

Code Regulation

P3

R16



**Aditya College of
Engineering & Technology**

Course file

Mechanical Department

Subject Name : Heat Transfer

Faculty name : K Vijay

Email : vijay.kotamarthi@acet.ac.in

Year & Sem : III – II/2020-21

Contact No : 9701717017



Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

Internal Quality Assurance Cell (IQAC)

CourseFileAudit

Course Name:	Heat Transfer	Class	III ME-A
Faculty Name:	K Vijay	Regulation	R16
Department:	Mechanical Engineering	Academic year	2020-21

S.No.	Content	Available
1.	Cover Page	Yes/No
2.	IQAC verification page	Yes/No
3.	Content Page	Yes/No
4.	Vision and Mission of the Institute– Principal signed Xerox copy	Yes/No
5.	Vision and Mission of the Department– HoD signed Xerox copy	Yes/No
6.	Program Educational Objectives(PEOs)-HoD signed Xerox copy	Yes/No
7.	Program Outcomes(POs)-HoD signed Xerox copy	Yes/No
8.	Program Specific Outcomes(PSOs)-HoD signed Xerox copy	Yes/No
9.	Course Syllabus–Xerox copy from University curriculum book	Yes/No
10.	Academic Calendar–given by University-Xerox copy	Yes/No
11.	Class Time table – Signed and Xerox copy (highlighting the course periods Including tutorial)	Yes/No
12.	Lesson Plan with S.No as L.No, Topic, Teaching aid (TA)/Methodology(TM), Text/Reference book and web references.	L: T: TA: TM:
13.	i. Course Outcomes(COs)–Based on syllabus with BT level mapped ii. Course Outcomes Mapping with POs and PSOs iii. Justification for CO-PO and CO-PSO mapping	Cos: POs: PSOs:
14.	List of Gaps within the syllabus–Mapping to CO, Pos and PSOs with Justification and proposed mode of addressing	Gaps: COs: POs: PSOs:
15.	List of Gaps beyond the syllabus–Mapping to Pos and PSOs with Justification and proposed mode of addressing	Gaps: POs: PSOs:
16.	CO–PO/PSO Mapping including Gaps	POs: PSOs:
17.	Gap addressed–Single page report	Yes/No
18.	Brief notes on the importance of the course	Yes/No
19.	Lecture Notes-Unit wise including gaps	Pages:

20.	List of Power Point Presentations /Videos along with CD	PPTs: Videos:
21.	University Question Papers(3previousyearsXeroxcopies)	Yes/No
22.	Unit wise short and long answer question bank	Qs:
23.	Unit wise Quiz Questions	Qs:
24.	Class Tests Question Papers mapped with CO and BT with solutions (Awardlist,Xeroxcopyofany3studentsanswerscripts)	Yes/No
25.	Assignment Question Papers mapped with CO and BT with solutions (Awardlist,Xeroxcopyofany3studentsanswerscripts)	Yes/No
26.	Internal Question Papers mapped with CO and BT(Present sem course and previous3yearsXeroxcopy)with solutions(Award list, Xerox copy of any3studentsanswerscripts)	Yes/No
27.	Scheme of evaluation with CO and BT mapping	Yes/No
28.	Tutorial topics with evidence both material and attendance	Yes/No
29.	3listsofslowandadvancedlearners– 1. Based on previous semester/up to previous semester. 2. Basedonfacultyobservationsupto3weeks. 3. Basedon1 st midexams.	Yes/No Yes/NoYes/ No
30.	Remedial class for slow learners–schedule and contents/materials.	Yes/No
31.	Remedial class attendance sheet with delivery record	Yes/No
32.	Advance Learners – Engagement documentation For GATE preparations Or any others (please specify)	No. No.
33.	List of student certifications in relevant NPTEL/other MOOC courses	Reg: Cert:
34.	Course Assessment(Plan & Execution)	Att:
35.	Course end survey form, filled form sand analysis	Att:
36.	Students feedback on faculty and TL analysis, corrective measured planned–3 rd &13 th week	Yes/No Yes/No
37.	Result Analysis at the end of the course	Pass%:
38.	Observation for not attaining CO or for improvement	No. of obs
39.	Plan of action to improve CO attainment next time	No. of act
40.	Attendance register(including Theory/Tutorial)–Teacher/Course delivery Record ,continuous evaluation	Filled Yes/No
41.	Course file (Digital form)–all the above contents	Yes/No

Note: Other than Yes/No, please give the number/statistics

Observations:

Remarks:

Signatures of Audit Committee members



Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

Institute Vision

To induce higher planes of learning by imparting technical education with

- International standards
- Applied research
- Creative Ability
- Value based instruction and
- To emerge as a premiere institute.

Institute Mission

Achieving academic excellence by providing globally acceptable technical education by forecasting technology through

- Innovative Research And development
- Industry Institute Interaction
- Empowered Manpower

Principal



Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

Department of Mechanical Engineering

Department Vision:

To be a center of excellence in Mechanical Engineering education and research.

Department Mission:

1. To promote trainings with institutional association
2. To achieve learning centric infra-structure
3. To provide skill-based education with focus on Automotive
4. To promote innovative ideas through creativity and leadership quality

Head-ME



Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

Department of Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. Learn the principles of applied and fundamental engineering sciences that are required to formulate and solve problems in Mechanical Engineering.
2. Exhibit technical skills in solving real world problems using emerging technologies considering societal, technological and business challenges.
3. Work effectively as individuals and as team members in multidisciplinary projects.
4. Engage in professional practice with ethical values and attitude of lifelong learning.

Head-ME



Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

Department of Mechanical Engineering

PROGRAM OUTCOMES (POs)

1. **ENGINEERING KNOWLEDGE:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **PROBLEM ANALYSIS:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **DESIGN/DEVELOPMENT OF SOLUTIONS:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **CONDUCT INVESTIGATIONS OF COMPLEX PROBLEMS:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **MODERN TOOL USAGE:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **THE ENGINEER AND SOCIETY:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **ENVIRONMENT AND SUSTAINABILITY:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **ETHICS:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **INDIVIDUAL AND TEAM WORK:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **COMMUNICATION:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, give and receive clear instructions.
11. **PROJECT MANAGEMENT AND FINANCE:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **LIFE-LONG LEARNING:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Head-ME



Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

Department of Mechanical Engineering

PROGRAM SPECIFIC OBJECTIVES (PSOs)

1. Mechanical Engineers must be able to analyze, design, and evaluate mechanical components and systems using cutting-edge software tools as required by the industries from time to time.
2. The ability to work in manufacturing and other sectors' operations and maintenance plants.
3. As part of a team or individually, plan and manage activities in micro, small, medium, and large enterprises.

Head-ME

HEAT TRANSFER

UNIT – I

INTRODUCTION: Modes and mechanisms of heat transfer – basic laws of heat transfer – General discussion about applications of heat transfer.

CONDUCTION HEAT TRANSFER: Fourier rate equation – general heat conduction equation in cartesian, cylindrical and Spherical coordinates. Steady, unsteady and periodic heat transfer – initial and boundary conditions.

ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER: Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – critical radius of insulation- Variable thermal conductivity – systems with heat sources or heat generation

UNIT – II

extended surface (fins) heat Transfer – long fin, fin with insulated tip and short fin, application to error measurement of temperature.

ONE DIMENSIONAL TRANSIENT CONDUCTION HEAT TRANSFER: Systems with negligible internal resistance – significance of biot and fourier numbers - chart solutions of transient conduction systems

UNIT – III

CONVECTIVE HEAT TRANSFER: Classification of convective heat transfer – dimensional analysis as a tool for experimental investigation – Buckingham Pi Theorem for forced and free convection, application for developing semi – empirical non- dimensional correlation for convective heat transfer – Significance of non- dimensional numbers – concepts of continuity, momentum and Energy Equations.

UNIT –IV

FORCED CONVECTION

EXTERNAL FLOWS: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -flat plates and cylinders.

INTERNAL FLOWS: Concepts about hydrodynamic and thermal entry lengths – division of internal flow based on this –use of empirical relations for horizontal pipe flow and annulus flow.

FREE CONVECTION: Development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for vertical plates and pipes.

UNIT V

HEAT TRANSFER WITH PHASE CHANGE

BOILING: Pool boiling – regimes- calculations on nucleate boiling, critical heat flux and film boiling.

CONDENSATION: Film wise and drop wise condensation –Nusselt's theory of condensation on a vertical plate - film condensation on vertical and horizontal cylinders using empirical correlations.

HEAT EXCHANGERS:

Classification of heat exchangers – overall heat transfer coefficient and fouling factor – concepts of LMTD and NTU methods – Problems.

