# LESSON PLAN

| Course Code | Course Title | Semester | Branch | Contact Periods /Week | Academic Year | Date of commencement of Semester |
|---|---|---|---|---|---|---|
| 20ME6T02 | HEAT TRANSFER | VI | ME | 5 | 2024-25 | 18-11-24 |

**COURSE OUTCOMES**

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|---|---|
| CO1 | Describe modes of heat transfer and solve one-dimensional heat conduction problems without and with heat generation.[K3] |
| CO 2 | Develop heat transfer relations for different fin configurations and solve one dimensional transient heat conduction problems.[K3] |
| CO 3 | Apply different correlations developed for estimation of forced and natural convection heat transfer |
| CO 4 | Describe various regimes of boiling and types of condensation heat transfer and also analyze different heat exchangers.[K4] |
| CO 5 | State and apply laws of radiation and estimate radiation heat transfer between bodies [K3] |

| UNIT | Out Comes / Bloom's Level | Topics No. | Topics/Activity | Text Book / Reference | Contact Hour | Delivery Method |
|---|---|---|---|---|---|---|
| I | CO1: Describe modes of heat transfer and solve one-dimensional heat conduction problems without and with heat generation.[K3] | | **INTRODUCTION TO HEAT TRANSFER AND CONDUCTION** | | | Chalk & Talk, PPT Videos and Active learning |
| | | 1.1 | Basic modes of heat transfer, laws of heat transfer | T1,T2 | 1 | |
| | | 1.2 | Multi-mode heat transfer-simple problems | T4,R2 | 1 | |
| | | 1.3 | General conduction equation in Cartesian coordinates | T1,T2 | 1 | |
| | | 1.4 | General conduction equation in cylindrical coordinates | T1,T2 | 1 | |
| | | 1.5 | General conduction equation in spherical coordinates | T1,T2 | 1 | |
| | | 1.6 | Initial and boundary conditions. | T1,T2 | 1 | |
| | | 1.7 | One dimensional conduction heat transfer without heat generation in plane, composite planes, cylinder and composite cylinders. | T1,T3 | 1 | |
| | | 1.8 | One dimensional conduction heat transfer with heat generation in plane and cylinder. | T1,T3 | 2 | |
| | | 1.9 | Thermal contact resistance, Overall heat transfer coefficient. | T1,T3 | 1 | |
| | | 1.10 | Conduction shape factor. | T3,R3 | 1 | |
| | | 1.11. | Problems | T1,T3,R2 | 2 | |
| | | 1.12 | One dimensional conduction heat transfer without heat generation in sphere (**Beyond syllabus**) | T1,T3 | 1 | |
| | | | | **Total** | 14 | |

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| II | CO2: Develop heat transfer relations for fin different | **CONDUCTION ANDCONVECTION SYSTEMS** | | | | |
| | | 2.1 | Extended surface (fins) Heat Transfer –types | T1,T3 | 1 | Chalk & Talk, PPT Videos |
| | | 2.2 | General fin heat transfer equation for long Fin | T1,T3 | 1 | |
| | | 2.3 | General fin heat transfer equation for fin with insulated tip. | T1,T3 | 1 | |
| | | 2.4 | General fin heat transfer equation Short Fin, | T1,T3 | 1 | |
| | | 2.5 | Fin effectiveness, Fin efficiency | T1,T3 | 1 | |
| | | 2.6 | problems | T1,T3,R2 | 1 | |
| | | 2.7 | Systems with negligible internal resistance, | T1,T2 | 1 | |
| | | 2.8 | Significance of Biot and Fourier Numbers, | T1,T2 | 1 | |
| | | 2.9 | Chart solutions of transient conduction systems. | T1,T3 | 1 | |
| | | 2.10 | Problems | T1,T3,R2 | 2 | |
| | | 2.11 | **(Beyond syllabus)** Semi – infinite body and finite bodies of cylinders and cubes. | T1,T3 | 1 | |
| | | | | **Total** | 12 | |
| III | CO3: Apply different correlations developed for estimation of forced and natural convection heat transfer.[ K3] | **CONVECTIVE HEAT TRANSFER:** | | | | |
| | | 3.1 | Classification of convective heat transfer, | T1,T2,T4 | 1 | Chalk & Talk, PPT Videos and Active learning |
| | | 3.2 | Dimensional analysis – Buckingham Pi Theorem for forced and free convection, | T1,T2,T4 | 1 | |
| | | 3.3 | Significance of non-dimensional numbers, | T1,T2,T4 | 1 | |
| | | 3.4 | differential mass, momentum and energy equations of laminar boundary layer on a flat Plate, | T1,T2,T4 | 1 | |
| | | 3.5 | Reynold's and Colburn analogy, | T1,T2 | 1 | |
| | | 3.6 | Empirical relations of laminar and turbulent flows over geometries of different shapes. | T1,T2,T4 | 1 | |
| | | 3.7 | Flow through pipes: Concepts about hydrodynamic and thermal entry lengths | T1,T2,T4 | 1 | |
| | | 3.8 | Use of empirical relations for horizontal pipe flow and annulus flow. | T1,T2,T4 | 1 | |
| | | 3.9 | Natural convection heat transfer-Laminar Free Convection on a vertical surface, effects of turbulence, | T1,T2,T4 | 1 | |
| | | 3.10 | Empirical correlations -Vertical Plate, Inclined and Horizontal Plates, long Horizontal Cylinder, Spheres. | T1,T2,T4 | 1 | |
| | | 3.11 | Problems | T1,T2,R1 | 2 | |

