Course Information Sheet (CIS)

1. **Academic Year** : 2023 – 24 ODD Semester
2. **Name of Course Coordinator** : Manoj Kumar K
3. **Department** : Aeronautical Engineering
4. **Programme** : B.E - Aeronautical Engineering
5. **Class and semester** : II & III
6. **Course code and title** : 22AE3201 – ELEMENTS OF AERONAUTICS
7. **Regulations** : R2022
8. **Course Category** : ~~BS~~/~~HS~~/~~ES~~/PC/~~PE~~/~~OE~~
9. **Contact hours** : 45
10. **Type of course** : Theory / ~~Theory with Lab Component~~
11. **Credit** : 3
12. **Course Attainment level** : **60**
13. **Course pre-requisites** : -
14. **Course Learning Objectives (CLO)** :

a) To introduce the history of aviation, concept of flying and aircraft components.
b) To study about the various systems and instruments used in aircraft
c) To understand the structure of atmosphere and concept of flight mechanics.
d) To impart the knowledge about various propulsion systems used in aircraft and rocket.
e) To comprehend the various structures and materials used in aircraft.

15. **Course Outcomes (COs):**

Upon successful completion of this course, the student will be able to:

CO1	Understand the functions of aircraft components.
CO2	Able to identify the types of flight vehicles and control systems.
CO3	Understand the basic concepts of flight mechanics.
CO4	Understand the working principle of various aircraft propulsion system.
CO5	Acquire the knowledge about various materials used for aircraft construction.

16. Syllabus:

	UNIT-I HISTORY AND INTRODUCTION OF FLIGHT	**9**
CO1	Balloon flight – ornithopters - Early Airplanes- Pre Wright Brothers era-Biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years, Components of an Airplane and their functions - Introduction to rotorcraft - UAV and MAVs.	
	UNIT-II AIRCRAFT CONFIGURATIONS	**10**
CO2	Different Types of Flight Vehicles - Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems – Digital fly by wire systems - Engine control systems – Auto pilot system – Instrument Landing Systems - Basic Instruments for flying.	
	UNIT- III BASICS OF FLIGHT MECHANICS	**8**
CO3	Physical properties and structure of the atmosphere- Temperature, pressure and altitude relationships- Newton's law of motions applied to aeronautics, Evolution of Lift, Drag and Moment- Airfoils characteristics and nomenclature-Mach Number, Maneuvers.	
	UNIT-IV AIRCRAFT PROPULSION	**10**
CO4	Basic Ideas about piston engine and jet engines - working principle and basic components, Use of Propeller and Jets for Thrust Production, -Comparative Merits - Principles of Operation of Rocket - Types of Rocket and typical applications – exploration into space.	
	UNIT-V AIRCRAFT STRUCTURES AND MATERIALS	**8**
CO5	General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke"s law- stress-strain diagrams-elastic constants-Factor of Safety.	

Total Instructional Hours - 45

17. Text books and Reference books:

T1 - Anderson, J.D., "Introduction to flight", 8th edition, McGraw Hill, 2015

T2 - A.C. Kermode, "Flight without formulae", Pearson education, 5th edition, 2010.

R1 - Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

R2 - George P. Sutton and Oscar Biblarz, Rocket Propulsion Elements, 7th edition, John Wiley& Sons, Inc., New York, 2001.

R3 - Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", 5th edition, Butterworth-Heinemann Publishers, London, 2003.

Web Resource:

- https://www.nasa.gov/centers/armstrong/capabilities/CodeR/aerodynamics.html
- www.springer.com/gp/book/9783319300207
- www.dept.aoe.vt.edu/~mason/Mason_f/ConfigAeroDesignOpt.pdf
- https://www.grc.nasa.gov/WWW/K-12/airplane/bgp.html
- www.sciencedirect.com/science/article/pii/S187770581102707X

18. Course plan:

Sl. No	Topic	No. of Hrs	Cum Hrs	Text/ Ref Book	Teaching Methods	Teaching Aids
UNIT-I HISTORY AND INTRODUCTION OF FLIGHT						
GROUP – I						
1	Balloon flight	1	1	T1,T2	Lecture / Flipped Classroom/ Activity based Learning	Power point presentation/ Recorded video / Models
2	Ornithopters	1	2	T1,T2		
3	Early Airplanes	1	3	T1,T2		
4	Biplanes and monoplanes	1	4	T1,T2		
5	Components of an Airplane and their functions	1	5	T1,T2		
6	Introduction to rotorcraft	1	6	T1,R1		
7	UAV and MAVs	1	7	T1,R1	Activity (Glider Making)	Video
GROUP – II						
8	Pre Wright Brothers era	1	8	T1,R1	Seminar /Group Discussion/ Quiz	Power point presentation / Animation
9	Developments in aerodynamics, materials, structures and propulsion over the years	1	9	T1,R1		
UNIT-II AIRCRAFT CONFIGURATIONS						
GROUP – I						
1	Different Types of Flight Vehicles	1	10	T1,R1	Quiz	Testmoz
2	Conventional Systems	1	11	T1,R1	Lecture	Power point presentation/ Recorded video /Animation
3	Power assisted and fully powered flight controls	2	13	T1,R1		
4	Power actuated systems	1	14	T1,R1		
5	Basic Instruments for flying.	1	15	T1,R1		
GROUP – II						
6	Digital fly by wire systems	1	16	T1,R1	Flipped class room /Group Discussion	Power point presentation/ Animation
7	Engine control systems	1	17	T1,R1		
8	Auto pilot system	1	18	T1,R1		
9	Instrument Landing Systems	1	19	T1,R1		

UNIT- III BASICS OF FLIGHT MECHANICS						
GROUP – I						
1	Physical properties and structure of the atmosphere	1	20	T1,R1	Lecture	Power point presentation/ Recorded video /Quiz
2	Temperature, pressure and altitude relationships	1	21	T1,R1		
3	Newton's law of motions applied to aeronautics	1	22	T1,R1		
4	Evolution of Lift	1	23	T1,R1		
5	Drag and Moment	1	24	T1,R1		
6	Airfoils characteristics and nomenclature	1	25	T2,R3		
GROUP – II						
7	Mach Number	1	26	T1,R1	Flipped class room	Power point presentation/ Animation
8	Maneuvers	1	27	T1,R1		
UNIT-IV AIRCRAFT PROPULSION						
GROUP – I						
1	Basic Ideas about piston engine	1	28	T1,R1	Seminar/ Group Discussion	Power point presentation/ Recorded video /Animation
2	Basic Ideas about jet engines	1	29	T1,R2		
3	Comparative Merits	1	30	T1,R2		
4	Principles of Operation of Rocket	1	31	T1,R2	Lecture	PPT, Videos
5	Exploration into space	1	32	T1,R2		
GROUP – II						
6	Working principle and basic components-Piston engine	1	33	T1,R1	Lecture/ Flipped class room	Power point presentation/ Models
7	Working principle and basic components-Jet engine	1	34	T1,R1		
8	Use of Propeller for Thrust Production	1	35	T1,R1		
9	Jets for Thrust Production	1	36	T1,R1		
10	Types of Rocket and typical applications	1	37	T1,R2		

UNIT-V AIRCRAFT STRUCTURES AND MATERIALS						
GROUP – I						
1	General types of construction, Monocoque, semi-monocoque and geodesic constructions	1	38	T1,R1	Lecture/Quiz /Activity based Learning	Power point presentation/ Recorded video /Animation
2	Typical wing structure	1	39	T1,R1		
3	Fuselage structure	1	40	T1,R1		
4	Composite materials	1	41	T1,R1		
GROUP – II						
6	Metallic and non-metallic materials	1	42	T1,R1	Flipped class room/ Seminar	Power point presentation
7	Use of Aluminium alloy, titanium, stainless steel	1	43	T1,R1		
8	Stresses and strains-Hooke"s law-stress-strain diagrams	1	44	T2,R1		
9	Elastic constants-Factor of Safety	1	45	T2,R1		

Total No. of lecture hours allotted: 45

19. Weightage of unit contents:

Factors considered,

F1. Number of periods allotted for teaching the unit, and weightage per hour is equal to 1.

