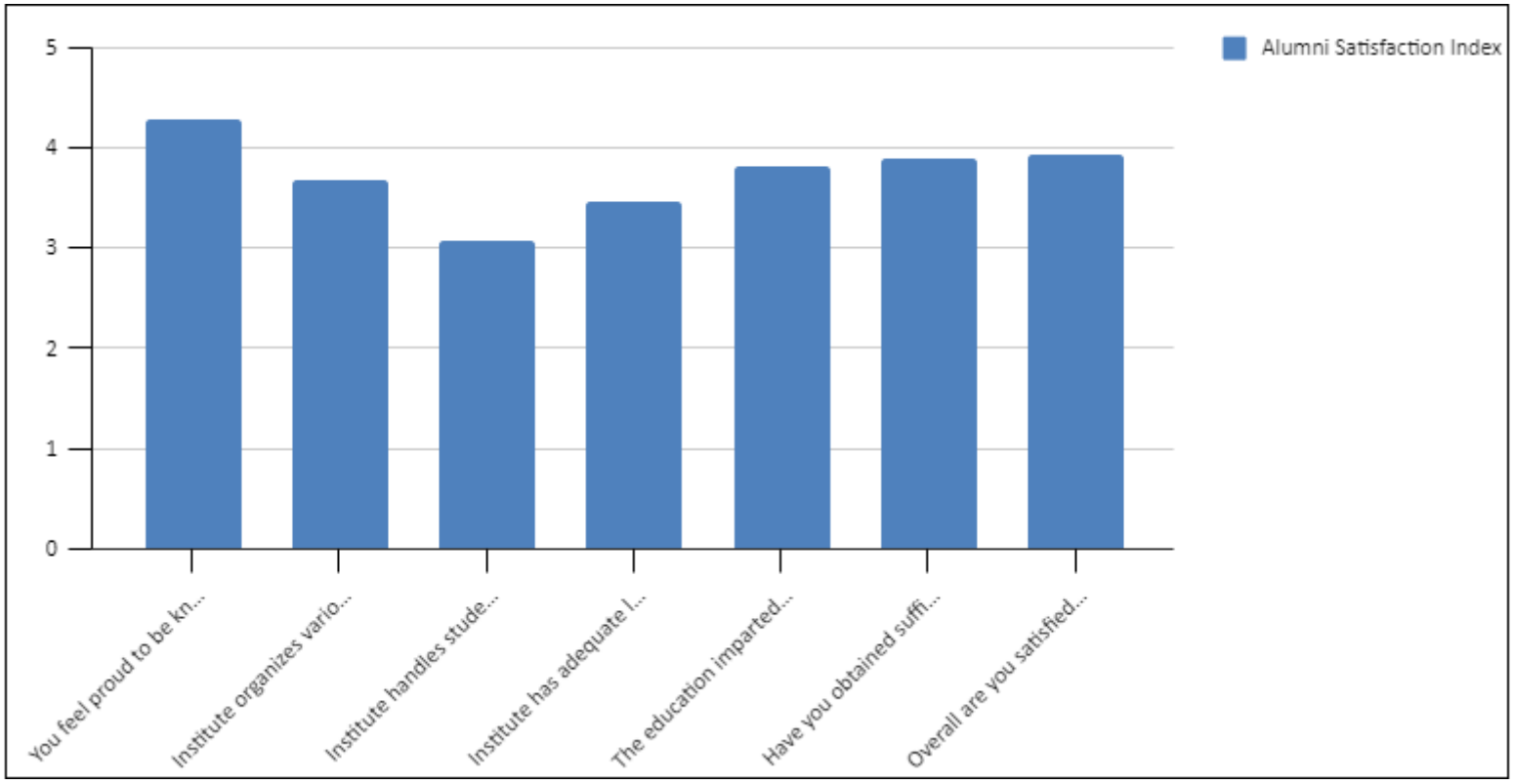
Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree
You feel proud to be known as an MITS Alumnus
Institute organizes various kinds of activities for the overall development of students
Institute handles students' grievances properly
Institute has adequate laboratories and equipment 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
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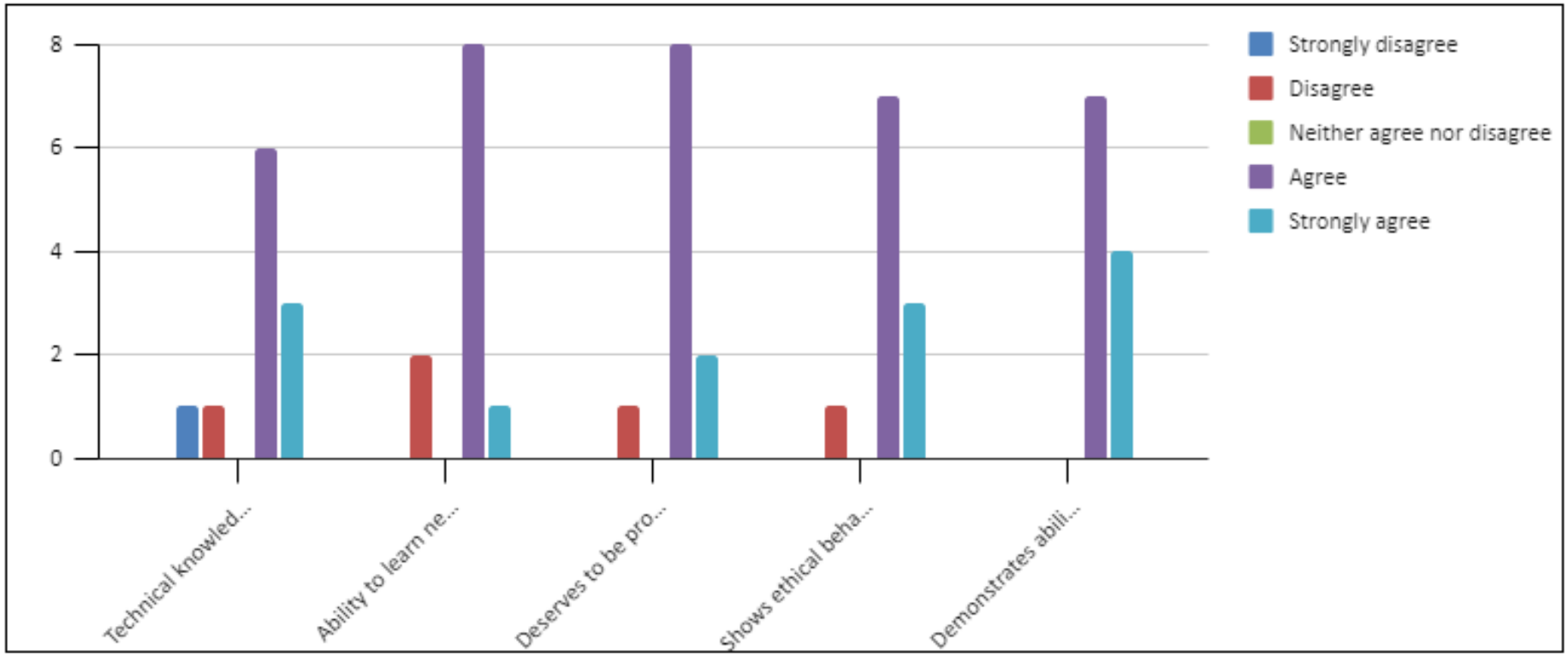
You feel proud to be kn...
Institute organizes vario...
Institute handles stude...
Institute has adequate l...
The education imparted...
Have you obtained suffi...
Overall are you satisfied...