UNIT VI

RADIATION HEAT TRANSFER:

Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

Text Books:

1. Heat Transfer /JPHOLMAN/TMH
2. Heat Transfer /P.K.Nag/ TMH
3. Principles of Heat Transfer /Frank Kreith, RM Manglik& MS Bohn/Cengage learning publishers

References:

1. Heat and Mass Transfer /Arora and Domkundwar/Dhanpatrai&sons
2. Fundamentals of Engg. Heat and Mass Transfer / R.C.Sachdeva / New Age International
3. Heat and Mass Transfer /Cengel/McGrawHill.
4. Heat and Mass Transfer /D.S.Kumar / S.K.Kataria&Sons
5. A Text book on Heat Transfer-4th Edition/ S.P Sukhatme/Universities Press

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Directorate of Academic Planning
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA-533003, Andhra Pradesh, INDIA
(Established by AP Government Act No. 30 of 2008)

Lr. No. 02-08/ JNTUK/DAP/AC//II-III-IV Year/B. Arch2020-21

Date: 29-12-2020

Dr. R. Srinivasa Rao,
Director, Academic Planning
JNTUK, Kakinada

To
All the Principals of Affiliated Colleges,
JNTUK, Kakinada.

Academic Calendar for II, III and IV Year - B. Arch
Academic year 2020-21

I SEMESTER			
Description	From	To	Weeks
Commencement of Class Work	02.11.2020		
I Unit of Instruction	02.11.2020	19.12.2020	7W
II Unit of Instructions	21.12.2020	23.01.2021	5W
I Mid Examinations	25.01.2021	30.01.2021	1W
II Unit of Instructions(Continued)	01.02.2021	20.02.2021	3W
II Mid Examinations	22.02.2021	27.02.2021	1W
Preparation & Practicals	01.03.2021	06.03.2021	1W
End Examinations	08.03.2021	20.03.2021	2W
Commencement of II Semester Class Work	22.03.2021		
II SEMESTER			
I Unit of Instructions	22.03.2021	08.05.2021	7W
I Mid Examinations	10.05.2021	12.05.2021	1/2W
II Unit of Instructions	13.05.2021	30.06.2021	7W
II Mid Examinations	01.07.2021	03.07.2021	1/2W
Preparation & Practicals	05.07.2021	10.07.2021	1W
End Examinations	12.07.2021	24.07.2021	2W
Commencement of next Year Class Work			
<i>Note: Calendar is prepared with 8 hrs/day hence 7 weeks per instruction period</i>			

R. Srinivasa Rao
Director Academic Planning

Director
Academic Planning
JNTUK Kakinada

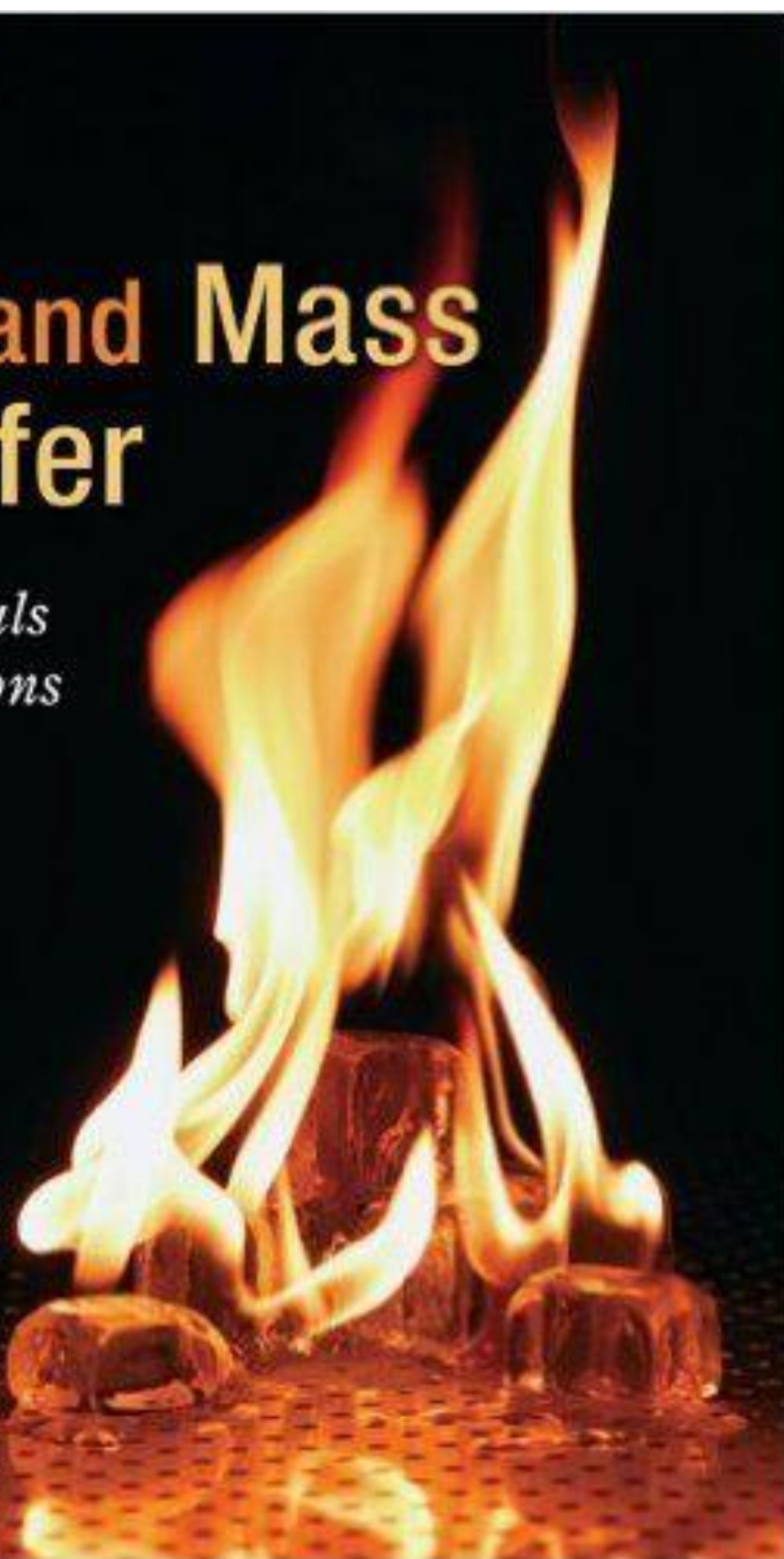
Copy to the Secretary to the Hon'ble Vice Chancellor, JNTUK
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Copy to Registrar, JNTUK
Copy to Director Academic Audit, JNTUK
Copy to Director of Evaluation, JNTUK

Fifth Edition

Heat and Mass Transfer

*Fundamentals
& Applications*

Yunus A. Çengel
Afshin J. Ghajar





Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

Department of Mechanical Engineering

LESSON PLAN

PROGRAM: B.TECH	CLASS: III- II MECHANICAL – A
COURSE NAME: HEAT TRANSFER	FACULTY NAME: K VIJAY

L.No	Topic/ Sub Topic	Reference	Teaching method ^{##}
1.	Introduction to heat transfer	R3 (02-09)	C&T
2.	Modes and mechanisms of heat transfer	R3 (17-29)	C&T, RTCS
3.	Basic laws of heat transfer & applications	R3 (17-29)	C&T
4.	General conduction equation in cartesian coordinates	R3 (74-75)	C&T
5.	General conduction equation in cylindrical coordinates	R3 (75-76)	C&T
6.	General conduction equation in spherical coordinates	R3 (76)	C&T
7.	Initial and boundary conditions	R3(77-84)	C&T, RTCS
8.	1D steady state conduction heat transfer: Homogeneous slabs	T1 (41-42)	C&T, RTCS
9.	Hollow cylinder	T1(43-44)	C&T
10.	Spheres	R3(71)	C&T
11.	Overall heat transfer coefficient and thermal resistance	R3(131-33)	C&T
12.	Electrical analogy	R3(131-33)	C&T
13.	Critical radius of insulation	R3(39-40)	C&T, RTCS
14.	Variable thermal conductivity	R3(104-105)	C&T
15.	Systems with heat generation	R3 (97-99)	C&T
16.	Extended surfaces or fins: introduction	R3 (156-158)	C&T, RTCS
17.	Heat transfer analysis with long fin	R3 (158-159)	OL, RTCS
18.	Heat transfer analysis with short fin with insulation	R3 (159-160)	OL
19.	Heat transfer analysis with short fin without insulation	R3 (160)	OL
20.	Efficiency and effectiveness of fins	R3 (160-161)	OL
21.	Problems practicing on short fin with insulation	R3 (196-200)	OL
22.	Problems practicing on fins with different geometries	R3 (196-200)	OL
23.	1D Transient heat conduction: introduction	T1 (140)	OL, RTCS
24.	Systems with negligible internal resistance	T1 (141-142)	OL
25.	Significance of biot and fourier numbers	T1 (142)	OL
26.	Chart solutions of transient heat conduction	T1 (145)	OL, SEM
27.	Problems on infinite solids	T1 (162-165)	OL, SEM
28.	Problems on semi-infinite solids	T1 (146-147)	OL, SEM
29.	Classification of convective heat transfer and introduction	R3 (333-335)	OL
30.	Dimensional analysis as a tool for experimental investigation	W1	OL
31.	Buckingham pi theorem for forced convection	W2	OL