F2. Usefulness of the content matter of the unit in the student's learning point of view and its weightage equal to 1 if useful otherwise zero.

F3. Usefulness of the content matter of the unit in understanding other units of the same subject and its weightage equal to 1 if useful otherwise zero.

F4. Usefulness of the content matter of the unit in understanding other subjects prescribed for the programme and its weightage equal to 1 if useful otherwise zero.

S.NO.	Name of the Topic	F_1	F_2	F_3	F_4	A_1 (Weightage)	A_2 (%)
UNIT-I HISTORY AND INTRODUCTION OF FLIGHT							
1	Balloon flight	9	1			26	16.88
2	Ornithopters		1				
3	Early Airplanes		1				
4	Pre Wright Brothers era		1				
5	Biplanes and monoplanes		1	1			
6	Developments in aerodynamics, materials, structures and propulsion		1	1			

	over the years						
7	Components of an Airplane and their functions		1	1	1		
8	Introduction to rotorcraft		1	1	1		
9	UAV and MAVs		1	1	1		
UNIT-II AIRCRAFT CONFIGURATIONS							
10	Different Types of Flight Vehicles	10	1	1	1	36	23.37
11	Conventional Systems		1	1	1		
12	Power assisted and fully powered flight controls		2	1	1		
13	Power actuated systems		1	1	1		
14	Digital fly by wire systems		1	1	1		
15	Engine control systems		1		1		
16	Auto pilot system		1		1		
17	Instrument Landing Systems		1	1	1		
18	Basic Instruments for flying		1	1	1		
UNIT- III BASICS OF FLIGHT MECHANICS							
19	Physical properties and structure of the atmosphere	8	1	1	1	27	17.53
20	Temperature, pressure and altitude relationships		1	1	1		
21	Newton's law of motions applied to aeronautics		1		1		
22	Evolution of Lift		1		1		
23	Drag and Moment		1		1		
24	Airfoils characteristics and nomenclature		1		1		
25	Mach Number		1	1	1		
26	Maneuvers		1		1		
UNIT-IV AIRCRAFT PROPULSION							
27	Basic Ideas about piston engine	10	1	1	1	34	22.07
28	Basic Ideas about jet engines		1	1	1		
29	Working principle and basic components-Piston engine		1		1		
30	Working principle and basic components-Jet engine		1		1		
31	Use of Propeller for Thrust Production		1		1		
32	Jets for Thrust Production		1	1	1		
33	Comparative Merits		1	1	1		
34	Principles of Operation of Rocket		1		1		
35	Types of Rocket and typical applications		1		1		
36	Exploration into space		1		1		

UNIT-V AIRCRAFT STRUCTURES AND MATERIALS							
37	General types of construction, Monocoque, semi-monocoque and geodesic constructions	8	1	1	1	29	18.83
38	Typical wing structure		1	1	1		
39	Fuselage structure		1	1	1		
40	Metallic and non-metallic materials		1	1	1		
41	Use of Aluminium alloy, titanium, stainless steel		1	1	1		
42	Composite materials		1		1		
43	Stresses and strains-Hooke"s law-stress-strain diagrams		1	1	1		
44	Elastic constants-Factor of Safety		1				
					Total	**154**	**100%**
A_1 – Total weightage							
A_2 – % of Weightage							

20. Mapping syllabus with Bloom's Taxonomy LOT and HOT:

Lower Order Thinking		
R	Remembering	Students are expected to Recall the information through Recognizing, listing, describing, retrieving, naming, finding
U	Understanding	Students are expected to Explain an ideas or concepts through Interpreting, summarizing, paraphrasing, classifying, explaining
Ap	Applying	Students are expected to Use the information in another familiar situation through Implementing, carrying out, using, executing
Higher Order Thinking		
A	Analyzing	Students are expected to Break the information into parts to explore understandings and relationships through Comparing, organizing, deconstructing, interrogating, finding
E	Evaluating	Students are expected to Evaluate the Justifying a decision or course of action through Checking, hypothesizing, experimenting, judging
C	Creating	Students are expected to Generate new ideas, products, or ways of viewing things through Designing, constructing, planning, producing, inventing.

UNIT-I HISTORY AND INTRODUCTION OF FLIGHT (Weightage 16.88 %)			
Sl.No	**Name of the Topic**	**Process verb**	**Types of thinking CO1**
1	Balloon flight	Define, What, How	Remembering
2	Ornithopters	Explain, Compare	Understanding
3	Early Airplanes	Recall,What, How, When	Remembering
4	Pre Wright Brothers era	Define,What, How	Remembering
5	Biplanes and monoplanes	Explain, Compare	Understanding

6	Developments in aerodynamics, materials, structures and propulsion over the years	Explain, Compare	Understanding
7	Components of an Airplane and their functions	Explain, Illustrate	Understanding
8	Introduction to rotorcraft	Explain, Illustrate	Understanding
9	UAV and MAVs	Explain, Illustrate	Understanding

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	3	6	0	0	0	0	9
Weightage,%	**5.63**	**11.25**	**0**	**0**	**0**	**0**	**16.88%**

UNIT-II AIRCRAFT CONFIGURATIONS (Weightage 23.37 %)

Sl.No	Name of the Topic	Process verb	Types of thinking CO2
1	Different Types of Flight Vehicles	Find, What	Remembering
2	Conventional Systems	Find, What, Why	Remembering
3	Power assisted and fully powered flight controls	Apply	Applying
4	Power actuated systems	Apply, Develope	Applying
5	Digital fly by wire systems	Explain, Relate	Understanding
6	Engine control systems	Explain, Compare	Understanding
7	Auto pilot system	Explain, Relate	Understanding
8	Instrument Landing Systems	Classify, Explain, Relate	Understanding
9	Basic Instruments for flying	Illustrate, Show	Understanding
10	Different Types of Flight Vehicles	Illustrate, Show	Understanding

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	2	5	2	0	0	0	9
Weightage,%	**4.91**	**12.26**	**4.91**	**0**	**0**	**0**	**22.08%**

UNIT- III BASICS OF FLIGHT MECHANICS (Weightage 17.53 %)

Sl.No	Name of the Topic	Process verb	Types of thinking CO3
1	Physical properties and structure of the atmosphere	Classify, Compare	Understanding
2	Temperature, pressure and altitude relationships	Classify	Understanding
3	Newton's law of motions applied to aeronautics	Apply,Identify	Applying
4	Evolution of Lift	Explain	Understanding
5	Drag and Moment	Explain, Show	Understanding
6	Airfoils characteristics and nomenclature	Explain, Show	Understanding
7	Mach Number	Identify,Apply	Applying
8	Maneuvers	Explain, Illustrate	Understanding

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	0	7	2	0	0	0	9
Weightage,%	**0**	**15.66**	**4.47**	**0**	**0**	**0**	**20.13%**

UNIT-IV AIRCRAFT PROPULSION(Weightage 22.07 %)

