**NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**

**Department of Mechanical Engineering**

| COURSE PLAN | | | |
|---|---|---|---|
| Course Title | Heat and Mass Transfer | | |
| Course Code | MEPC 22 | No. of Credits | 3 |
| Department | MECHANICAL ENGINEERING | Faculty | Dr. S. VENKATACHALAPATHY<br>Dr. S. SURESH |
| Pre-requisites Course Code | MAIR32 - Fourier Series and Partial Differential Equations<br>MEPC11 - Engineering Thermodynamics<br>MEPC18 - Fluid Mechanics | | |
| Course Coordinator(s) (if, applicable) | Dr. S. VENKATACHALAPATHY (Section B)<br>Dr. S. SURESH (Section A) | | |
| Other Course Teacher(s)/Tutor(s), E-mail | svc@nitt.edu<br>ssuresh@nitt.edu | Telephone No. | 04312503415<br>04312503422 |
| Course Type | ☒ Core course ☐ Elective course | | |

## 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 and mass transfer 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 exchangers will be discussed.

## COURSE OBJECTIVE

1. To learn the various modes of heat transfer and understand the basic concepts of mass transfer.
2. To understand the applications of various experimental heat transfer correlations in engineering applications.
3. To discuss the thermal analysis and sizing of heat exchangers.

| COURSE OUTCOMES (CO) | |
|---|---|
| ***Upon the completion of the course, the students will be able*** | Aligned Programme Outcomes (PO) |
| Explain the real time applications of heat transfer in both solids and fluids. | 1,2,3,7,10 |
| Describe the fundamentals of natural and forced convective heat transfer processes | 1,2,3,5 |
| Design the heat exchange equipment | 1,2,4,7,10 |
| Explore the real time applications of radiation mode of heat transfer | 1,2,7,10 |
| Relate the mass transfer concepts for various industrial applications | 1,2,3,4,7,10 |

## COURSE TEACHING AND LEARNING ACTIVITIES

| Sl. No. | Week | Topics | Mode of Delivery |
|---|---|---|---|
| 1 | 1st week | Introduction to Heat Transfer - Basic laws of heat transfer - General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates - One-Dimensional Steady-State Conduction Heat Transfer: Homogeneous slabs - hollow cylinders and spheres – Overall heat transfer coefficient – Electrical analogy – Critical radius of insulation. | Chalk & Talk; PPT |
| 2 | 2nd week | Extended surface (fins) heat transfer – Long fin, Fin with insulated tip and Short Fin, unsteady state conduction. | Chalk & Talk |
| 3 | 3rd week | Problems related to basic heat transfer, extended surfaces, and unsteady state conduction | Chalk & Talk |
| 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 | Chalk & Talk; PPT |

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| 5 | 5th week | Radiation shields - Green house effect<br>Problems related to radiation heat transfer | Chalk & Talk; Multimedia |
| 6 | 6th 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 – Turbulent forced convection – Reynolds' analogy | Chalk & Talk; PPT |
| 7 | 7th week | Free/Natural convection – Natural convection heat transfer from vertical plates and horizontal tubes | Chalk & Talk |
| 8 | 8th week | Free convection correlations<br>Problems related to free convection | Chalk & Talk; PPT |
| 9 | 9th week | Heat Exchangers: Types - Overall heat transfer coefficient- Fouling factors - Logarithmic mean temperature difference (LMTD) - LMTD for parallel flow and counter flow heat exchangers | Chalk & Talk; Multimedia |
| 10 | 10th week | LMTD correction factor- Effectiveness, NTU method of heat exchanger analysis- Effectiveness for parallel flow and counter flow heat exchangers. | Chalk & Talk; PPT |
| 11 | 11th week | Problems related to heat exchangers - LMTD and NTU methods | Chalk & Talk |
| 12 | 12th week | Condensation and Boiling – Film and dropwise condensation – Pool boiling and flow boiling – Introduction to multiphase flow and heat transfer. | Chalk & Talk; Multimedia |
| 13 | 13th week | Diffusion and convective mass transfer - Fick's law of diffusion. | Chalk & Talk |
| 14 | 14th week | Revision and repeat class for particular topics | Chalk & Talk |

## COURSE ASSESSMENT METHODS

| Sl. No. | Mode of Assessment | Week/Date | Duration | % Weightage (marks) |
|---|---|---|---|---|
| 1. | Cycle Test – 1 | After 6th week | 1 hour | 20 |
| 2. | Cycle Test – 2 | 12th -13th week | 1 hour | 20 |
| 3. | Assignment & Seminars | Two Assignments & One Seminar | ----- | 10 |

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|---|---|---|---|---|
| 4. | End Semester Examination | At the end of semester | 3 hours | 50 |
| | | | **Total** | 100 |

**ESSENTIAL READINGS : Textbooks and Data book**


1. T. L. Bergman, A. S. Lavine, F. P. Incropera, D. P. Dewitt., Fundamentals of Heat and Mass Transfer, 7th ed., John Wiley, 2012.
2. Holman, J.P., Heat Transfer, 10th ed., Tata McGraw-Hill, 2010.
3. Ozisik, M.N., Heat Transfer - A Basic Approach, McGraw-Hill, 1985.
4. Yunus A Cengel, Afshin J. Ghajar., Heat and Mass Transfer: Fundamentals & Applications, 5nd ed., McGraw-Hill, 2002.
5. Data Book - Heat & Mass Transfer – C.P. Kothandaraman and S.Subramanyan, New Age International Publishers.


## COURSE EXIT SURVEY

1. Students can meet the faculty at any stage in the course duration in case he/she finds difficulty in understanding the concept.
2. Feedback from the students during the class committee meeting.
3. End semester feedback on Course Outcomes.

## COURSE POLICY (Attendance, Assessment, academic honesty, etc.)

### CORRESPONDENCE

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

### ATTENDANCE

1. Attendance will be taken by the faculty in all contact hours.
2. The minimum attendance for appearing for the end semester examination is 75%.
3. Any student, who fails to maintain 75 % attendance, but above 60% in a subject, shall attend mandatory classes before the semester examinations to qualify to write the semester exam.
4. The students who are having attendance less than 60% has to redo the course in the next semester.

## EXAMINATION / ASSESSMENT

Attending all the assessments is **MANDATORY** for every student.

If any student is not able to attend any of the continuous assessments (CTs: 1&2) due to genuine reason, a retest examination shall be conducted for 20 marks comprising the syllabus of both the cycle tests.

Students should submit the assignments before the last date of submission. In case if a student fails to submit the assignments within the last date of submission, he/she will be awarded zero marks for that particular assignment.

The passing minimum should be 33 marks or 50% of the class average.

## ACADEMIC HONESTY & PLAGIARISM

All the students are expected to be genuine during the course work. Taking of information by means of copying assignments, looking or attempting to look at another student's paper or bringing and using study material in any form for copying during any assessments is considered dishonest.

Preventing or hampering other students from pursing their academic activities is also considered as academic dishonesty.

**FOR SENATE'S CONSIDERATION**

Course Faculty : 1-

2-

CC-Chairperson : July 25, 2017

HOD : 25/7/17