DEPARTMENT OF MECHANICAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Name of the programme and specialization	M.Tech/ Thermal power Engineering		
Course Title	Advanced Heat Transfer		
Course Code	ME 605	**No. of Credits**	3
Course Code of Pre-requisite subject(s)			
Session	**July 2020**	**Section (if, applicable)**	
Name of Faculty	Dr. S. SURESH	**Department**	Mechanical Engineering
Email	ssuresh@nitt.edu	**Telephone No.**	04312503422
Course Type	☑ **Core course**	☐ **Elective course**	

Syllabus (approved in BoS)

Transient heat conduction – Exact solution – Use of Heisler and Grober charts– Semi-infinite solids – Multidimensional systems.

Extended surfaces – Steady state analysis and optimization – Longitudinal fin of rectangular, triangular and parabolic profile radiating to free space – Radial fins.

Thermal boundary layers – Momentum and energy equations – Internal and external flows – Forced convection over cylinders, spheres and bank of tubes, turbulent convection.

Heat transfer with phase change – Condensation and boiling heat transfer – Heat transfer in condensation, Effect of non-condensable gases in condensing equipment – Pool and flow boiling correlations.

Thermal radiation – View factor – Gas radiation – Transmitting, reflecting and absorbing media – Flame radiation in furnaces – Radiation effect on temperature measurement.

References:

1. Ozisik, M.N., Heat Transfer - A Basic Approach, McGraw-Hill, 1987.

2. Incropera, P.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, 5th ed., John Wiley, 2002.

3. Bejan, A., Heat Transfer, John Wiley & Sons Inc., 1993.

4. Kakac, S. and Yener, Y., Convective Heat Transfer, CRC Press, 1995.

5. Kraus, A.D., Aziz, A., and Welty, J., Extended Surface Heat Transfer, John Wiley, 2001.

COURSE OBJECTIVES
1. To use Heisler and Grober charts and to discuss about transient heat conduction 2. To compare and optimization of longitudinal fin of rectangular, triangular and parabolic profiles 3. To understand boundary layers and to formulate pool and flow boiling correlations 4. To discuss thermal radiation, view factor, gas radiation, radiation effect on temperature measurement.

COURSE OUTCOMES (CO)

Course Outcomes ***Upon the completion of the course, the students will be able***	**Aligned Programme Outcomes (PO)**
1. Discuss about transient heat conduction and to use Heisler and Grober charts	1,2,3,7,10
2. Analyze and optimize various fins like rectangular, triangular and parabolic profiles for heat transfer applications.	1,2,3,5
3. Understand thermal boundary layers, momentum and energy equations	1,2,4,7,10
4. Describe condensation and boiling heat transfer and estimate pool and flow boiling heat transfer	1,2,7,10
5. Analyze thermal and gas radiation in heat transfer equipment	1,2,3,4,7,10

COURSE PLAN – PART II

COURSE OVERVIEW

It is planned to teach the course interactively, rather than by a strict lecture format. The class will cover the fundamentals such as conduction, convection, thermal radiation as well as thermally driven problems of current importance. This course is designed to introduce a basic study of the phenomena of heat and mass transfer. The methodologies for solving a wide variety of practical engineering problems and useful information concerning the design and performance of heat transfer equipment will be discussed.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1	1st week	General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates - One-Dimensional Steady-State Conduction Heat	Online Board

		Transfer: Homogeneous slabs - hollow cylinders - and spheres – overall heat transfer coefficient – electrical analogy – Critical radius of insulation. Transient heat conduction Exact solution Use of Heisler and Grober chart Integrated method.	
2	2nd week	Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, unsteady state Conduction.	Presentation
3	3rd week	Problems related to basic heat transfer, extended surfaces, and unsteady state conduction	Online Board
4	4th week	Radiative transfer – electromagnetic radiation spectrum – thermal radiation – radiation properties - Black body, gray body – monochromatic and total emissive power – Planck's law – Stefan-Boltzmann law – Wien's displacement law – Kirchhoff's identity – shape factor- reciprocity relation – heat exchange between nonblack bodies	Online Board
5	5th week	Radiation shields - Green house effect Problems related to radiation heat transfer	Presentation
6	6th week	Radiative exchange in furnaces, Radiation characteristics of particle systems,	Online Board
7	7th week	Thermal radiation of a luminous fuel oil and gas, Soot flame overall heat transfer in furnaces.	Online Board
8	8th week	Convective heat transfer – Newton's law of cooling – Prandtl number – Laminar forced convection heat transfer from flat plates – fully developed laminar flow in pipes	Presentation
9	9th week	Turbulent forced convection – Reynolds' analogy , Free/Natural convection –	Online Board
10	10th week	Natural convection heat transfer from vertical plates and horizontal tubes	Presentation

11	11th week	Free convection correlations Problems related to free convection	Online Board
12	12th week	Condensation and Boiling – film and dropwise condensation – pool boiling and flow boiling – Introduction to multiphase flow and heat transfer.	Presentation
13	13th week	Effect of non-condensable gases in condensing equipment. Flow boiling correlations.	Online Board
14	14th week	Revision and repeat class for particular topics	Online Board

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Seminar	2 Seminars for semester	20 min/student	30
2.	Mid semester exam	After 6th week	1.5 hours	30
3.	One Assignment	One assignment	Varying	10
CPA	Compensation Assessment	After 10th week	1.5 hours	30
4.	Final Assessment *	At the end of semester	2 hours	30

COURSE EXIT SURVEY

- Students feedback in the class after every 4 weeks and also through class committee meetings.
- Feedback from students on the course outcomes shall be obtained at the end of the course.

COURSE POLICY

MODE OF CORRESPONDENCE (email/ phone etc)

All the correspondence will be done through their class representative (**CR**).

ATTENDANCE

- All the students are expected to attend all the contact hours. Students should maintain 75% minimum physical attendance by the end of the course to attend the end semester examination
- Absence due to medical reason and institutional activities will be considered when the

student falls below 75% of physical attendance and it should be supported by a letter (in professional letterhead) from the concerned authorities. Any preparatory works in view of institution activities should not be taken up in class contact hours.

- Students not having 75% minimum attendance at the end of the semester will be awarded 'V' Grade and have to REDO the course.

COMPENSATION ASSESSMENT POLICY

- Attending all the assessments (1, 2, 3, 4, 5) are mandatory for every student. Flexibility is given to the students to fix the date for each mode of evaluation convenient to majority of the students.

- If any student fails to attend cycle test 1 and 2 due to genuine reason like medical emergency, the student may be permitted to appear for the compensation assessment (CPA) on submission of appropriate documents as proof and prior intimation. (Not valid for students having attendance lag). The portion for compensation assessment is full portion

- Students not having 75% minimum attendance at the end of the semester and also didn't attend cycle test 1 and 2 will be awarded 'V' Grade and have to REDO the course.

- In any case, compensation assessment (CPA) is not considered as an improvement test.

- The minimum marks for passing this course and grading pattern will adhere to the regulations of the institute.

ACADEMIC HONESTY & PLAGIARISM

1. Possessing a mobile phone, carrying a bit of paper, talking to other student, 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 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 fact of the malpractice and award the punishment if the student found guilty. The report shall be submitted to the academic office.

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

FOR APPROVAL

Dr.S.Suresh		
Course Faculty	**CC-Chairperson**	**HOD (ME)**

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. This is not applicable for project work/industrial lectures/internship.

d) Attendance policy and the policy on academic dishonesty & plagiarism by student are uniform for all the courses.

e) Absolute grading policy shall be incorporated if the number of student per course is less than 10.

f) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.