Sl.No	Name of the Topic	Process verb	Types of thinking CO4
1	Basic Ideas about piston engine	Explain,Relate	Understanding
2	Basic Ideas about jet engines	Explain	Understanding
3	Working principle and basic components-Piston engine	Explain	Understanding
4	Working principle and basic components-Jet engine	Explain, Relate	Understanding
5	Use of Propeller for Thrust Production	Compare, Explain	Understanding
6	Jets for Thrust Production	Explain, compare	Understanding
7	Comparative Merits	Relate, Compare	Understanding
8	Principles of Operation of Rocket	Explain	Understanding
9	Types of Rocket and typical applications	Classify	Understanding
10	Exploration into space	Relate, Summarize	Understanding

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	0	10	0	0	0	0	10
Weightage,%	**0**	**22.08**	**0**	**0**	**0**	**0**	**22.08%**

UNIT-V AIRCRAFT STRUCTURES AND MATERIALS (Weightage 18.83 %)

Sl. No.	Name of the Topic	Process verb	Types of thinking CO5
1	General types of construction, Monocoque, semi-monocoque and geodesic constructions	Explain,Summarize	Understanding
2	Typical wing structure	Explain, Illustrate	Understanding
3	Fuselage structure	Explain, Illustrate	Understanding
4	Metallic and non-metallic materials	Explain, Illustrate	Understanding
5	Use of Aluminium alloy, titanium, stainless steel	Relate, Compare	Understanding
6	Composite materials	Classify,Show	Understanding
7	Stresses and strains-Hooke"s law- stress-strain diagrams	Apply, Develop	Applying
8	Elastic constants-Factor of Safety	Find,Recall	Remembering

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	1	6	1	0	0	0	8
Weightage,%	**2.35**	**14.13**	**2.35**	**0**	**0**	**0**	**18.83%**

	R	U	AP	A	E	C	TOTAL
UNIT 1	5.63	11.25	0	0	0	0	16.88%
UNIT 2	4.91	12.26	4.91	0	0	0	23.37 %
UNIT 3	0	15.66	4.47	0	0	0	17.53 %
UNIT 4	0	22.08	0	0	0	0	22.07 %
UNIT 5	2.35	14.13	2.35	0	0	0	18.83 %
TOTAL	12.53	73.57	11.43	0	0	0	100
Lower Order Thinking				100 %			
Higher Order Thinking				0 %			

21. Mapping course outcome with Bloom's Taxonomy LOT and HOT:

	R	U	Ap	A	E	C
CO1	√√√	√√√√√				
CO2	√√	√√√√√	√√			
CO3		√√√√√√√	√√			
CO4		√√√√√√√√√				
CO5	√	√√√√√	√			

22. Mapping Course Outcome (CO) with Program Outcomes (PO) and Program Specific Outcomes (PSO):

	Program Outcomes	Descriptions
PO1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions	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.
PO4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage	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.
PO6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the

		consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication	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.
PO11	Project management and finance	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 projects and in multidisciplinary environments.
PO12	Life-long learning	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.

PSO1	Apply the knowledge of aerodynamics, structures, propulsion, avionics, and aircraft maintenance to give solutions for complex engineering problems.
PSO2	Use progressive methodology and tools involving design, analyze, and experiment in aircraft design.

PO & PSO →	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	-	-	-	-	-	-	-	-	-	-	1	2	1
CO2	3	-	-	-	-	-	-	-	-	-	-	2	2	1
CO3	3	-	-	-	-	-	-	-	-	-	-	2	2	1
CO4	3	-	-	-	-	-	-	-	-	-	-	2	2	1
CO5	3	-	-	-	-	-	-	-	-	-	-	2	2	1

3	High	2	Moderate	1	Low

23. Course assessment: (Direct Assessment Method)

Internal Test: 40 Marks

Objective	To identify what students have learned and also to identify students strength and weakness.
Product	Answer scripts
Frequency	Twice per semester
Format	Part –A 10x 2 = 20 Marks; Part –B 5 x 14 =70 Marks; Part – C 1 x 10 = 10 Marks Total marks= 100 Duration: 3 Hours
Evaluation	Based on answer given in the scripts
Criteria	Pass mark – 50marks Attainment level: To be fixed by the Course coordinator based on the nature of the course.

Individual Assignment/Tutorial:

Objective	To enhance students' understanding of a particular reading
Product	Hand written / Tutorial sheets
Frequency	Within each Assessment Period
Format	Important area from the course
Evaluation	Based on rubrics
Criteria	Submit on or before the date of submission

Seminar / Case Study / Any other component relevant to the course

Objective	To enhance students' understanding of a particular reading and Communication
Product	Oral Presentation / Recorded audio/Recorded video /Report/ Quiz/ based on the nature of other component
Frequency	Within each Assessment Period
Format	Important area from the course
Evaluation	Based on rubrics
Criteria	No. of Seminars : 1 per Assessment

End semester exam: 60 marks

Objective	**To assess the each student's knowledge of the course**
Product	Result analysis
Frequency	Every Semester
Format	Part –A 10 x 2= 20 marks Part –B 5 x 14= 70 marks Part – C 1 x 10 = 10 Marks Total marks= 100 Duration : 3 Hours
Evaluation	Based on answer given in the scripts

24. Course Assessment: (Indirect Assessment Method)

Course Exit Survey: Course Exit Survey consists of few critical questions that evaluate the level of students' satisfaction level with curriculum and course being taught.

Prepared by,

Course Coordinator

Checked by,

Head of the Department

Approved by,

Dean (Academics)

PRINCIPAL

Course Information Sheet (CIS)

1. **Academic Year** : 2023 – 24 ODD Semester
2. **Name of Course Coordinator** : Dr. S.PANEERSELVAM
3. **Department** : Agricultural Engineering
4. **Programme** : B.E Agricultural Engineering
5. **Class and semester** : IV year and VII semester
6. **Course code and title** : 19AG7201/ Agricultural Extension
7. **Regulations** : 2019
8. **Course Category** : Core -Theory
9. **Contact hours** : 45
10. **Type of course** : Theory
11. **Credit** : 3
12. **Course Attainment level** : **60%**
13. **Course pre-requisites:**

Basic knowledge about Agriculture Extension Mass Transfer

14. **Course learning objectives:**

- To explain the extension functionaries on the latest developments in the field of agricultural extension
- To equip the extension functionaries in latest tools and techniques for participatory decision making
- To develop an insight into various extension models to enrich the agri - value chain

15. **Course Outcomes (COs):**

Upon successful completion of this course, the student will be able to:

CO1 -	To critically analyze different Agricultural Extension approaches
CO2 -	: Understand Agricultural Knowledge Information System
CO3 -	New trends in agriculture extension: privatization extension.

CO4 -	Monitoring and evaluation – concept and definition, monitoring, and evaluation of Extension programmes, Transfer of Technology- Concept and models
CO5 -	To expose with various Rural development programmes aimed at poverty alleviation and to increase employment opportunities and their analysis

16. Course Syllabus:

	UNIT I - Principles of Extension	**9**
CO1	Extension Education – Meaning, objectives, concepts, principles and philosophy–Extension teaching methods and factors influencing the selection of teaching.	

	UNIT II – Methods of contact	**9**
CO2	Individual contact-Group contact Exhibition-campaign and public speaking -Field trips and tours -purpose procedure, advantage and limitations	

	UNIT III - Methods of communication	**9**
CO3	Mass contact -written communication, circular letter, leaflet, folder, pamphlet and newspaper-purpose procedure advantages and limitations. Organizing youth club -farmer club mahila mandal purpose and procedure.	

	UNIT IV - Visual communication	**9**
CO4	Audio -visual aids-definition, importance, selection, use and factors influencing selection, merits and demerits-Electronic media -radio, television and video procedure – advantage and limitations- Transfer of technology -meaning , importance and major components – communication -definition, meaning, scope and importance-functions	

	UNIT V - Current Approaches in Extension	**9**
CO5	Decentralised Decision Making-Bottom up Planning-Farming System Approach,Farming Situation Based Extension- Market – Led – Extension	

Total Instructional Hours 45

17. Text book and Reference book:

T1. Annamalai, R., M. Manoharan, S.Somasundarm and K.N.Krishnakumar, 1987;Extension methods and their principles. Palaniappa printers, Tirunelveli.