7. EMPLOYER FEEBACK

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	3.818181818
Ability to learn new areas, engage in professional development, and adapt to technological changes	0	2	0	8	1	3.727272727
Deserves to be promoted/has potential for elevation to higher level	0	1	0	8	2	4
Shows ethical behaviour and social responsibility	0	1	0	7	3	4.090909091
Demonstrates ability to work well on a team	0	0	0	7	4	4.363636364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Deserves to be pro...
Shows ethical beha...
Demonstrates abili...
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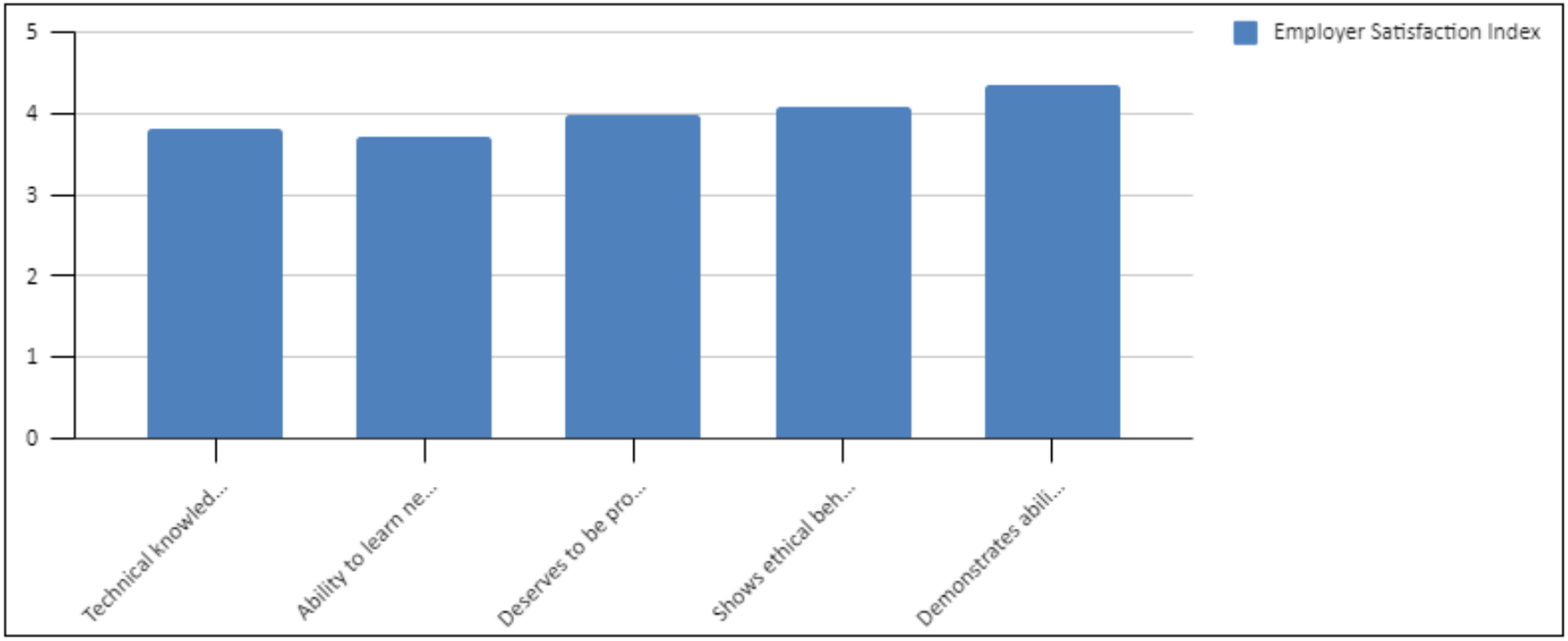
Disagree
Neither agree nor disagree
Agree
Strongly agree


Employer Satisfaction Index
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Shows ethical beh...
Demonstrates abili...