NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF CHEMICAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

<table>
<tr><th colspan="6">COURSE PLAN – PART I</th></tr>
<tr><td>Name of the programme and specialization</td><td colspan="5">B.Tech and CHEMICAL ENGINEERING</td></tr>
<tr><td>Course Title</td><td colspan="5">HEAT TRANSFER</td></tr>
<tr><td>Course Code</td><td>CLPC21</td><td>No. of Credits</td><td colspan="3"><table><tr><th>L</th><th>T</th><th>P</th><th>C</th></tr><tr><td>3</td><td>0</td><td>0</td><td>3</td></tr></table></td></tr>
<tr><td>Course Code of Pre-requisite subject(s)</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Session</td><td>July 2019</td><td>Section (if, applicable)</td><td colspan="3">NA</td></tr>
<tr><td>Name of Faculty</td><td>Dr.P.KALAICHELVI</td><td>Department</td><td colspan="3">CHEMICAL ENGINEERING</td></tr>
<tr><td>Email</td><td>kalai@nitt.edu</td><td>Telephone No.</td><td colspan="3">04312503110</td></tr>
<tr><td>Name of Course Coordinator(s) (if, applicable)</td><td colspan="5">Dr. K.M.MEERA SHERIFFA BEGUM</td></tr>
<tr><td>E-mail</td><td>meera@nitt.edu</td><td>Telephone No</td><td colspan="3">04312503109</td></tr>
<tr><td>Course Type</td><td colspan="5">Core course</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">Syllabus (approved in BoS)</td></tr>
<tr><td colspan="6">Basic modes of heat transfer and the laws governing them. Steady state conduction through plane and composite walls general heat conduction equation, concepts of thermal diffusivity and equivalent thermal conductivity. Radial Heat conduction through thick cylindrical and spherical vessels, Transient heat conduction.
Convection – Dimensional analysis and empirical correlations, critical insulation thickness for cylindrical and spherical surfaces, Hydrodynamic and thermal Boundary layers, physical significance of the dimensionless groups.
Thermal Radiation laws, spectrum of electromagnetic radiation, Black and Gray bodies, and configuration factor – typical examples. Boiling and condensation.
Heat Exchangers – classification and design, overall and individual film coefficients, mean temperature difference, LMTD correction factor for multiple pass exchanger, NTU and efficiency of Heat exchangers, use of efficiency charts.
Evaporation, single and multiple effect operation, material and Energy balance in evaporators, boiling point elevation, Duhring’s rule, effect of liquid head, illustrative examples.
REFERENCE BOOKS
1. W. L. McCabe and J. C. Smith, “Unit Operations in Chemical Engineering", 7th Edn., McGraw Hill Publishing Co., 2004.
2. Binay K. Dutta, “Heat Transfer Principles and applications” Prentice Hall of India Pvt. Ltd., 2003
3. S. Foust, L. A. Wenzel, C. W. Clump, Louis maus and L. B. Anderson Principles of Unit Operations’’ John Wily, New York.
4. D.Q. Kern,” Process Heat Transfer,” McGraw Hill Publishing</td></tr>
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COURSE OBJECTIVES	
1. To study the fundamental concepts of heat transfer viz., conduction, convection, radiation, boiling and condensation. 2. To use these fundamentals in typical engineering applications (Heat exchanger and Evaporator) and current research.	
COURSE OUTCOMES (CO)	
Course Outcomes	**Aligned Programme Outcomes (PO)**
1. able to estimate steady state and transient heat transfer rates from/to object such as tanks, pipes, building etc	**1,5,9,11,12**
2. able to develop equations for different types of convection and solve for heat transfer rate by convection.	**1,5,8,9,10,11,12**
3. able to estimate the rate of radiation heat transfer with and without participating medium. Ability to identify the roll of re-radiating surface, radiation shields, boiling and condensation.	**1,2,5,8,9,10,11.12**
4. able to carry out thermal analysis of heat exchanger using LMTD and effectiveness method.	**1,2,3,5,8,9,10,11,12**
5. able to estimate steam economy, capacity of single and multiple effect evaporators.	**1,2,3,5,8,9,10,11,12**
6. able to use the fundamentals learnt to understand the current research in heat transfer.	**4,5,6,7,8,9,10,11,12**