T2. Berlo,1970; Process of communication. Holt Rinehart Winston Inc. Newyork

T3. Dahama,O.P. and O.P.Bhatnagar,1985; Education and communication for development, Oxford and IBH publishing Co.,New Delhi.
R1. Directorate of extension, 1968; Extension education in community development, Ministry of food and agriculture, Government of India, New Delhi
R2. Ray G.L.1971;Extension communication and management, Naya Prakash, Kolkata
R3. Rogers E. 1985; Diffusion of innovation, Collier McMillan publishers, London.

18. Course plan:

S. No	Name of the Topic	No of Hours	Cumulative Hours	Teaching Methods	Teaching Aids	Text/Reference Book
			UNIT I			
1	Introduction to Extension Education – Meaning	2	2	PPT, Lecture,	Chalk & Talk,	T1, T2, R1
2	Extension Education – objectives	2	4	Blackboard Lecture, Video	Chalk & Talk,	T1, T2, R1
3	Extension Education – objectives, concepts	2	6	Blackboard Lecture	Chalk & Talk,PPT ,Video	T1, T2, R1
4	Extension Education-working objectives - concepts- principles and philosophy	1	7	Blackboard Lecture	PPT & Video	T1, T2, R1
5	Extension Education-factors influencing the selection of teaching	2	9	PPT & Videos	Chalk & Talk	T1, T2, R1
S. No	**Name of the Topic**	**No of Hours**	**Cumulative Hours**	**Teaching Methods**	**Teaching Aids**	**Text/Reference Book**
			UNIT II			
1	Methods of communication – Individual contact methods	3	13	Blackboard Lecture	Chalk & Talk	T2, T3, R2,R3
2	Group contact methods	2	15	Blackboard Lecture,PPT	Chalk & Talk	T2, T3, R2,R3
3	Exhibition-campaign	1	14	PPT & Videos	Chalk & Talk	T2, T3, R2,R3
4	public speaking -Field trips and tours -purpose procedure	2	16	Blackboard Lecture	Chalk & Talk	T2, T3, R2,R3
5	Group contact methods	1	17	Blackboard Lecture	Chalk & Talk	T2, T3, R2,R3

	advantage and limitations					

S. No	Name of the Topic	No of Hours	Cumulative Hours	Teaching Methods	Teaching Aids	Text/Reference Book
	UNIT III					
1	Mass contact -written communication	2	19	Blackboard Lecture	Chalk & Talk	T1, T3, R2
2	Circular letter, leaflet, folder, pamphlet and newspaper	2	21	Blackboard Lecture	Kahoot	T1, T3, R2
3	Circular letter, leaflet, folder, pamphlet and newspaper- purpose procedure advantages and limitations	2	23	Blackboard Lecture	Chalk & Talk	T1, T3, R2
4	Organizing youth club	1	24	Blackboard Lecture	Chalk & Talk	T1, T3, R2
5	Farmer club mahila mandal purpose and procedure.	2	26	Blackboard Lecture	Chalk & Talk	T1, T3, R2
S. No	**Name of the Topic**	**No of Hours**	**Cumulative Hours**	**Teaching Methods**	**Teaching Aids**	**Text/Reference Book**
	UNIT IV					
1	Audio -visual aids- definition	1	28	Blackboard Lecture	Seminar	T2, T3, R3
2	Audio -visual aids- definition -importance, selection, use	2	29	Blackboard Lecture	Chalk & Talk	T2, T3, R3
3	factors influencing selection, merits and demerit	2	31	videos	Board, PPT	T2, T3, R3
4	Electronic media -radio	1	33	Blackboard Lecture	Chalk & Talk	T2, T3, R3
5	Electronic media - television and video procedure	1	34	Blackboard Lecture	Chalk & Talk	T2, T3, R3
6	Advantage and limitations.	2	36	Lecture	Seminar	T2, T3, R3

S. No	Name of the Topic	No of Hours	Cumulative Hours	Teaching Methods	Teaching Aids	Text/Reference Book
			UNIT V			
1	Decentralised Decision Making	2	37	Blackboard Lecture	Chalk & Talk	T2,R1,R3
2	Bottom up Planning	1	38	Blackboard Lecture	PPT	T2,R1,R3
3	Farming System Approach	2	39	Blackboard Lecture	Chalk & Talk	T2,R1,R3
4	Farming Situation Based Extension	2	41	Blackboard Lecture	Board & PPT	T2,R1,R3
5	Market – Led – Extension	2	43	Blackboard Lecture	Chalk & Talk & PPT	T2,R1,R3

Total Instructional Hours 45

19. Weightage of unit contents:

Factors considered,

F1 Number of periods allotted for teaching the unit and weightage per hour is equal to 1.

F2 Usefulness of the content matter of the unit in the student's learning point of view and its weightage equal to 1 if useful otherwise zero.

F3 Usefulness of the content matter of the unit in understanding other units of the same subject and its weightage equal to 1 if useful otherwise zero.

F4 Usefulness of the content matter of the unit in understanding other subjects prescribed for the programme and its weightage equal to 1 if useful otherwise zero.

Topic	F_1	F_2	F_3	F_4	A_1 (Weightage)	A_2 (%)
UNIT I						
Extension Education – Meaning, objectives, concepts	9	1	1	1	20	20.42
Extension Education- concepts		1	1	1		
principles and philosophy- Extension teaching method		1	1	1		
Factors influencing the selection of teaching		1	0	1		
UNIT II						
Individual contact-Group contact	9	1	1	1	20	20.41
Exhibition-campaign and public speaking		1	1	1		
Field trips and tours		1	1	1		

Field trips and tours purpose procedure, advantage and limitations		1	0	1		
UNIT III						
Mass contact -written communication	9	1	1	1	**21**	**21.43**
circular letter, leaflet, folder, pamphlet and newspaper		1	1	1		
circular letter, leaflet, folder, pamphlet and newspaper-purpose procedure advantages and limitations		1	1	1		
Organizing youth club -farmer club mahila mandal purpose and procedure.		1	1	1		
UNIT IV						
Audio -visual aids-definition, importance, selection, use	9	1	1	1	**19**	**19.38**
factors influencing selection, merits and demerits-		1	1	1		
Electronic media -radio, television and video procedure		1	0	1		
Electronic media -radio, television and video procedure- advantage and limitations.		1	0	1		
UNIT V						
Decentralized Decision Making-Bottom up Planning	9	1	1	1	**18**	**18.36**
Farming System Approach		1	0	1		
Farming Situation Based Extension		1	0	1		
Market – Led – Extension		1	0	1		
				Total	**98**	**100%**
A1 – Total weightage						
A2 – % of Weightage						

20. Mapping syllabus with Bloom's Taxonomy LOT and HOT:

Lower Order Thinking		
R	Remembering	Students are expected to Recall the information through Recognizing, listing, describing, retrieving, naming, finding
U	Understanding	Students are expected to Explain an ideas or concepts through Interpreting, summarizing, paraphrasing, classifying, explaining
Ap	Applying	Students are expected to Use the information in another familiar situation through Implementing, carrying out, using, executing
Higher Order Thinking		
A	Analyzing	Students are expected to Break the information into parts to explore understandings and relationships through Comparing, organizing, deconstructing, interrogating, finding
E	Evaluating	Students are expected to Evaluate the Justifying a decision or course of action through Checking, hypothesizing, experimenting, judging
C	Creating	Students are expected to Generate new ideas, products, or ways of viewing things through Designing, constructing, planning, producing, inventing.