32.	Buckingham pi theorem for natural convection	W2	OL
33.	Significance of non-dimensional number	W3, T1 (401-408)	OL
34.	Derivation of continuity equation, momentum equation and energy equation	R3 (335-350)	OL
35.	External flows: introduction	T1 (215)	OL
36.	Boundary layer theory	T1 (222-226)	OL, RTCS
37.	Thermal boundary layer	T1 (231-235)	OL
38.	Empirical correlations for convective heat transfer – flat plates and cylinders	T1 (279-285)	OL
39.	Problems practicing on plates	R3 (408-409)	OL, SEM
40.	Problems practicing on cylinders	R3 (411-412)	OL, SEM
41.	Internal flows: boundary layer theory	R3 (424-425)	OL, RTCS
42.	Correlations for different cross sections of the pipe	R3 (426-430)	OL, SEM
43.	Problems practicing with laminar condition	R3 (453-454)	OL, SEM
44.	Problems practicing with turbulent flows	R3 (454-457)	OL, SEM
45.	Problems practicing with fully developed flows	R3 (454-457)	OL, SEM
46.	Free convection: Development of hydro dynamic boundary layer along the vertical plate	T1 (327-332)	OL, RTCS
47.	Empirical correlations for vertical plate and pipes	T1 (332-333)	OL
48.	Problems on free convection	T1 (338-343)	OL, SEM
49.	Boiling: classification, Regimes of pool boiling	R3 (518–520)	OL, RTCS
50.	Calculations and correlations of nucleate boiling	R3 (522-525)	OL, SEM
51.	Problems on nucleate boiling	R3 (554-556)	OL, SEM
52.	Critical heat flux and flow boiling	R3 (520-522)	OL
53.	Condensation: classification of condensation, film wise condensation and drop wise condensation	T1 (487)	OL, RTCS
54.	Nusselt's theory of condensation on a vertical plate	T1 (489-492)	OL
55.	Film condensation correlations for horizontal and vertical cylinders	R3 (535-540)	OL
56.	Problems practicing on boiling	R3 (554-556)	OL, SEM
57.	Problems practicing on condensation	R3 (556-557)	OL, SEM
58.	Heat exchangers – classification	T1 (528-531)	OL, RTCS, VIDEOS
59.	Overall heat transfer coefficient	T1 (521-523)	OL
60.	Fouling factor	T1 (527)	OL
61.	LMTD for counter flow and parallel flow	T1 (531-533)	OL
62.	Problems using LMTD method	T1 (536-540)	OL, SEM
63.	NTU (number of transfer units)	T1 (540-542)	OL
64.	Effectiveness of the heat exchanger using NTU	T1 (540-542)	OL
65.	Problems practicing on NTU	T1 (547-550)	OL, SEM
66.	Introduction and emission characteristics	R3 (582-585)	OL
67.	Laws of radiation (black body)	R3 (566-568, 584)	OL
68.	Heat exchange between two black bodies	R3 (620-622)	OL
69.	Shape factor	R3 (606-608)	OL
70.	Heat exchange between grey bodies	R3 (623-629)	OL
71.	Radiation shields	R3 (635-637)	OL
72.	Electrical analogy for radiation	R3 (624-627)	OL
73.	Problems practicing on radiation	R3 (657-664)	OL, SEM

74.	Problems practicing with different conditions (position of the plates like parallel, perpendicular)	R3 (657-664)	OL, SEM
75.	Practicing previous question papers		OL, SEM

Teaching Methods: C&T:-Chalk & Talk; S/P:-Slides/PPT;Videos; SEM: Seminar; DEMO; CHART; ET/GL: Expert Talk/Guest Lecture; QUIZ; GD:-Group discussion; RTCS: Real time case studies; JAR:-Journal article review; PD:-Poster design; OL:-Online lecture/ White Board through Microsoft Teams.

Text Books:

4. Heat Transfer /JPHOLMAN/TMH
5. Heat Transfer /P.K.Nag/ TMH
6. Principles of Heat Transfer /Frank Kreith, RM Manglik& MS Bohn/Cengage learningpublishers

References:

6. Heat and Mass Transfer /Arora and Domkundwar/Dhanpatrai&sons
7. Fundamentals of Engg. Heat and Mass Transfer / R.C.Sachdeva / New AgeInternational
8. Heat and Mass Transfer /Cengel/McGrawHill.
9. Heat and Mass Transfer /D.S.Kumar / S.K.Kataria&Sons
10. A Text book on Heat Transfer-4th Edition/ S.P Sukhatme/UniversitiesPress

Web Resources:

W1: [H&MT: Lesson 13. Dimensional analysis of free and forced convection \(iasri.res.in\)](http://iasri.res.in)

W2:[H&MT: Lesson 12. Free and Forced Convection- Newton's law of cooling, heat transfer coefficient in convection, Useful non dimensional numbers \(iasri.res.in\)](http://iasri.res.in)

W3: [Dimensionless Numbers In Heat Transfer - Engineering Units](http://iasri.res.in)

Faculty Signature



Aditya College of Engineering & Technology

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Department of Mechanical Engineering

COURSE OUTCOMES (COs):

Upon completion of the course, students will be able to:

CO#	Course Outcomes	Blooms Taxonomy level
CO1	Demonstrate 3D conduction heat transfer in Cartesian, cylindrical and spherical coordinates	Understand
CO2	Compute correlations and solve the problems on fins and transient with conduction	Apply
CO3	Analyze convection process in natural and forced modes	Analyze
CO4	Explain and solve convection problems	Understand
CO5	Design heat exchanger and understand the process involving in heat exchanger like boiling and condensation	Create
CO6	Explain radiation incorporated in heat transfer and solve the problems	Understand

CO-PO/PSO MATRIX:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		3			1								
CO2	3	3	3	2			1								
CO3	3	1				1	1								
CO4	3	3		2		2								1	
CO5	2	3	3	2										2	1
CO6	2	2		1											
Course	2.67	2.33	2.00	2.00		1.50	1.00							1.50	1.00

PO1	Engineering Knowledge	PO7	Environment & Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design / Development of Solutions	PO9	Individual & Team Work
PO4	Conduct Investigations of complex problems	PO10	Communication Skills
PO5	Modern Tool usage	PO11	Project Management & Finance
PO6	Engineer & Society	PO12	Life-long Learning

Faculty Signature



Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

CO-PO& PSO Justification

Sl. No	CO Number	PO / PSO	Mapping	Justification
1	CO1	PO1	3	Strongly mapped as student can be able to understand the basics of conduction and apply in real time cases
2	CO1	PO2	2	Moderately mapped as student can be able to analyze problems
3	CO1	PO4	3	Strongly mapped as student can be able to solve the problems with live examples
4	CO1	PO7	1	Slightly mapped as student can apply this for environment sustainability
5	CO2	PO1	3	Strongly mapped as student can be able to analyze and apply the subject in daily practice
6	CO2	PO2	3	Strongly mapped as student can be able to analyze the conditions
7	CO2	PO3	3	Strongly mapped as student can be able to design geometries for live examples
8	CO2	PO4	2	Moderately mapped as student can be able to solve the basic problems
9	CO2	PO7	1	Slightly mapped as student can apply this for environment conditions
10	CO3	PO1	3	Strongly mapped as student can be able to analyze the conditions
11	CO3	PO2	1	Slightly mapped as student can be able to compare the convection types
12	CO3	PO6	1	Slightly mapped as the student can be able to correlate the convection process
13	CO3	PO7	1	Slightly mapped as student can be able to know the application of the convection in environment sustainability with surroundings
14	CO4	PO1	3	Strongly mapped as the student can be able to apply the knowledge in live examples
15	CO4	PO2	3	Strongly mapped as the student can be able to analyze the convection problems
16	CO4	PO4	2	Moderately mapped as the student can be able to solve the live examples
17	CO4	PO6	2	Moderately mapped as the student can be able to understand the knowledge in regular practices
18	CO5	PO1	2	Moderately mapped as the student can be able to understand the knowledge in regular practices
19	CO5	PO2	3	Strongly mapped as the student can analyze the heat exchanger requirements
20	CO5	PO3	3	Strongly mapped as the student can design the heat exchanger under requirements
21	CO5	PO4	2	Moderately mapped as the student can solve the heat exchanger problems

22	CO6	PO2	2	Moderately mapped as the student can be able to understand the knowledge in regular practices
23	CO6	PO4	1	Slightly mapped as the student can be able to understand the radiation laws
24	CO4	PSO2	1	Slightly mapped as the student can be able to understand process of the convection in daily life applications and analyze
25	CO5	PSO2	2	Moderately mapped as the student can be able to understand the maintenance requirements
26	CO5	PSO3	1	Slightly mapped as the student will be able to do the team work for heat exchanger analysis

Faculty

Head- ME



Aditya College of Engineering & Technology

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Department of Mechanical Engineering

Gaps identified based on the CO-PO mappings:

- Visualization and simulation of the problems on conduction, convection using Ansys workbench.

Plan of Action /Corrective measures

- Introduced Ansys software to visualize temperature distribution, velocity and pressure for conduction and convection process.

