DEPARTMENT OF MECHANICAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY: TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Name of the program and specialization	M.Tech., Thermal Power Engineering		
Course Title	HEAT TRANSFER EQUIPMENT DESIGN		
Course Code	ME 604	**No. of Credits**	03
Course Code of Pre-requisite subject(s)	ME 605		
Session	Jan 2021	**Section If applicable)**	---
Faculty	S. Venkatachalapathy	**Department**	Mechanical Engineering
E-mail	svc@nitt.edu	**Tel. No.**	0431-2503415
Name of Course Coordinator (if applicable)	--		
Course Type	✓ **Core course** ☐ **Elective course** ☐ **Laboratory course**		

Syllabus (Approved in BoS)

Classification of heat transfer equipment - Design of shell and tube heat exchanger - Finned surface heat exchanger –Heat exchangers for special services – Fired heaters

Plate and spiral plate heat exchanger – Plate heat exchanger for dairy industry – Heat pipes

Thermal design of heat exchange equipment such as Air preheater, Economizer, Superheater and Condenser.

Selection of compact heat exchangers. Analysis and design of cooling towers.

Essential Readings

1. Ozisik, M.N., Heat Transfer - A Basic Approach, McGraw-Hill, 1985
2. Coulson and Richardson, Chemical Engineering Design, Vol.6, Elsevier Butterworth-Heinemann, 2005.
3. Ganapathy, V., Applied Heat Transfer, Pennwell Books, 1982
4. Kays, W.M. and London, A.L., Compact Heat Exchangers, Mc Graw-Hill, 1998
5. Kakac, S. and Liu, H., Heat Exchangers, CRC Press, 2002
6. Shah, R.K and Sekulic, D.S., Fundamentals of Heat Exchanger Design, John Wiley & Sons, Inc., 2003.
7. Hand-outs of Class Materials & Data Book

COURSE OBJECTIVES

1. To discuss the types of heat transfer equipment and various flow patterns.
2. To study shell and tube heat exchanger and other types of heat exchangers for special services
3. To understand the design procedure of air pre-heaters, economizers, super heaters, condensers and cooling towers for thermal power plants

4. To design plate and compact heat exchangers for industrial applications

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
Upon completion of the course, the student will be able to	
1. Classify the various heat transfer equipment	PO1, PO2, PO4
2. Design various heat exchangers viz. shell and tube, finned surface & special purposes for thermal engineering industries.	PO1, PO2, PO3, PO4, PO5, PO7
3. Analyze the performance of air preheaters, economizers, super heaters and condensers for power plants.	PO1, PO2, PO3, PO4, PO5, PO7
4. Design compact heat exchangers and cooling towers	PO1, PO2, PO3, PO4, PO5, PO7
5. Select a suitable heat exchanger for any given application	PO1, PO2, PO3, PO4, PO6

COURSE PLAN – PART II

COURSE OVERVIEW

This course is designed for Post Graduate students who have studied the course Advanced Heat Transfer and have adequate knowledge on various components of boilers and their performances.

It teaches the skills needed to design a variety of heat transfer equipment or simply heat exchangers in thermal applications. It seeks to enable participants to recognise their strength and needs in designing thermal equipment and give them confidence to use design principles more effectively to achieve their own goals. It also helps the students to develop the skills in independent learning outside of the class room.

COURSE TEACHING AND LEARNING ACTIVITIES

Sl. No.	Week	Topic	Mode of Delivery
1	1st week	Heat transfer basics and governing equations - Heat exchanger classifications - Fouling factors	Online – MS Teams
2	2nd week	LMTD and NTU methods - Effectiveness relations - Shell and tube heat exchanger - General guidelines - Tube layouts - Fluid streams	Online – MS Teams
3	3rd week	Baffle types & cut - Dimensionless numbers - Shell and tube side design procedure- Kern's method	Online – MS Teams
4	4th week	Bell's method - leakages and losses - Radial low fin heat exchanger design - Design procedure for fired heaters	Online – MS Teams
5	5th week	Plate heat exchanger - Comparison with shell and tube - Colburn factor - Heat transfer coefficient - Gasket material - Flow patterns - Plate types - Design procedure	Online – MS Teams
6	6th week	Spiral plate heat exchanger design - Heat pipes basics - Fluid selection - Operation - Wick selection - Effect of	Online – MS Teams

		orientation	
7	7th week	Pressure drop - Limitations - Design for electronic equipment - Air preheaters - Tube banks - Flow across tube banks	Online – MS Teams
8	8th week	Heat transfer coefficient - Pressure drop - Nusselt number - Surface temperature - Recuperative & Regenerative type air heaters	Online – MS Teams
9	9th week	Regenerators in gas turbine plants & Process plants - Air heater design - Design of economizers	Online – MS Teams
10	10th week	Super heater design - Steam temperature control - Boiling and condensation - Nusselt's theory - Shell and Tube type condenser design	Online – MS Teams
11	11th week	Compact heat exchangers - Types - Bernoulli's equation - Loss coefficients - Pressure distribution - Total pressure drop - Effect of finned surfaces	Online – MS Teams
12	12th week	Design of compact heat exchangers; Cooling towers – Natural Convection - Forced Convection - Approach & Range	Online – MS Teams
13	13th week	Geometry - Effective temp. difference - Tower characteristics - Fill geometry - Air pressure drop - Procedure for estimating the size of cooling tower & Cooling tower design	Online – MS Teams

COURSE ASSESSMENT METHODS (Shall range from 4 to 6)

S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Cycle Test - I	6th Week	1½ hour	25%
2.	Cycle Test - II	11th Week	1½ hour	25%
CPA	Compensation test (I & II Cycle Test Topics Combined)	12th Week	1½ hour	25%
3.	Quiz/Seminar Talk	13th Week	---	20%
4.	End Semester Examination	15th Week	2 hours	30%

COURSE EXIT SURVEY

1. Students feedback through class committee meetings
2. Feedback form issued to students to express their comments about the course after completing the syllabus. Students are requested to give genuine feedback about the course.
3. Student knowledge about the topic covered in this course will be judged during continuous assessments based on the performance in the written examination.

COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, academic honesty and plagiarism etc.)

Mode of Correspondence

1. The Faculty is available for consultation during the time intimated to the students.
2. All correspondence will be sent to the webmail id of the students, if required.
3. The students will be communicated through the email id: svc@nitt.edu for any academic related issues (including sharing of study materials) with respect to this course.

Attendance

1. Attendance will be taken by the faculty in all contact hours.
2. The minimum attendance for appearing the end semester examination is 75%.
3. A maximum of 10% is allowed under On Duty (OD) category.
4. Students who are having attendance less than 65% will be prevented from writing the final assessment and shall be awarded 'V' Grade.

Compensation Assessment

1. Attending all the assessments is **MANDATORY** for every student.
2. If any student is not able to attend any of the continuous assessments (CTs: 1-2) due to genuine reason, a Compensation examination shall be conducted for 25 marks comprising the syllabus of both the cycle tests.
3. Students should attend the Quiz or give a seminar presentation on a given topic. If a student fails to attend the Quiz or give seminar presentation on a specified date, an alternate date will be given. If he/she could not complete the process within these two dates, he/she will be awarded zero marks.

Academic Honesty & Plagiarism

1. Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
2. Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
3. The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

FOR APPROVAL

Course Faculty	**CC Chairperson**	**HoD (Dept. of ME)**
(S. Venkatachalapathy)	(T. Ramesh)	(AR. Veerappan)