UNIT I (Weightage 20.42%)			
S. No	Name of the Topic	Process verb	Types of thinking
1	Extension Education – Meaning, objectives, concepts	Define/State/what/Name/Write	Remembering **CO1**
2	Principles and philosophy-Extension teaching methods	What/Define/Write/State/List	Remembering **CO1**
3	Factors influencing the selection of teaching	Distinguish / Explain/ Outline / Relate/ Summarize	Understanding **CO1**

	R	**U**	**Ap**	**A**	**E**	**C**	**Total**
Type of thinking in Nos	2	1	0	0	0	0	3
Weightage, %	**13.61**	**6.81**	**0**	**0**	**0**	**0**	**20.42**

UNIT II (Weightage 20.41%)			
S. No	Name of the Topic	Process verb	Types of thinking
4	Individual contact-Group contact	Distinguish / Explain/ Outline / Relate/ Summarize	Understanding **CO2**
5	Exhibition-campaign and public	Compare/Determine/Estimate	Understanding

	speaking		CO2CO2
6	Field trips and tours -purpose procedure, advantage and limitations	Compare/Determine/Estimate	Understanding CO2

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	1	2	0	0	0	0	3
Weightage, %	**6.81**	**13.61**	**0**	**0**	**0**	**0**	**20.42**

UNIT III (Weightage 21.43%)

S. No	Name of the Topic	Process verb	Types of thinking
7	Mass contact -written communication	Identify/list/Explain	Understanding CO3
8	circular letter, leaflet, folder, pamphlet and newspaper-purpose procedure advantages and limitations	Apply/Identify/Organize	Applying CO3
9	Organizing youth club -farmer club mahila mandal purpose and procedure.	Apply/Identify/Organize	Applying CO3

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	0	1	2	0	0	0	3
Weightage, %	**0**	**7.15**	**14.28**	**0**	**0**	**0**	**21.43**

UNIT IV (Weightage 19.38%)

S. No	Name of the Topic	Process verb	Types of thinking
20	Audio -visual aids-definition, importance, selection, use	Define/State/what/ Name/Write	Remembering CO4
21	Factors influencing selection, merits and demerits	Identify/outline/Explain	Understanding CO4
22	Electronic media -radio, television and video procedure – advantage and limitations.	Identify/outline/Explain	Understanding CO4

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	1	2	0	0	0	0	3
Weightage, %	**6.46**	**12.92**	**0**	**0**	**0**	**0**	**19.38**

UNIT V (Weightage 18.36%)			
S. No	Name of the Topic	Process verb	Types of thinking
25	Decentralised Decision Making-Bottom up Planning	Identify/outline/Explain	Understanding CO5
26	Farming System Approach	Apply/Identify/Organize	Applying CO5
27	Farming situation based extension - market led -Extension	Compare/Determine/Estimate	Evaluating CO5

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	0	1	1	0	1	0	3
Weightage, %	**0**	**6.00**	**6.36**	**0**	**6.00**	**0**	**18.36**

	R	U	AP	A	E	C	TOTAL
UNIT 1	13.61	6.81	0	0	0	0	**20.42**
UNIT 2	6.81	13.61	0	0	0	0	**20.42**
UNIT 3	0	7.15	14.28	0	0	0	**21.43**
UNIT 4	6.46	12.92	0	0	0	0	**19.38**
UNIT 5	0	6.00	6.36	0	6.00	0	**18.36**
TOTAL	**26.88**	**46.48**	**20.64**	**0**	**6.00**	**0**	**100**
Lower Order Thinking				**85.72**			
Higher Order Thinking				**14.28**			

21. Mapping course outcome with Bloom's Taxonomy LOT and HOT:

	R	U	Ap	A	E	C
CO1	✓✓	✓				
CO2	✓	✓✓				
CO3		✓	✓✓			
CO4	✓	✓✓				
CO5		✓	✓		✓	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	2		2		1	1			1	1		1	1	1	
CO2	2	1	1			1	2		2	1	1	2	1	2	
CO3	3		1		2	2			1	2		1	2	1	
CO4	2		1		1		2		1	1	1		2	2	1
CO5	3	2	1	1	1	2	1		1	1	1	2	2	1	1

3	High level	2	Moderate level	1	Low level

22. **Mapping Course Outcome (CO) with Program Outcomes (PO) and Program Specific Outcomes (PSO):**

	Program Outcomes	Descriptions
PO1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions	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.
PO4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage	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.
PO6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable

		development.
PO8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication	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.
PO11	Project management and finance	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 projects and in multidisciplinary environments
PO12	Life-long learning	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.

PSO1	Apply the knowledge of extension education and principles of Extension communication
PSO2	Acquire working knowledge of communication and e learning process
PSO3	Innovate and integrate the new ideas of extension education and recent approach

23. Mapping with programme educational objectives:

Programme educational objectives:

Graduates of Chemical Engineering will be able to:

PEO 1: Participate as leaders in their fields of expertise and in activities that support service and economic development nationally and throughout the world.

PEO 2: Pursue continued life-long learning through professional practice, research and training programs in the field of chemical engineering and science.

PEO 3: Solve real-life problems in a broad perspective to fulfil ethical, economic, environmental and social responsibilities.

COURSE	PEO1	PEO2	PEO3
AGRICULTURAL EXTESNION	2	2	-

3	High level	2	Moderate level	1	Low level

24. Course assessment: (Direct Assessment Method)

Internal Assessment (40 Marks)							External Assessment (60 Marks)
Assessment I (100 Marks) – First 2.5 Units			Assessment II (100 Marks) - Second 2.5 Units			Total (200 Marks)	
Individual Assignment I /Tutorial (20)	Seminar / Case Study /Quiz/ Any other component relevant to the course (20)	Written Test (Internal I(100))	Individual Assignment I /Tutorial (20)	Seminar / Case Study /Quiz/ Any other component relevant to the course (20)	Written Test (Internal I(100))	Internal Assessment (To be converted into 40 marks)	End Semester Exam (100 Marks)
40		60	40		60	200	100
Total marks secured out of 200 has to be converted as Internal Assessment (40 Marks)							Total 100 marks to be converted as External Assessment 60 Marks

Internal Test:

Objective	To Identify What Students Have Learned and also to identify students strength and weakness
Product	Answer scripts
Frequency	Twice per semester
Format	Part –A 10x 2 = 20 Marks Part –B 5 x 14 =70 Marks Part – C 1 x 10 = 10 Marks Total marks= 100 Duration: 3 Hours
Evaluation	Based on answer given in the scripts

Criteria	Pass mark – 50marks Attainment level: To be Fixed by the Course coordinator based on the Nature of the Course.

Individual Assignment/Tutorial:

Objective	To enhance students' understanding of a particular reading
Product	Hand written /Tutorial sheets
Frequency	Within each Assessment Period
Format	Important area from the course
Evaluation	Based on rubrics
Criteria	Submit on or before the date of submission

Seminar / Case Study / Any other component relevant to the course

Objective	To enhance students' understanding of a particular reading and Communication
Product	Oral Presentation / Recorded audio/Recorded video /Report/ Quiz/based on the nature of other component
Frequency	Within each Assessment Period
Format	Important area from the course
Evaluation	Based on rubrics
Criteria	No. of Seminars : 1 per Assessment

End semester exam:

Objective	**To assess each student's knowledge of the course**
Product	Result analysis
Frequency	Semester
Format	Part –A 10 x 2= 20 marks Part –B 5 x 14= 70 marks Part – C 1 x 10 = 10 Marks Total marks= 100 Duration: 3 Hours
Evaluation	Based on answer given in the scripts
Criteria	Minimum Pass Mark: 50 Attainment level: To be Fixed by the Course coordinator based on the Nature of the Course.