Revised Mapping considering the gaps

PO's/Co's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		3			1								
CO2	3	3	3	3	3		1						3		
CO3	3	1				1	1								
CO4	3	3		3	3	2							3	1	
CO5	2	3	3	3	3								3	2	1
CO6	2	2		1	2								2		
Course	2.67	2.33	2.00	2.60	2.75	1.50	1.00						2.75	1.50	1.00

PO1	Engineering Knowledge	PO7	Environment & Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design / Development of Solutions	PO9	Individual & Team Work
PO4	Conduct Investigations of complex problems	PO10	Communication Skills
PO5	Modern Tool usage	PO11	Project Management & Finance
PO6	Engineer & Society	PO12	Life-long Learning

Faculty Signature



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CO-PO& PSO Justification after Gaps identification & addressing

Sl. No	CO Number	PO / PSO	Mapping	Justification
1	CO1	PO1	3	Strongly mapped as student can be able to understand the basics of conduction and apply in real time cases
2	CO1	PO2	2	Moderately mapped as student can be able to analyze problems
3	CO1	PO4	3	Strongly mapped as student can be able to solve the problems with live examples
4	CO1	PO7	1	Slightly mapped as student can apply this for environment sustainability
5	CO2	PO1	3	Strongly mapped as student can be able to analyze and apply the subject in daily practice
6	CO2	PO2	3	Strongly mapped as student can be able to analyze the conditions
7	CO2	PO3	3	Strongly mapped as student can be able to design geometries for live examples
8	CO2	PO4	3	Strongly mapped as student can be able to solve the problems
9	CO2	PO5	3	Strongly mapped as student can be able to design and simulate
10	CO2	PO7	1	Slightly mapped as student can apply this for environment conditions
11	CO3	PO1	3	Strongly mapped as student can be able to analyze the conditions
12	CO3	PO2	1	Slightly mapped as student can be able to compare the convection types
13	CO3	PO6	1	Slightly mapped as the student can be able to correlate the convection process
14	CO3	PO7	1	Slightly mapped as student can be able to know the application of the convection in environment sustainability with surroundings
15	CO4	PO1	3	Strongly mapped as the student can be able to apply the knowledge in live examples
16	CO4	PO2	3	Strongly mapped as the student can be able to analyze the convection problems
17	CO4	PO4	3	Strongly mapped as the student can be able to solve the live examples
18	CO4	PO5	3	Strongly mapped as the student can be able to simulate the problems
19	CO4	PO6	2	Moderately mapped as the student can be able to understand the knowledge in regular practices

20	CO5	PO1	2	Moderately mapped as the student can be able to understand the knowledge in regular practices
21	CO5	PO2	3	Strongly mapped as the student can analyze the heat exchanger requirements
22	CO5	PO3	3	Strongly mapped as the student can design the heat exchanger under requirements
23	CO5	PO4	3	Strongly mapped as the student can solve the heat exchanger problems
24	CO5	PO5	3	Strongly mapped as the student can simulate the heat exchanger requirements
25	CO6	PO2	2	Moderately mapped as the student can be able to understand the knowledge in regular practices
26	CO6	PO4	1	Slightly mapped as the student can be able to understand the radiation laws
27	CO6	PO5	2	Moderately mapped as the student can be able to simulate basic examples
28	CO2	PSO1	3	Strongly mapped as student can be able to design and simulate the fin problems
29	CO4	PSO1	3	Strongly mapped as student can be able to design and simulate the convection problems
30	CO4	PSO2	1	Slightly mapped as the student can be able to understand process of the convection in daily life applications and analyze
31	CO5	PSO1	3	Strongly mapped as student can be able to design and simulate the heat exchanger problems
32	CO5	PSO2	2	Moderately mapped as the student can be able to understand the maintenance requirements
33	CO5	PSO3	1	Slightly mapped as the student will be able to do the team work for heat exchanger analysis
34	CO6	PSO1	2	Moderately mapped as the student can be able to simulate basic examples

Faculty

Head- ME



Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

Department of Mechanical Engineering

Single Page report for the gaps identified:

In Heat Transfer subject, for the visualization of the heat transfer rate through the composite slabs, cylinders and spheres in the conduction; convection heat transfer rate with fluid flows will enhance the knowledge on theory subject. As including live examples, will also create enthuse to students on the subject.

Course Objectives:

This course is intended to impart knowledge of principles of heat transfer and analyze the heat exchange process in various modes for the evaluation of rate of heat transfer and the temperature distribution in different configurations.

Course outcomes:

The student after undergoing this course is expected to know the principles of heat transfer and be able to apply to practical situations where in heat exchange takes place through various modes of heat transfer including phase change.

III B. Tech II Semester Supplementary Examinations, November -2019

HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)

2. Answer **ALL** the question in **Part-A**

3. Answer any **FOUR** Questions from **Part-B**

4. Heat transfer data book allowed

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**PART –A (14 Marks)**

1. a) Why the metals are good conductors of both heat and electricity, while some non-metallic crystalline solids are very good conductors of heat but very poor conductors of electricity? Explain. [2M]
- b) What is the significance of Biot number? [2M]
- c) Distinguish between natural and forced convective heat transfers. [2M]
- d) What do you understand by hydrodynamic and thermal boundary layers? [3M]
- e) Why the heat transfer coefficients in condensation and boiling very high are compared to those in forced convection without phase change? [3M]
- f) What is meant by view factor and why is it so important in calculation of radiation heat transfer? [2M]

**PART –B (56 Marks)**

2. a) Explain the effect of variable thermal conductivity and deduce expression for heat transfer in a slab considering  $k=k_0(1+\alpha T)$ , where  $k_0$  and  $\alpha$  are constants. [7M]
- b) Consider a 20 mm thick plate with uniform heat generation of  $80 \text{ MW/m}^3$ . The left and right faces are kept at constant temperatures of  $160^\circ\text{C}$  and  $120^\circ\text{C}$  respectively. The plate has a constant thermal conductivity of  $200 \text{ W/m K}$ . Determine: [7M]
  - i) the expression for temperature distribution in the plate,
  - ii) the location and value of maximum temperature, and
  - iii) the rate of heat transfer at the plate centre.
3. a) Two fins are identical except the diameter of one is twice that of the other. Compare their efficiencies and effectiveness. [6M]
- b) Consider two very long, slender rods of the same diameter but of different materials. One end of each rod is attached to a base surface maintained at  $100^\circ\text{C}$ , while the surfaces of the rods are exposed to ambient air at  $20^\circ\text{C}$ . By traversing the length of each rod with a thermocouple, it was observed that the temperatures of the rods were equal at the positions  $X_A=0.15 \text{ m}$  and  $X_B=0.075 \text{ m}$ , where  $X$  is measured from the base surface. If the thermal conductivity of rod A is known to be  $k_A=72 \text{ W/mK}$ , determine the value of  $k_B$  for the rod B. [8M]
4. a) Explain the concept of momentum and energy equation. [7M]
- b) Discuss the detailed classification of convective heat transfer. [7M]

5. a) Consider two identical flat plates one above another in quiescent air. [6M]  
 i) In one situation, the bottom plate is at  $100^{\circ}\text{C}$  and the top one is at  $500^{\circ}\text{C}$ . ii) In another situation, the bottom plate is at  $500^{\circ}\text{C}$  and the top one is at  $100^{\circ}\text{C}$ . State in which case the rate of heat transfer is expected to be higher and why?
- b) Atmospheric air,  $T_{\infty}=300\text{ K}$  and with a free stream velocity,  $U_{\infty}=30\text{ m/s}$  flows over a [8M]  
 flat plate parallel to a side of length  $2\text{ m}$  and is maintained at a uniform temperature of  $T_w=400\text{ K}$ . Determine: i) The average heat transfer coefficient over the region where the boundary layer is laminar; ii) The average heat transfer coefficient over the entire length  $L=2\text{ m}$  of the plate.
6. a) Under what conditions is the effectiveness-NTU method definitely preferred over [6M] the LMTD method in the analysis of a heat exchanger?
- b) A counter flow heat exchanger has an overall heat transfer coefficient of  $225\text{ W/m}^2\text{K}$  [8M]  
 and a surface area of  $33\text{ m}^2$ . The hot fluid [ $c_p=3.56\text{ kJ/kg K}$ ] enters at  $94^{\circ}\text{C}$  and flows at the rate of  $2.52\text{ kg/s}$ . The cold fluid [ $c_p=1.67\text{ kJ/kg K}$ ] enters at  $16^{\circ}\text{C}$  and flows at the rate of  $2.27\text{ kg/s}$ . Determine the rate of heat transfer.
7. a) State Planck's distribution law and describe how monochromatic emissive power [6M] varies with wavelength?
- b) Derive the expression for surface resistance and shape resistance using electrical [8M] analogy.