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| | | | | | 12 | |
| IV | types of condens ation heat | **Boiling and Condensation & Heat Exchangers** | | | | |
| | | 4.1 | Boiling– types of boiling, Pool boiling, different regimes of pool boiling, | T1,T2 | 1 | Chalk & Talk, PPT Videos |
| | | 4.2 | Empirical relation for heat flux in nucleate boiling, maximum or critical heat flux and Leiden frost point, applications of boiling | T1,T2 | 1 | |
| | | 4.3 | Film wise and drop wise condensation, applications of condensation | T1,T2 | 1 | |
| | | 4.4 | Nusselt theory of film condensation | T1,T2 | 1 | |
| | | 4.5 | Problems on boiling | T1,T2,R1 | 1 | |
| | | 4.6 | Problems on condensation. | T1,T2,R1 | 1 | |
| | | **Heat Exchangers** | | | | |
| | | 4.7 | Applications, types of heat exchanger | T1,T2 | 1 | |
| | | 4.8 | Heat exchanger analysis - LMTD method | T1,T2 | 1 | |
| | | 4.9 | Effectiveness- NTU method | T1,T2 | 2 | |
| | | 4.10 | Cross flow heat exchanger, Shell and tube heat exchanger. | T1,T2 | 1 | |
| | | 4.11 | Problems | T1,T2,R1 | 2 | |
| | | 4.12 | **(Beyond syllabus)** Fouling of Heat exchanger | | 1 | |
| | | | | **Total** | 14 | |
| V | CO5: State and apply laws of radiation and estimate radiation heat transfer between bodies. [K3] | **5 Radiation Heat Transfer** | | | | |
| | | 5.1 | Plank's theory of radiation, Surface, surface emission properties, | T1,T4,R3 | 1 | Chalk & Talk, PPT &Videos |
| | | 5.2 | Emissivity, Absorbvity, Reflectivity and transmissivity, Concept of Black body | T1,T4,R3 | 1 | |
| | | 5.3 | Stefan – Boltzmann's law of radiation, Kirchoff's law, | T1,T4,R3 | 1 | |
| | | 5.4 | Planck's law and Wein's displacement law, | T1,T4,R3 | 1 | |
| | | 5.5 | Intensity od radiation and Lambert cosine law | T1,T4,R3 | 1 | |
| | | 5.6 | Radiation heat transfer between black bodies, Shape factor algebra | T1,T4,R3 | 2 | |
| | | 5.7 | Radiation heat transfer between infinite and finite surfaces, | T1,T4,R3 | 1 | |
| | | 5.8 | Radiation shields. | T1,T4,R3 | 1 | |
| | | 5.9 | Problems | T1,T2,R1 | 2 | |
| | | 5.10 | **(Beyond syllabus)** Radiation from Gasses and Vapours | T1,T2,R1 | 1 | |
| | | | | **Total** | 12 | |
| | | | | **CUMULATIVE PROPOSED PERIODS** | **64** | |

| Text Books: | |
|---|---|
| **S.No** | **AUTHORS, BOOK TITLE, EDITION, PUBLISHER, YEAR OF PUBLICATION** |
| T1 | R. C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, 6th edition, New Age Internationals, 2022 |
| T2 | R K Rajput, Heat and Mass Transfer, Revised 7th Edition, S Chand- 2018 |
| T3 | D.S. Kumar, Heat Transfer, 8thEdition, S. K. Kataria, & Sons, 2015. |
| T4 | J. P. Holman,Heat Transfer, 10thEdition, Tata McGraw-Hill publishing Company Limited, 2017. |
| **Reference Books:** | |
| R1 | Yunus A. Cengel Heat and Mass Transfer - Fundamentals and Applications, 6th Edition, McGraw Hill Education, 5 August 2020 |
| R2 | P. K. Nag, Heat and Mass Transfer,3rdEdition, Tata McGraw-Hill Education, 2011. |
| R3 | S. C Arora,S. Domkundwar and Anand V. Domkundwar, Heat and Mass Transfer, 2nd Edition, , Dhanpat Rai & co, 2007. |
| **Web Details** | |
| 1 | https://nptel.ac.in/courses/112101097 |
| 2 | https://www.youtube.com/watch?v=qa-PQOjS3zA |
| 3 | https://www.youtube.com/watch?v=jc_hL_tSFzo |
| 4 | https://www.youtube.com/watch?v=6OGnB9tywtI |
| 5 | https://www.youtube.com/watch?v=CDncSyDvpdQ |

| | | Name | Signature with date |
|---|---|---|---|
| i. | Faculty1 | Mr. B. SRINIVAS | |
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| iii. | Course Coordinator | Mr. B. SRINIVAS | |
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Principal