25. Course assessment: (Indirect Assessment Method)

Course Exit Survey: Course Exit Survey consists of few critical questions that evaluate the level of students' satisfaction level with curriculum and course being taught.

Prepared by,

Course Coordinator

Checked by,

Head of the Department

Approved by,

Dean (Academics)

PRINCIPAL

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Course Information Sheet (CIS)

1. **Academic Year** : 2023-24 EVEN Semester
2. **Name of Course Coordinator** : S.NAGULDEV
3. **Department** : Chemical Engineering
4. **Programme** : B. Tech – Chemical Engineering
5. **Class and semester** : II B.Tech Chemical Engg./ IV Sem
6. **Course code and title** : 22CH4203 – PROCESS HEAT TRANSFER
7. **Regulations** : R2022
8. **Course Category** : PC
9. **Contact hours** : 45
10. **Type of course** : Theory
11. **Credit** : 3
12. **Course Attainment level** : 65%
13. **Course pre-requisites** : Fluid Mechanics
14. **Course Learning Objectives (CLO)** :

The student should be able to:

- Learn various heat transfer methods involved in chemical processes
- Study the mechanism of heat transfer in unit operations such as evaporation, drying etc
- Apply heat transfer concepts in real industry scenario
- Understand the concept of radiation and evaporation.
- Calculate the various dimensionless numbers in heat exchangers.

15. **Course Outcomes (COs)** :

Upon successful completion of this course, the student will be able to:

CO1: Ability to understand and solve conduction problems.

CO2: Ability to analyze and solve problems on convection.

CO3: Ability to apply analogies and correlations to solve industrial problems.

CO4: Ability to analyze and solve problems on radiation and Evaporation.

CO5: Ability to design and analyze the performance of heat exchangers.

16. Syllabus:

UNIT I 9

Unit-I **CONDUCTION:**
Importance of heat transfer in Chemical Engineering operations – Modes of heat transfer – Fourier's law of heat conduction – one dimensional steady state heat conduction equation for flat plate, hollow cylinder and sphere – Heat conduction through a series of resistances – Thermal conductivity measurement; effect of temperature on thermal conductivity; Heat transfer in extended surfaces- Optimum and economic thickness of insulation.

UNIT II 9

Unit-II **CONVECTION:** Concepts of heat transfer by convection – Natural and forced convection; analogies between transfer of momentum and heat – Reynold's analogy, Prandtl and Coulburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate, flow through packed beds

UNIT III 9

Unit-III **HEAT TRANSFER WITH PHASE CHANGE:** Heat transfer to fluids with phase change – heat transfer from condensing vapours, drop wise and film wise condensation. Derivation of Nusselt equation for vertical and horizontal tubes, condensation of superheated vapors. Heat transfer to boiling liquids – mechanism of boiling, nucleate boiling and film boiling.

UNIT IV 9

Unit-IV **RADIATION:** Radiation heat transfer – Thermal radiation – Laws of radiation – Black body concepts– Emissive power – Radiation shape factor – Gray bodies – Radiation shields **EVAPORATION:** Introduction – Types of Evaporators – Capacity – Steam economy – Boiling point elevation (Duhring rule); Material and energy balance of single effect evaporator; Theory of multiple effect evaporators; Design of single and multiple effect evaporators. Vapor recompression method.

UNIT V 9

Unit-V **HEAT EXCHANGERS:** Heat exchangers – Types and practical application –Concept of LMTD & Overall heat transfer coefficient; Effectiveness – NTU method for heat exchanger design; Fouling factor and estimation of Overall heat transfer coefficient; Special type of heat exchangers.

State of the Art: Basics of Cryogenic – Heat Transfer and Cooling Technics at Low Temperature 3

Total Instructional Hours – 45+3=48

17. Text books and Reference books:

TEXT BOOKS:

1 BinayK.Dutta., "Heat Transfer Principles and Applications", Prentice Hall of India, 14thn Edition, 2015.

2 McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005

3 G.K. Roy, Fundamentals of Heat and Mass Transfer, Khanna Publishers, Sixth Edition, 2017

4 Gavahane.K., "Heat Transfer", Nirali Prakasan, Pune, 1996

REFERENCE BOOKS:

1 Coulson, J.M. and Richardson, J.F., "Chemical Engineering " Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

2 Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999.

3 Holman, J. P., 'Heat Transfer, 8th Edition., Tata McGraw Hill, 1997.
4 Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I and II,4th Edition, Asian Books Pvt. Ltd., India,1998.

18. Course plan:

S. No.	Name of the Topic	No of Hours	Cumulative Hours	Teaching Methods	Teaching Aids	Text/Reference Books
UNIT-I- CONDUCTION						
Group-1						
1.	Importance of heat transfer in Chemical Engineering operations	1	1	Video	Youtube	T4/R2
Group-2						
2.	Modes of heat transfer, Fourier's law of heat conduction	1	2	PPT, Video	Google slides Youtube	T4/R2
3.	one dimensional steady state heat conduction equation for flat plate,sphere,cylinder	3	5	Blackboard Lecture	Chalk & Talk	T4/R2
4.	Heat conduction through a series of resistances	1	6	Blackboard Lecture	Chalk & Talk	T4/R2
5.	Thermal conductivity measurement; effect of temperature on thermal conductivity;	1	7	Blackboard Lecture	Chalk & Talk	T4/R2
6	Heat transfer in extended surfaces	1	8	Blackboard Lecture	Chalk & Talk	T4/R2
7	Optimum and economic thickness of insulation.	1	9	Blackboard Lecture	Chalk & Talk	T4/R2
UNIT-II - CONVECTION						
Group-1						
1.	Concepts of heat transfer by convection	1	10	Video	Youtube	T4/R2
Group-2						
2	Natural and forced convection,	3	13	Blackboard Lecture	Chalk & Talk	T4/R2
3	Analogies between transfer of momentum and heat - Reynolds's analogy, Prandtl and Coulburn analogy..	2	15	PPT, Video	Google slides Youtube	T4/R2
4	Dimensional analysis in heat transfer,	1	16	Blackboard Lecture, Video	Chalk & Talk PPT	T4/R2
5	Heat transfer coefficient for flow through a pipe, flow past flat plate, flow through packed beds	2	18	Blackboard Lecture	Chalk & Talk	T4/R2
UNIT-III - HEAT TRANSFER WITH PHASE CHANGE						
Group-1						
1.	Heat transfer to fluids with phase change -Heat transfer from condensing vapors,	2	20	Blackboard Lecture	Chalk & Talk	T4/R2
Group-2						