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**III B. Tech II Semester Regular/Supplementary Examinations, October/November - 2020****HEAT TRANSFER**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

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- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)  
2. Answer **ALL** the question in **Part-A**  
3. Answer any **FOUR** Questions from **Part-B** 4. Heat transfer data book allowed

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**PART -A (14 Marks)**

1. a) Define the critical thickness of insulation. [3M] b) Define Fin effectiveness. [2M]  
c) Define the thermal boundary layer. [2M]  
d) Why airplanes are designed aerodynamic? [2M]  
e) What are the practical difficulties in maintaining drop wise condensation? [3M]  
f) What is visible light and to which part of the electromagnetic spectrum it belongs? [2M]

**PART -B (56 Marks)**

2. a) A metal ( $k=45 \text{ W/m}^\circ\text{C}$ ) steam pipe of 5 cm ID and 6.5 cm OD is lagged with 2.75 cm radial thickness of inside and outside surface are  $h_i=4650 \text{ W/m}^2\text{K}$  and  $h_o=11.5 \text{ W/m}^2\text{K}$  respectively, if the steam temperature is  $200^\circ\text{C}$  and ambient is  $25^\circ\text{C}$ , Calculate: i) heat loss per meter length of pipe, and ii) temperature at interfaces. [7M]  
b) Derive an expression for the variation of temperature along the radius for a solid [7M] sphere of constant,  $k$  when there is uniform internal heat generation in the solid.
3. a) Derive an expression for heat dissipation for an infinitely long fin. [7M] b) A 50 cm x 50 cm copper slab, 6 mm thick at a uniform temperature of  $350^\circ\text{C}$  suddenly [7M] has its surface temperature lowered to  $30^\circ\text{C}$ . Find the time at which the slab temperature becomes  $100^\circ\text{C}$ .  $h = 100 \text{ W/m}^2\text{C}$ . Also, find the rate of cooling after 60 seconds.
4. a) Derive the momentum equation for a laminar boundary layer stating the assumptions [10M] made.  
b) What are dimensional homogeneity and state its uses? [4M]
5. a) Water flows at  $45^\circ\text{C}$  over a flat plate 1m x 1m size maintained at  $22^\circ\text{C}$  with a velocity [7M] of 1.5 m/s. Estimate the variation of heat transfer coefficient along the length of heating starts from 0.25 m from the leading edge.  
b) A vertical pipe 7.5 cm OD and 2.2 m long have a surface temperature of  $95^\circ\text{C}$  [7M] surrounded by air at  $22^\circ\text{C}$ , Estimate the rate of heat loss from the cylinder when i) vertical ii) horizontal.
6. a) Draw and explain with suitable graph various regimes of boiling. [7M]  
b) Water at a rate of 4080 kg/h is heated from  $35^\circ\text{C}$  to  $75^\circ\text{C}$  by the oil of  $C_p 1.9 \text{ kJ/kgK}$ . [7M]  
The heat exchanger is a double pipe counter flow. Oil enters at  $110^\circ\text{C}$  and leaves at

75°C. Determine: i) mass flow rate of oil, ii) area of the heat exchanger to handle heat duty if the overall heat transfer coefficient is 320 W/m<sup>2</sup>K.

7. a) What is the intensity of radiation and prove total emissive power is  $\pi$  times the [7M] intensity of radiation.

b) A long pipe 40 mm in diameter passes through a room and is exposed to air at 35°C. [7M] The surface temperature of the tube is 95°C. Assuming the emissivity of the pipe as 0.6, estimate the radiation heat loss per meter length.

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## III B. Tech II Semester Regular Examinations, April/May - 2019

## HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)  
 2. Answer **ALL** the question in **Part-A**  
 3. Answer any **FOUR** Questions from **Part-B**  
 4. Heat transfer data book allowed

**PART -A**

1. a) Write the Fourier rate equation for heat transfer by conduction. Give the physical significance of each term. [2M]
- b) Define effectiveness and efficiency of a fin. [2M]
- c) Write the expression for Biot number and explain its physical significance. [2M]
- d) What is meant by a hydrodynamic boundary layer? Explain the formation of Hydrodynamic boundary layer over a flat plate [3M]
- e) Distinguish between film wise and drop wise condensation. Which of the two gives a higher heat transfer coefficient? Why? [3M]
- f) Define irradiation and radiosity. [2M]

**PART -B**

2. a) Derive a three dimensional generalized heat conduction equation in cylindrical co-ordinates. [7M]
- b) A furnace wall is made of 25 cm fire brick, 20 cm common brick, 6 cm of magnesia and 4mm of steel plate on the outside. The inside and the outside surface temperatures are 1200 °C and 100 °C respectively. Calculate the temperature between layers and rate of heat transfer. Assume the thermal conductivities of fire brick, common brick, Magnesia and steel are 1.2 W/m-K, 0.75 W/m-K, 0.07 W/m-K and 71 W/m-K respectively. [7M]
3. a) A longitudinal copper fin ( $k=3.5$  W/m-K), 6 cm long and 5 mm in diameter is exposed to air stream at 20 °C. The convective heat transfer coefficient is 20 W/m<sup>2</sup>-K. If the fin has the base temperature of 150 °C, calculate the heat transfer by the fin and fin efficiency. [7M]
- b) In quenching process a copper plate of 3 mm thickness is heated up to 350 °C and is suddenly dipped into water bath and cooled to 25 °C. Calculate the time required for the plate to reach the temperature of 50 °C. The heat transfer coefficient on the surface of the plate is 28 W/m<sup>2</sup>-K. The length and width of the plates are 40 cm and 30 cm respectively. The properties of copper are as follows: specific heat=380.9 J/Kg-K, density 8800 kg/m<sup>3</sup> and thermal conductivity 385 W/m-K. [7M]
4. a) State and explain Buckingham  $\pi$  theorem. [7M]
- b) Water flows in a duct having a cross section 5 X 10 mm with a mean bulk temperature of 20 °C. If the duct wall temperature is constant at 60 °C and fully developed laminar flow is experienced, calculate the heat transfer per unit length. [7M]

5. a) Air at 15 °C and at a pressure of 1 atm is flowing along a flat plate at a velocity of 4.75 km/sec. If the plate is one meter wide and at 70 °C, find the quantities given below at  $x=1\text{m}$ . [7M]  
 (i) Hydrodynamic Boundary layer thickness.  
 (ii) Local friction factor  
 (iii) Average friction  
 (iv) Local heat transfer co-efficient  
 (v) Rate of heat transfer.
- b) A flat plate having dimensions 50 cm X 20 cm and at a uniform temperature of 100 °C is kept in air stream at temperature 20 °C. The velocity of air is 3 m/sec. Find out the rate of heat loss from the plate when the flow is (i) parallel to 50 cm (ii) parallel to 20 cm side. The Nusselt number for laminar and turbulent flows are given as  $N_u=0.664 P_r^{1/3} R_e^{1/2}$  and  $N_u=0.037 R_e^{1/4} P_r^{1/3}$ . [7M]
6. a) Explain the regimes of pool boiling. [7M]  
 b) A liquid chemical flows through a thin walled copper tube of 12 mm diameter at the rate of 0.5 kg/sec water flows in opposite direction at the rate 0.37 kg/sec through the annular space formed by this tube and a tube diameter of 20 mm. The liquid chemical enters and leaves at 100 °C and 60 °C, while water enters at 10 °C. Find the length of tube required. Also find the length of tube required if the water flows in the same direction as liquid chemical. The properties of water and liquid chemical are: [7M]
- | Properties                     | Liquid Chemical At 80 °c | Water At 27 °c       |
|--------------------------------|--------------------------|----------------------|
| $\rho$ , Kg/m <sup>3</sup>     | 1078                     | 995                  |
| $\mu$ .Kg/m - Sec <sup>2</sup> | $3200 \times 10^{-6}$    | $853 \times 10^{-6}$ |
| Cp, J/Kg-K                     | 2050                     | 4180                 |
| K, W/mK                        | 0.261                    | 0.614                |
7. a) Two large parallel plates having emissivity of 0.5 and 0.6 are maintained at 1000 K and 500 K respectively. A radiation shield having an emissivity of 0.03 on both sides is placed between the plates. Calculate: [7M]  
 (i) Heat transfer per unit area without shield.  
 (ii) Find out the temperature of the shield and heat transfer per unit area with shield.
- b) Assuming the sun to be a black body having a surface temperature of 5800 K. [7M]  
 Calculate:  
 (i) the total emissive power  
 (ii) the wave length at which the maximum spectral intensity occurs,  
 (iii) the maximum value of  $E_b$  and  
 (iv) the total amount of radiant energy emitted by the sun per unit time if its diameter can be assumed to be  $1.391 \times 10^9$  m.