COURSE PLAN – PART II

COURSE OVERVIEW

The course will cover the three modes of heat transfer namely conduction, convection and radiation in detail. These modes will be explained through descriptions and problems. Thermal performances of Heat exchangers and Evaporators will also be dealt in detail.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1.	Week 1	Introduction	Chalk and Talk
2.	Week 1	basics of heat transfer modes	Chalk and Talk
3.	Week 1	3D heat conduction equation derivation	Chalk and Talk
4.	Week 2	Cylindrical system and Spherical system	Chalk and Talk
5.	Week 2	Composite plane	Chalk and Talk
6.	Week 2	Composite cylinders	Chalk and Talk
7.	Week 3	Composite spheres	Chalk and Talk
8.	Week 3	Critical insulation thickness	Chalk and Talk
9.	Week 3	Heat generation in composite walls	Chalk and Talk
10.	Week 4	Transient heat conduction	Chalk and Talk
11.	Week 4	Convective heat transfer and its estimation methods	Chalk and Talk
12.	Week 4	Hydrodynamic and thermal boundary layer	Chalk and Talk
13.	Week 5	Exact solution method	Chalk and Talk
14.	Week 5	Approximate solution method	Chalk and Talk
15.	Week 5	Dimensional Analysis	Chalk and Talk
		Assessment I	Chalk and Talk

16.	Week 6	Equations and Problems on free convection	Chalk and Talk
17.	Week 6	Equations and Problems on forced convection	Chalk and Talk
18.	Week 6	Radiation laws	Chalk and Talk
19.	Week 7	Radiation exchange	Chalk and Talk
20.	Week 7	Radiation from gases (participating and non-participating)	Chalk and Talk
21.	Week 7	Greenhouse effect and reradiating walls	Chalk and Talk
22.	Week 8	Boiling	Chalk and Talk
23.	Week 8	Condensation	Chalk and Talk
24.	Week 8	Boiling	Chalk and Talk
25.	Week 9	Heat exchanger types	Chalk and Talk
26.	Week 9	LMTD method	Chalk and Talk
27.	Week 9	Effectiveness method	Chalk and Talk
		Assessment II	Chalk and Talk
28.	Week 10	Problems on LMTD method	Chalk and Talk
29.	Week 10	Problems on Effectiveness method	Chalk and Talk
30.	Week 10	Evaporation	Chalk and Talk
31.	Week 11	Material and energy balance for single effect	Chalk and Talk
32.	Week 11	Multiple effect	Chalk and Talk
33.	Week 11	Economy calculation	Chalk and Talk
34.	Week 12	Problems on single effect	Chalk and Talk
35.	Week 12	Problems on multiple effect	Chalk and Talk
36.	Week 12	Discussion on overall course	Talk
		Compensation Assessment	
		Final Assessment	

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assesssment I	End of 5th week since commencement	1 hour	20%
2	Assessment II	End of 9th week since commencement	1 hour	20%
3	Assessment III – (Assignment submission)	After Assessment II	On research topic related to heat transfer	10 %
4	Compensation Assessment*	After 12th week	1 hour	20%
5	Final Assessment*	At the end of Course	3 hours	50%

***mandatory; refer to guidelines on page 5**

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COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

1. Feedback is planned to be collected thrice; At class committee meetings during the assessment period and one at the end of course as soon as classes are over.
2. The academic performance of the students will be assessed based on **Two** assessments by written test (each 20 marks), Assignment (10 marks) during the course and **One** final assessment (50 marks) at the end of course.

Suitable mapping of COs with POs will be made and attainment will be calculated.

COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)

MODE OF CORRESPONDENCE (email/ phone etc)

Email : kalai@nitt.edu

COMPENSATION ASSESSMENT POLICY

One Compensation assessment will be conducted only for absentees in either the Assessments under Medical or Institute related activities.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under On Duty (OD) category.**
- Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- 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.

The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION

The Course Coordinator is available for consultation and Queries may also be emailed to the Course Coordinator directly at **kalai@nitt.edu**

FOR APPROVAL

Course Faculty: Dr.P.Kalaichelvi **CC-Chairperson: Dr.A.Arunagiri**

31/7/2019

HOD: Dr.K.M.Meera S. Begum **(Approved by CC Chairman and HOD)**

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Guidelines:

a. The number of assessments for a course shall range from 4 to 6.
b. **Every course shall have a final assessment on the entire syllabus with at least 30% weightage.**
c. **One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.**
d. **The passing minimum shall be as per the regulations.**

B.Tech. Admitted in				P.G.
2018	**2017**	**2016**	**2015**	
35% or class average/2 whichever is greater.		Peak/3 or class average/2 whichever is lower		40%

e. **Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.**

f. **Absolute grading policy shall be incorporated if the number of students per course is less than 10.**
g. Necessary care shall be taken to ensure that the course plan is reasonable and is objective.