2	Drop wise and film wise condensation,	2	22	Blackboard Lecture,	Chalk & Talk Edupuzzle	T4/R2
3	Nusselt equation for vertical and horizontal tubes,	2	24	Blackboard Lecture	Chalk & Talk	T4/R2
4	condensation of superheated vapors.	1	25	Blackboard Lecture,	Chalk & Talk Youtube, Edupuzzle	T4/R2
5	Heat transfer to boiling liquids – mechanism of boiling, nucleate boiling and film boiling.	2	27	Blackboard Lecture, PPT	Chalk & Talk Edupuzzle	T4/R2
UNIT -IV RADIATION & EVAPORATION						
Group-1						
1.	Radiation heat transfer -	1	28	Blackboard Lecture, Video	Chalk & Talk, Youtube	T4/R2
Group-2						
2	Thermal radiation – Laws of radiation – Black body concepts– Emissive power	1	29	Blackboard Lecture, PPT	Chalk & Talk Edupuzzle	T4/R2
3	Radiation shape factor – Gray bodies – Radiation shields	1	30	Blackboard Lecture,	Chalk & Talk	T4/R2
4	Introduction – Types of Evaporators – Capacity – Steam economy – Boiling point elevation (Duhring rule)	1	31	Blackboard Lecture,	Chalk & Talk	T4/R2
5	Material and energy balance of single effect evaporator; Theory of multiple effect evaporators	1	32	Blackboard Lecture, Video	Chalk & Talk, Youtube	T4/R2
6	Design of single and multiple effect evaporators,	3	35	Blackboard Lecture, Video	Chalk & Talk, Youtube	T4/R2
7	Vapor recompression method.	1	36	Blackboard Lecture,	Chalk & Talk	T4/R2
UNIT-V - HEAT EXCHANGERS						
Group-1						
1.	Heat exchangers – Types and practical application	2	38	Blackboard Lecture, PPT	Chalk & Talk Edupuzzle	T4/R2
Group-2						
2	Concept of LMTD & Overall heat transfer coefficient	2	40	Blackboard Lecture, Video	Chalk & Talk, Youtube Edupuzzle	T4/R2
3	Effectiveness – NTU method for heat exchanger design	2	42	Blackboard Lecture, Video	Chalk & Talk, Youtube	T4/R2
4	Fouling factor and estimation of Overall heat transfer coefficient;	2	44	Blackboard Lecture,	Chalk & Talk	T4/R2
5	Special type of heat exchangers.	1	45	Blackboard Lecture,	Chalk & Talk	T4/R2

19. Weightage of unit contents:

Factors considered,

F1 - Number of periods allotted for teaching the unit and weightage per hour is equal 1.

F2 - Usefulness of the content matter of the unit in the students' learning point of view and its weightage equal to 1 if useful, otherwise zero.

F3 - Usefulness of the content matter of the unit in understanding other units of the same Subject and its weightage equal to 1 if useful, otherwise zero.

F4- Usefulness of the content matter of the unit in understanding other subjects prescribed for the programme and its weightage equal to 1 if useful, otherwise zero.

TOPICS	F_1	F_2	F_3	F_4	A_1 (Weightage)	A_2 (%)
UNIT-I -CONDUCTION						
Importance of heat transfer in Chemical Engineering operations	9	1	1	1	26	24.07
Modes of heat transfer, Fourier's law of heat conduction		1	0	1		
one dimensional steady state heat conduction equation for flat plate,sphere,cylinder		1	0	1		
Heat conduction through a series of resistances		1	0	1		
Thermal conductivity measurement; effect of temperature on thermal conductivity;		1	0	1		
Heat transfer in extended surfaces		1	1	1		
Optimum and economic thickness of insulation.		1	1	1		
UNIT-II - CONVECTION						
Concepts of heat transfer by convection - Natural and forced convection,.	9	1	1	1	22	20.37
Natural and forced convection,		1	1	1		
Analogies between transfer of momentum and heat - Reynolds's analogy, Prandtl and Coulburn analogy..		1	1	1		
Dimensional analysis in heat transfer,		1	1	1		
Heat transfer coefficient for flow through a pipe, flow past flat plate, flow through packed beds		1	0	0		
UNIT-III - HEAT TRANSFER WITH PHASE CHANGE						
Heat transfer from condensing vapours,	9	1	0	0	19	17.59
Drop wise and film wise condensation,		1	0	0		
Nusselt equation for vertical and horizontal tubes,		1	1	1		
Condensation of superheated vapors.		1	1	1		
Heat transfer to boiling liquids – mechanism of boiling, nucleate boiling and film boiling.		1	0	1		
UNIT -IV RADIATION & EVAPORATION						
Radiation heat transfer -	9	1	0	0	21	19.44
Thermal radiation – Laws of radiation – Black body concepts– Emissive power		1	0	0		
Radiation shape factor – Gray bodies – Radiation shields		1	0	1		

Introduction – Types of Evaporators – Capacity – Steam economy – Boiling point elevation (Duhring rule)		1	0	1		
Material and energy balance of single effect evaporator; Theory of multiple effect evaporators		1	0	1		
Design of single and multiple effect evaporators.		1	0	1		
Vapor recompression method.		1	0	1		
UNIT-V - HEAT EXCHANGERS						
Heat exchangers – Types and practical application	9	1	1	1	22	20.37
Concept of LMTD & Overall heat transfer coefficient		1	1	1		
Effectiveness – NTU method for heat exchanger design		1	0	1		
Fouling factor and estimation of Overall heat transfer coefficient;		1	0	1		
Special type of heat exchangers.		1	1	1		
				Total	**108**	**100%**

A_1 – Total weightage

A_2 – % of Weightage

20. Mapping syllabus with Bloom's Taxonomy LOT and HOT:

Lower Order Thinking		
R	Remembering	Students are expected to Recall the information through Recognizing, listing, describing, retrieving, naming, finding
U	Understanding	Students are expected to Explain an ideas or concepts through Interpreting, summarizing, paraphrasing, classifying, explaining
Ap	Applying	Students are expected to Use the information in another familiar situation through Implementing, carrying out, using, executing
Higher Order Thinking		
A	Analyzing	Students are expected to Break the information into parts to explore understandings and relationships through Comparing, organizing, deconstructing, interrogating, finding
E	Evaluating	Students are expected to Evaluate the Justifying a decision or course of action through Checking, hypothesizing, experimenting, judging
C	Creating	Students are expected to Generate new ideas, products, or ways of viewing things through Designing, constructing, planning, producing, inventing.

UNIT-I- CONDUCTION (Weightage 24.07%)			
Sl.No	**Name of the Topic**	**Process verb**	**Types of thinking**
1	Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Fourier's law of heat conduction -	**Compare, Outline, Explain,**	Understanding **CO1**
2	one dimensional steady state heat conduction equation for flat plate, hollow cylinder -	**Assesing, Estimate , Evaluate**	Evaluating CO1

3	Heat conduction through a series of resistances -	Assesing, Estimate , Evaluate	Evaluating **CO1**
4	Thermal conductivity measurement; Effect of temperature on thermal conductivity;	Determine, Sketch	Apply **CO1**
5	Heat transfer in extended surfaces, Optimum and economic thickness of insulation.	Determine, Estimate , Evaluate	Evaluating CO1

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	0	1	1	0	3	0	5
Weightage,%	**0**	**4.814**	**4.814**	**0**	**14.442**	**0**	**24.07**

Unit-II-CONVECTION (Weightage 20.37%)

Sl.No.	Name of the Topic	Process verb	Types of thinking
1	Concepts of heat transfer by convection - Natural and forced convection,.	Define, What, Find, Recall, List, How, Classify	Remembering **CO2**
2	Analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Coulburn analogy.	Calculate,Estimate , Evaluate	Apply CO2
3	Dimensional analysis in heat transfer	Determine, Estimate , Evaluate	Evaluating CO2
4	Heat transfer coefficient for flow through a pipe, flow past flat plate, flow through packed beds	Determine, Estimate , Evaluate	Evaluating CO2

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	1	0	1	0	2	0	4
Weightage, %	**5.0925**	**0**	**5.0925**	**0**	**10.185**	**0**	**20.37**

UNIT-III-HEAT TRANSFER WITH PHASE CHANGE (Weightage 17.59%)

Sl.No.	Name of the Topic	Process verb	Types of thinking
1	Heat transfer from condensing vapours,	Compare, Outline, Explain, Show	Understanding **CO3**
2	Drop wise and film wise condensation,	Determine, Estimate , Evaluate	Evaluating CO3
3	Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours,	Calculate,Estimate , Evaluate	Apply CO3
4	Heat transfer to boiling liquids – mechanism of boiling, nucleate boiling and film boiling.	Determine, Estimate , Evaluate	Evaluating CO3