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## III B. Tech II Semester Regular Examinations, April/May - 2019

## HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)2. Answer **ALL** the question in **Part-A**3. Answer any **FOUR** Questions from **Part-B**

4. Heat transfer data book allowed

**PART -A**

1. a) Define thermal resistance and thermal conductance. [2M]
- b) Describe various types of fins. [2M]
- c) Define Reynolds number. Why is it important? [2M]
- d) What is meant by a thermal boundary layer? How is Prandtl Number related to its thickness? [3M]
- e) Differentiate between pool boiling and flow boiling. [3M]
- f) Define Black body, White body and Grey Body. [2M]

**PART -B**

2. a) Derive the three dimensional heat conduction equations in Cartesian coordinates for a homogeneous and isotropic material with uniform heat generation under unsteady state. [7M]
- b) A 1.0 mm diameter wire is maintained at a temperature of 400 °C and exposed to a convective environment at 40 °C with  $h=50\text{ W/m}^2\text{K}$ . Calculate thermal conductivity which just causes an insulation thickness of 0.2 mm produce a critical radius. How much of this insulation must be added to reduce the heat transfer by 75% from that which would be experienced by bare wire? [7M]
3. a) Derive an expression for temperature distribution and heat loss from a cylindrical rod extending out of a heat source. Assume the end of the rod is perfectly insulated. [7M]
- b) A long steel cylinder 12 cm in diameter and initially at 20 °C is placed into a furnace at 820 °C where the heat transfer coefficient,  $h=140\text{ W/m}^2\text{K}$ . Calculate the time required for the axis temperature to reach 800 °C. Calculate also,
  - (i) The corresponding temperature at a radius of 4.8 cm at that time.
  - (ii) The heat energy absorbed by the cylinder during this period, given that the thermal diffusivity,  $\alpha = 6.11 \times 10^{-6}\text{ m}^2/\text{s}$  and the thermal conductivity,  $k=21\text{ W/m.K}$ .
4. a) Show by dimensional analysis that data for forced convection may be correlated by an equation of the form  $N_u=f(Re, Pr)$ . [7M]
- b) For heating water from 20 °C to 60 °C an electrically heated tube resulting in a constant heat flux of  $10\text{ k/W/m}^2$  is proposed. The mass flow rate is to be such that  $Re_D=2000$ , and consequently the flow must remain laminar. The tube inside diameter is 25 mm. The flow is fully developed (velocity profile). Determine the length of tube required. [7M]

5. a) Explain the phenomena of natural convection over a vertical hot plate. Sketch the boundary layer, temperature and velocity profiles. [7M]
- b) Water at 38 °C flows over a wide, 6 m long, heated plate at 0.06 m/s. For a surface temperature of 93 °C, determine: (a) the hydrodynamic boundary layer thickness  $\delta$  at the end of the plate (b) the total drag on the surface per unit width (c) The thermal boundary layer thickness  $\delta_t$  at the end of the plate (d) the local heat transfer coefficient  $h_x$  at the end of the plate and (e) the total heat flux from the surface per unit width. [7M]
6. a) Deduce average heat transfer co-efficient equation in film condensation on a vertical flat plate using Nusselt's theory. [7M]
- b) In an industry 0.6 kg/Sec of oil ( $C_p=2.5$  kJ/kg-K) is to be cooled in a counter flow heat exchanger from 110 °C to 35 °C by the use of water entering at 20 °C. The overall heat transfer coefficient is 1500 W/m<sup>2</sup>-K. Presuming the exit water temperature should not exceeds 80 °C, using NTU method, Calculate: [7M]
- (i) Water flow rate  
(ii) surface area required  
(iii) The effectiveness of heat exchanger.
7. a) State and prove Kirchhoff's law of radiation. [7M]
- b) Two parallel square plates each 4 m<sup>2</sup> area are large compared to a gap of 5 mm separating them. One plate has a temperature of 800 K and surface emissivity of 0.6, while the other has temperature of 300 K and surface emissivity of 0.9; Find the net exchange by radiation between the plates. If a thin polished metal sheet of surface emissivity 0.1 on both sides is now located centrally between the two plates, what will be its steady state temperature? [7M]

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## III B. Tech II Semester Regular Examinations, April/May - 2019

## HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)2. Answer **ALL** the question in **Part-A**3. Answer any **FOUR** Questions from **Part-B**

4. Heat transfer data book allowed

**PART -A**

1. a) Explain the mechanism of thermal conduction in gases, liquids and solids. [2M]
- b) Briefly explain the applications of extended surfaces. [2M]
- c) Describe the physical mechanism of convection. How is the convection heat-transfer coefficient related to the mechanism? [2M]
- d) Sketch the temperature and velocity profiles in free convection on an isothermal vertical wall, for the cases of heating and cooling of a fluid. [3M]
- e) Differentiate between film condensation and drop wise condensation. [3M]
- f) Establish the relation between emissive power and intensity of radiation of a black body. [2M]

**PART -B**

2. a) Derive the general heat conduction equation in spherical coordinates. Obtain the reduced form for one-dimensional unsteady conduction with variable thermal conductivity and no heat generation. [7M]
- b) A hot gas at 573 K flows through a long metal pipe of 0.1 m Outer Diameter and 0.003 m thick. From the stand point of safety and of reducing heat loss from the pipe, mineral wool insulation ( $k=0.052 \text{ W/m K}$ ) is wrapped around so that the exposed surface of the insulation is at a temperature of 323 K. Calculate the thickness of insulation required to achieve this temperature if  $h_i=29 \text{ W/m}^2\text{K}$ ,  $h_o=11.6 \text{ W/m}^2\text{K}$  and the surrounding air temperature in 298 K. Also calculate the corresponding heat transfer rate per unit length. [7M]
3. a) A 0.5 cm thick and 4 cm long fin has its base on a plane plate which is maintained at  $1100^\circ\text{C}$ . The ambient air temperature is  $20^\circ\text{C}$ . The conductivity of the fin material is  $60 \text{ W/m-K}$  and the heat transfer coefficient  $h=150 \text{ W/m}^2\text{-K}$ . Assume that the tip of the fin is insulated. Determine: [7M]
  - (i) Temperature at the end of the fin
  - (ii) Temperature at the middle of the fin
  - (iii) Total heat dissipated by the fin.
- b) Derive An expression for instantaneous heat transfer in a lumped body. [7M]
4. a) Show by dimensional analysis that data for free convection may be correlated by an equation of the form  $N_u=f(G_r, P_r)$ . [7M]
- b) How the local and average convection coefficients for flow past a flat plate are related? Derive the relationship. [7M]

5. a) Explain the concept of boundary layer for flow over flat plate showing different regimes of fluid flow. [7M]
- b) Oil at  $25^{\circ}\text{C}$  is heated in a horizontal tube 15 m long having a surface temperature of  $50^{\circ}\text{C}$ . The pipe has an inner diameter of 0.05 m. The oil flow rate is 1 kg/s at inlet temperature. What will be the oil temperature as it leaves the tubes? What is the average heat transfer coefficient? The flow rate is in the laminar region. The properties of the oil are:  
Specific gravity 0.8; Thermal conductivity 0.125 W/m.K; Specific heat 3.14 kJ/kg.K. Viscosity at  $50^{\circ}\text{C}$  is 0.025 kg/m-s; Viscosity at  $25^{\circ}\text{C}$  is 0.015 kg/m-s. [7M]
6. a) The outer surface of a vertical tube of 1.5 m length and outer diameter of 10 cm is exposed to saturated steam at atmospheric Pressure and is maintained at  $50^{\circ}\text{C}$  by the flow of cool water through the tube. Calculate the rate of heat transfer to the coolant and the rate of condensation of steam. The properties of saturated vapour at atmospheric pressure are as follow. Density =  $0.596 \text{ Kg/m}^3$ , latent heat of condensation is 2257 KJ/Kg. The properties of water are  $\rho=975 \text{ Kg/m}^3$ ,  $\mu = 375 \times 10^{-6} \text{ W.Sec/m}^2$ ,  $K=0.668 \text{ W/m-K}$ . [7M]
- b) Derive an expression for effectiveness of a counter flow heat exchanger using NTU method. [7M]
7. a) Define radiation Intensity. Prove that for a diffusive surface, the emissive power is equal to  $\pi$  times the intensity of radiation. [7M]
- b) A black body of total area  $0.045 \text{ m}^2$  is completely enclosed in a sphere bounded by 5 cm thick walls. The walls have a surface area  $0.5 \text{ m}^2$  and the thermal conductivity is  $1.1 \text{ W/m}^{\circ}\text{C}$  if the inner surface of the enveloping wall is to be maintained at  $215^{\circ}\text{C}$  and the outer wall surface is at  $30^{\circ}\text{C}$  calculate the temperature of the black body. [7M]

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5. a) What is the criterion for transition from laminar to turbulent boundary layer in free convection on a vertical flat plate? Explain. [7M]  
b) Explain velocity and temperature profile for a flat plate and vertical plate in forced convection. [7M]
6. a) The condenser of a steam power plant operates at a pressure of 7.38 kPa. Steam at this pressure condenses on the outer surfaces of horizontal pipes through which cooling water circulates. The outer diameter of the pipes is 2 cm, and the outer surfaces of the pipes are maintained at 30 °C. Determine [7M]  
(i) the rate of heat transfer to the cooling water circulating in the pipes  
(ii) the rate of heat transfer to the cooling water circulating in the pipes and  
(iii) The rate of condensation of steam per unit length of a horizontal pipe.  
b) Refrigeration is designed to cool 250 kg/h of hot liquids of heat 3350 J/kg K at 120 °C using a parallel flow arrangement. 1000 kg/h of cooling water is available for cooling purpose at a temperature of 10 °C. If the overall heat transfer co-efficient is 1160 W/m<sup>2</sup>K and the surface area of the heat exchanger is 0.25 m<sup>2</sup>. Calculate the outlet temperature of the cooled liquid and water and also effectiveness of the heat exchanger. [7M]
7. a) Derive an expression for radiation shape factor and hence deduce reciprocity relation. [7M]  
b) Two large parallel planes having emissivities of 0.25 and 0.5 are maintained at temperatures of 1000 K and 500 K, respectively. A radiation shield having an emissivity of 0.1 on both sides is placed between the two planes. Calculate (i) the heat-transfer rate per unit area if the shield were not present, (ii) the heat-transfer rate per unit area with the presence of the shield and (iii) the temperature of the shield. [7M]