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	0	1	1	0	2	0	4
Weightage,%	**0**	**4.397**	**4.397**	**0**	**8.795**	**0**	**17.59**

UNIT -IV RADIATION AND EVAPORATION (Weightage 19.44%)

Sl.No	Name of the Topic	Process verb	Types of thinking
1	Radiation heat transfer – Thermal radiation – Laws of radiation	Compare, Outline, Explain, Show	Understanding **CO4**
2	Black body concepts– Emissive power – Radiation shape factor – Gray bodies – Radiation shields.	Determine, Estimate , Evaluate	Evaluating CO4
3	Introduction – Types of Evaporators – Capacity – Steam economy – Boiling point elevation (Duhring rule); Material and energy balance of single effect evaporator;	Calculate,Estimate , Evaluate	Apply CO4
4	Theory of multiple effect evaporators; Design of single and multiple effect evaporators, Vapor recompression method.	Determine, Estimate , Evaluate	Evaluating CO4

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	0	1	1	0	2	0	4
Weightage,%	**0**	**4.86**	**4.86**	**0**	**9.72**	**0**	**19.44**

UNIT-V-HEAT EXCHANGERS (Weightage 20.37%)

Sl.No.	Name of the Topic	Process verb	Types of thinking
1	Heat exchangers – Types and practical application	Determine, Estimate , Evaluate	Evaluating CO5
2	Concept of LMTD & Overall heat transfer coefficient; Effectiveness –	Estimate, Evaluate	Apply CO5
3	NTU method for heat exchanger design	Calculate, Distinguish ,Estimate	Analyze **CO5**
4	Fouling factor and estimation of Overall heat transfer coefficient	Compare, Outline, Explain, Show	Understanding **CO5**
5	Special type of heat exchangers.	Calculate, Distinguish ,Estimate	Analyze **CO5**

	R	U	Ap	A	E	C	Total
Type of thinking in Nos	0	1	1	2	1	0	5
Weightage,%	**0**	**4.074**	**4.074**	**8.148**	**4.074**	**0**	**20.37**

	R	U	AP	A	E	C	TOTAL
UNIT 1	**0**	**4.814**	**4.814**	**0**	**14.442**	**0**	**24.07**
UNIT 2	**5.0925**	**0**	**5.0925**	**0**	**10.185**	**0**	**20.37**
UNIT 3	**0**	**4.397**	**4.397**	**0**	**8.795**	**0**	**17.59**
UNIT 4	**0**	**4.86**	**4.86**	**0**	**9.72**	**0**	**19.44**
UNIT 5	**0**	**4.074**	**4.074**	**8.148**	**4.074**	**0**	**20.37**
TOTAL	**5.0925**	**18.145**	**23.237**	**8.148**	**47.216**	**0**	**100**
Lower Order Thinking				**44.474%**			
Higher Order Thinking				**55.364%**			

21. Mapping course outcome with Bloom's Taxonomy LOT and HOT:

	R	U	Ap	A	E	C
CO1		✓	✓		✓✓	
CO2	✓		✓		✓✓	
CO3		✓	✓		✓✓	
CO4		✓	✓		✓✓	
CO5		✓	✓	✓✓	✓	

22. Mapping Course Outcome (CO) with Program Outcomes (PO) and Program Specific Outcomes (PSO):

	Program Outcomes	Descriptions
PO1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions	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.
PO4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage	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.
PO6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10	Communication	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.
PO11	Project management and finance	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 projects and in multidisciplinary environments
PO12	Life-long learning	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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Apply the knowledge of unit processes and operations for the design of Chemical plant
PSO2	Acquire working knowledge of process safety and environment issues in Chemical Processes.
PSO3	Innovate and integrate the new ideas of chemical engineering processes as a team for the complex problems and development of chemical industries.

PO& PSO ⟶	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	1			1		1				3		1
CO2	3	3	3	1			1		1				3		1
CO3	3	3	2	1			1		1		1		3	1	1
CO4	3	3	3	1			1		1				3	1	2
CO5	3	3	2	1			1		1		2		3	2	3

3	High	2	Moderate	1	Low

23. Mapping with Programme Educational Objectives (PEOs):

Programme Educational Objectives:

Graduates of Chemical Engineering will be able to:

PEO 1: Participate as leaders in their fields of expertise and in activities that support service and economic development nationally and throughout the world.

PEO 2: Pursue continued life-long learning through professional practice, research and training programs in the field of chemical engineering and science.

PEO 3: Solve real-life problems in a broad perspective to fulfil ethical, economic, environmental and social responsibilities.

Objective	To Identify What Students Have Learned and also to identify students' strength and weakness
Product	Answer scripts
Frequency	Twice per semester
Format	Part –A 10x 2 = 20 Marks Part –B 5 x 14 =70 Marks Part – C 1 x 10 = 10 Marks Total marks= 100 Duration: 3 Hours
Evaluation	Based on answer given in the scripts
Criteria	Pass mark – 50marks Attainment level: To be Fixed by the Course coordinator based on the Nature of theCourse.

Individual Assignment/Tutorial:

Objective	To enhance students' understanding of a particular reading
Product	Hand written /Tutorial sheets
Frequency	Within each Assessment Period
Format	Important area from the course
Evaluation	Based on rubrics
Criteria	Submit on or before the date of submission

Seminar / Case Study / Any other component relevant to the course

Objective	To enhance students' understanding of a particular reading and Communication
Product	Oral Presentation / Recorded audio/Recorded video /Report/ Quiz/based on the natureof another component
Frequency	Within each Assessment Period
Format	Important area from the course
Evaluation	Based on rubrics
Criteria	No. of Seminars: 1 per Assessment

End semester exam:

Objective	To assess each student's knowledge of the course
Product	Result analysis
Frequency	Semester
Format	Part –A 10 x 2= 20 marks Part –B 5 x 14= 70 marks Part – C 1 x 10 = 10 Marks Total marks= 100 Duration: 3 Hours
Evaluation	Based on answer given in the scripts
Criteria	Minimum Pass Mark: 50 Attainment level: To be Fixed by the Course coordinator based on the Nature of theCourse.

Course	PEO1	PEO2	PEO3
PROCESS HEAT TRANSFER	3	2	3

3	High	2	Moderate	1	Low

24. **Course assessment: (Direct Assessment Method)**

Internal Assessment (40 Marks)							**External Assessment (60 Marks)**
Assessment I (100 Marks) – First 2.5 Units			**Assessment II (100 Marks) - Second 2.5 Units**			**Total (200 Marks)**	**End Semester Exam (100 Marks)**
Individual Assignment I /Tutorial (20)	Seminar / Case Study /Quiz/ Any other component relevant to the course(20)	Written Test (Internal I(100))	Individual AssignmentI /Tutorial (20)	Seminar / Case Study /Quiz/ Anyother componen trelevant to the course(20)	Written Test (Internal I(100))	Internal Assessment(Tobe converted into 40 marks)	
40		**60**	**40**		**60**	**200**	100
Total marks secured out of 200 has to be converted as Internal Assessment (40 Marks)							**Total 100 marks to be converted as External Assessment 60 Marks**

25. Course assessment: (Indirect Assessment Method)

Course Exit Survey: Course Exit Survey consists of few critical questions that evaluate the level of students' satisfaction level with curriculum and course being taught.

Prepared by,

Course Coordinator
(Name and Dept.)

S. MANUDEVI
CHEMISTRY

Dean (Academics)

Checked by,

Head of the Department

Approved by,

PRINCIPAL