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## III B. Tech II Semester Supplementary Examinations, November -2019

## HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)  
 2. Answer **ALL** the question in **Part-A**  
 3. Answer any **FOUR** Questions from **Part-B**  
 4. Heat transfer data book allowed

**PART -A**

(14 Marks)

1. a) Why the metals are good conductors of both heat and electricity, while some non-metallic crystalline solids are very good conductors of heat but very poor conductors of electricity? Explain. [2M]
- b) What is the significance of Biot number? [2M]
- c) Distinguish between natural and forced convective heat transfers. [2M]
- d) What do you understand by hydrodynamic and thermal boundary layers? [3M]
- e) Why the heat transfer coefficients in condensation and boiling very high are compared to those in forced convection without phase change? [3M]
- f) What is meant by view factor and why is it so important in calculation of radiation heat transfer? [2M]

**PART -B**

(56 Marks)

2. a) Explain the effect of variable thermal conductivity and deduce expression for heat transfer in a slab considering  $k=k_0(1+\alpha T)$ , where  $k_0$  and  $\alpha$  are constants. [7M]
- b) Consider a 20 mm thick plate with uniform heat generation of  $80 \text{ MW/m}^3$ . The left and right faces are kept at constant temperatures of  $160^\circ\text{C}$  and  $120^\circ\text{C}$  respectively. The plate has a constant thermal conductivity of  $200 \text{ W/m K}$ . Determine: [7M]
  - i) the expression for temperature distribution in the plate,
  - ii) the location and value of maximum temperature, and
  - iii) the rate of heat transfer at the plate centre.
3. a) Two fins are identical except the diameter of one is twice that of the other. Compare their efficiencies and effectiveness. [6M]
- b) Consider two very long, slender rods of the same diameter but of different materials. One end of each rod is attached to a base surface maintained at  $100^\circ\text{C}$ , while the surfaces of the rods are exposed to ambient air at  $20^\circ\text{C}$ . By traversing the length of each rod with a thermocouple, it was observed that the temperatures of the rods were equal at the positions  $X_A=0.15 \text{ m}$  and  $X_B=0.075 \text{ m}$ , where  $X$  is measured from the base surface. If the thermal conductivity of rod A is known to be  $k_A=72 \text{ W/mK}$ , determine the value of  $k_B$  for the rod B. [8M]
4. a) Explain the concept of momentum and energy equation. [7M]
- b) Discuss the detailed classification of convective heat transfer. [7M]
5. a) Consider two identical flat plates one above another in quiescent air. [6M]
  - i) In one situation, the bottom plate is at  $100^\circ\text{C}$  and the top one is at  $500^\circ\text{C}$ .
  - ii) In another situation, the bottom plate is at  $500^\circ\text{C}$  and the top one is at  $100^\circ\text{C}$ . State in which case the rate of heat transfer is expected to be higher and why?

- b) Atmospheric air,  $T_\infty=300$  K and with a free stream velocity,  $U_\infty=30$  m/s flows over a flat plate parallel to a side of length 2 m and is maintained at a uniform temperature of  $T_w=400$  K. Determine: i) The average heat transfer coefficient over the region where the boundary layer is laminar; ii) The average heat transfer coefficient over the entire length  $L=2$  m of the plate. [8M]
6. a) Under what conditions is the effectiveness-NTU method definitely preferred over the LMTD method in the analysis of a heat exchanger? [6M]
- b) A counter flow heat exchanger has an overall heat transfer coefficient of  $225 \text{ W/m}^2\text{K}$  and a surface area of  $33 \text{ m}^2$ . The hot fluid [ $c_p=3.56 \text{ kJ/kg K}$ ] enters at  $94^\circ\text{C}$  and flows at the rate of  $2.52 \text{ kg/s}$ . The cold fluid [ $c_p=1.67 \text{ kJ/kg K}$ ] enters at  $16^\circ\text{C}$  and flows at the rate of  $2.27 \text{ kg/s}$ . Determine the rate of heat transfer. [8M]
7. a) State Planck's distribution law and describe how monochromatic emissive power varies with wavelength? [6M]
- b) Derive the expression for surface resistance and shape resistance using electrical analogy. [8M]

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Code No: R1632034

**R16**

SET - 1

**III B. Tech II Semester Regular/Supplementary Examinations, October/November - 2020**

**HEAT TRANSFER**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)  
2. Answer **ALL** the question in **Part-A**  
3. Answer any **FOUR** Questions from **Part-B**  
4. Heat transfer data book allowed

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**PART -A**

**(14 Marks)**

1. a) Define the critical thickness of insulation. [3M]  
b) Define Fin effectiveness. [2M]  
c) Define the thermal boundary layer. [2M]  
d) Why airplanes are designed aerodynamic? [2M]  
e) What are the practical difficulties in maintaining drop wise condensation? [3M]  
f) What is visible light and to which part of the electromagnetic spectrum it belongs? [2M]

**PART -B**

**(56 Marks)**

2. a) A metal ( $k=45 \text{ W/m}^\circ\text{C}$ ) steam pipe of 5 cm ID and 6.5 cm OD is lagged with 2.75 cm radial thickness of inside and outside surface are  $h_i=4650 \text{ W/m}^2\text{K}$  and  $h_o=11.5 \text{ W/m}^2\text{K}$  respectively, if the steam temperature is  $200^\circ\text{C}$  and ambient is  $25^\circ\text{C}$ , Calculate: i) heat loss per meter length of pipe, and ii) temperature at interfaces. [7M]  
b) Derive an expression for the variation of temperature along the radius for a solid sphere of constant,  $k$  when there is uniform internal heat generation in the solid. [7M]
3. a) Derive an expression for heat dissipation for an infinitely long fin. [7M]  
b) A 50 cm x 50 cm copper slab, 6 mm thick at a uniform temperature of  $350^\circ\text{C}$  suddenly has its surface temperature lowered to  $30^\circ\text{C}$ . Find the time at which the slab temperature becomes  $100^\circ\text{C}$ .  $h = 100 \text{ W/m}^2\text{C}$ . Also, find the rate of cooling after 60 seconds. [7M]
4. a) Derive the momentum equation for a laminar boundary layer stating the assumptions made. [10M]  
b) What are dimensional homogeneity and state its uses? [4M]
5. a) Water flows at  $45^\circ\text{C}$  over a flat plate 1m x 1m size maintained at  $22^\circ\text{C}$  with a velocity of 1.5 m/s. Estimate the variation of heat transfer coefficient along the length of heating starts from 0.25 m from the leading edge. [7M]  
b) A vertical pipe 7.5 cm OD and 2.2 m long have a surface temperature of  $95^\circ\text{C}$  surrounded by air at  $22^\circ\text{C}$ , Estimate the rate of heat loss from the cylinder when i) vertical ii) horizontal. [7M]
6. a) Draw and explain with suitable graph various regimes of boiling. [7M]  
b) Water at a rate of 4080 kg/h is heated from  $35^\circ\text{C}$  to  $75^\circ\text{C}$  by the oil of  $C_p 1.9 \text{ kJ/kgK}$ . The heat exchanger is a double pipe counter flow. Oil enters at  $110^\circ\text{C}$  and leaves at  $75^\circ\text{C}$ . Determine: i) mass flow rate of oil, ii) area of the heat exchanger to handle heat duty if the overall heat transfer coefficient is  $320 \text{ W/m}^2\text{K}$ . [7M]

1 of 2

Code No: R1632034

**R16**

SET - 1

7. a) What is the intensity of radiation and prove total emissive power is  $\pi$  times the intensity of radiation. [7M]
- b) A long pipe 40 mm in diameter passes through a room and is exposed to air at 35°C. The surface temperature of the tube is 95°C. Assuming the emissivity of the pipe as 0.6, estimate the radiation heat loss per meter length. [7M]

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2 of 2



# Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

## Department of Mechanical Engineering

### Heat Transfer Question Bank

#### Unit-I

1. A furnace wall is made of 25 cm fire brick, 20 cm common brick, 6 cm of magnesia and 4mm of steel plate on the outside. The inside and the outside surface temperatures are 1200 °C and 100 °C respectively. Calculate the temperature between layers and rate of heat transfer. Assume the thermal conductivities of fire brick, common brick, Magnesia and steel are 1.2 W/m-K, 0.75 W/m-K, 0.07 W/m-K and 71 W/m-K respectively.
2. Write a short note on modes of heat transfer.
3. Derive a three-dimensional generalized heat conduction equation in spherical co-ordinates.
4. Derive a three-dimensional generalized heat conduction equation in cylindrical co-ordinates.

#### Unit-II

1. A long steel cylinder 12 cm in diameter and initially at 20 °C is placed into a furnace at 820 °C where the heat transfer coefficient,  $h=140 \text{ W/m}^2\cdot\text{K}$ . Calculate the time required for the axis temperature to reach 800 °C. Calculate also,
  - a. The corresponding temperature at a radius of 4.8 cm at that time.
  - b. The heat energy absorbed by the cylinder during this period, given that the thermal diffusivity,  $\alpha = 6.11 \times 10^{-6} \text{ m}^2/\text{s}$  and the thermal conductivity,  $k=21 \text{ W/m}\cdot\text{K}$ .
2. Write the expression for Biot number and explain its physical significance.
3. A longitudinal copper fin ( $k=3.5 \text{ W/m}\cdot\text{K}$ ), 6 cm long and 5 mm in diameter is exposed to air stream at 20 °C. The convective heat transfer coefficient is  $20 \text{ W/m}^2\cdot\text{K}$ . If the fin has the base temperature of 150 °C, calculate the heat transfer by the fin and fin efficiency.
4. In quenching process, a copper plate of 3 mm thickness is heated up to 350 °C and is suddenly dipped into water bath and cooled to 25 °C. Calculate the time required for the plate to reach the temperature of 50 °C. The heat transfer coefficient on the surface of the plate is  $28 \text{ W/m}^2\cdot\text{K}$ . The length and width of the plates are 40 cm and 30 cm respectively. The properties of copper are as follows: specific heat  $=380.9 \text{ J/Kg}\cdot\text{K}$ , density  $8800 \text{ kg/m}^3$  and thermal conductivity  $385 \text{ W/m}\cdot\text{K}$ .

5. Define effectiveness and efficiency of a fin.
6. A 0.5 cm thick and 4 cm long fin has its base on a plane plate which is maintained at 110°C. The ambient air temperature is 20 °C. The conductivity of the fin material is 60 W/m-K and the heat transfer coefficient  $h = 150 \text{ W/m}^2 \text{ } ^\circ\text{C}$ . Assume that the tip of the fin is insulated. Determine:
  - a. Temperature at the end of the fin
  - b. Temperature at the middle of the fin
  - c. Total heat dissipated by the fin.

### **Unit-III**

1. Show by dimensional analysis that data for forced convection may be correlated by an equation of the form  $Nu = f(Re, Pr)$ .
2. Write a short note about the Buckingham Pi theorem.
3. What is meant by a hydrodynamic boundary layer? Explain the formation of hydrodynamic boundary layer over a flat plate.

### **Unit-IV**

1. Air at 15 °C and at a pressure of 1 atm is flowing along a flat plate at a velocity of 4.75 km/sec. If the plate is one meter wide and at 70 °C, find the quantities given below at  $x = 1\text{m}$ .
  - a. Hydrodynamic Boundary layer thickness.
  - b. Local friction factor
  - c. Average friction
  - d. Local heat transfer co-efficient
  - e. Rate of heat transfer
2. A flat plate having dimensions 50 cm X 20 cm and at a uniform temperature of 100 °C is kept in air stream at temperature 20 °C. The velocity of air is 3 m/sec. Find out the rate of heat loss from the plate when the flow is (i) parallel to 50 cm (ii) parallel to 20 cm side. The Nusselt number for laminar and turbulent flows are given as  $Nu = 0.664 Pr^{1/3} Re^{1/2}$  and  $Nu = 0.037 Re^{0.8} Pr^{1/3}$ .
3. Oil at 25 °C is heated in a horizontal tube 15 m long having a surface temperature of 50 °C. The pipe has an inner diameter of 0.05 m. The oil flow rate is 1 kg/s at inlet temperature. What will be the oil temperature as it leaves the tubes? What is the average heat transfer coefficient? The flow rate is in the laminar region. The properties of the oil are: Specific gravity 0.8; Thermal conductivity 0.125 W/m.K; Specific heat 3.14 kJ/kg.K. Viscosity at 50 °C is 0.025 kg/m-s; Viscosity at 25 °C is 0.015 kg/m-s.
4. For heating water from 20 °C to 60 °C an electrically heated tube resulting in a constant heat flux of 10 k/W/m<sup>2</sup> is proposed. The mass flow rate is to be such that  $Re_D = 2000$ , and

consequently the flow must remain laminar. The tube inside diameter is 25 mm. The flow is fully developed (velocity profile). Determine the length of tube required.

5. What is the criterion for transition from laminar to turbulent boundary layer in free convection on a vertical flat plate? Explain.

### Unit-V

1. In an industry 0.6 kg/Sec of oil ( $C_p=2.5$  kJ/kg-K) is to be cooled in a counter flow heat exchanger from 110 °C to 35 °C by the use of water entering at 20 °C. The overall heat transfer coefficient is 1500 W/m<sup>2</sup>-K. Presuming the exit water temperature should not exceeds 80 °C, using NTU method, Calculate:
  - i. Water flow rate
  - ii. surface area required
  - iii. The effectiveness of heat exchanger.
2. The outer surface of a vertical tube of 1.5 m length and outer diameter of 10 cm is exposed to saturated steam at atmospheric Pressure and is maintained at 50 °C by the flow of cool water through the tube. Calculate the rate of heat transfer to the coolant and the rate of condensation of steam. The properties of saturated vapour at atmospheric pressure are as follow. Density = 0.596 Kg/m<sup>3</sup>, latent heat of condensation is 2257 KJ/Kg. The properties of water are  $\rho=975$  Kg/m<sup>3</sup>,  $\mu = 375 \times 10^{-6}$  W.Sec/m<sup>2</sup>,  $K=0.668$  W/m-K.
3. Derive an expression for effectiveness of a counter flow heat exchanger using NTU method.
4. Explain about the boiling curve in detail.
5. A liquid chemical flows through a thin walled copper tube of 12 mm diameter at the rate of 0.5 kg/sec water flows in opposite direction at the rate 0.37 kg/sec through the annular space formed by this tube and a tube diameter of 20 mm. The liquid chemical enters and leaves at 100 °C and 60 °C, while water enters at 10 °C. Find the length of tube required. Also find the length of tube required if the water flows in the same direction as liquid chemical. The properties of water and liquid chemical are:

| Properties                     | Liquid Chemical At 80 °c |       | Water At 27 °c       |
|--------------------------------|--------------------------|-------|----------------------|
| $\rho$ , Kg/m <sup>3</sup>     | 1078                     | 995   |                      |
| $\mu$ .Kg/m - Sec <sup>2</sup> | $3200 \times 10^{-6}$    |       | $853 \times 10^{-6}$ |
| $C_p$ , J/Kg-K                 | 2050                     | 4180  |                      |
| $K$ , W/mK                     | 0.261                    | 0.614 |                      |

# ADITYA COLLEGE OF ENGINEERING & TECHNOLOGY

ADB ROAD, ADITYA NAGAR, SURAMPALEM – 533437

## DEPARTMENT OF MECHANICAL ENGINEERING



### HOME ASSIGNMENT -I

| Q No | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Marks | CO | BT |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----|----|
| 1    | Derive a three-dimensional generalized heat conduction equation in cylindrical co-ordinates.                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 10    | 1  | 2  |
| 2    | A long steel cylinder 12 cm in diameter and initially at 20 °C is placed into a furnace at 820 °C where the heat transfer coefficient, $h=140 \text{ W/m}^2\text{K}$ . Calculate the time required for the axis temperature to reach 800 °C. Calculate also,<br>a. The corresponding temperature at a radius of 4.8 cm at that time.<br>b. The heat energy absorbed by the cylinder during this period, given that the thermal diffusivity, $\alpha = 6.11 \times 10^{-6} \text{ m}^2/\text{s}$ and the thermal conductivity, $k=21 \text{ W/m.K}$ . | 10    | 2  | 3  |
| 3    | Show by dimensional analysis that data for forced convection may be correlated by an equation of the form $Nu=f(Re, Pr)$ .                                                                                                                                                                                                                                                                                                                                                                                                                           | 10    | 3  | 2  |

# ADITYA COLLEGE OF ENGINEERING & TECHNOLOGY

ADB ROAD, ADITYA NAGAR, SURAMPALEM – 533437

## DEPARTMENT OF MECHANICAL ENGINEERING



### HOME ASSIGNMENT -II

| Q No | Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Marks | CO | BT |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----|----|
| 1    | For heating water from 20 °C to 60 °C an electrically heated tube resulting in a constant heat flux of 10 kW/m <sup>2</sup> is proposed. The mass flow rate is to be such that Re <sub>D</sub> =2000, and consequently the flow must remain laminar. The tube inside diameter is 25 mm. The flow is fully developed (velocity profile). Determine the length of tube required                                                                                                                                                                                                                  | 10    | 4  | 5  |
| 2    | The outer surface of a vertical tube of 1.5 m length and outer diameter of 10 cm is exposed to saturated steam at atmospheric Pressure and is maintained at 50 °C by the flow of cool water through the tube. Calculate the rate of heat transfer to the coolant and the rate of condensation of steam. The properties of saturated vapour at atmospheric pressure are as follow. Density = 0.596 Kg/m <sup>3</sup> , latent heat of condensation is 2257 KJ/Kg. The properties of water are $\rho=975$ Kg/m <sup>3</sup> , $\mu = 375 \times 10^{-6}$ W.Sec/m <sup>2</sup> , $K=0.668$ W/m-K. | 10    | 5  | 4  |
| 3    | Explain about the boiling curve in detail.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 10    | 5  | 2  |

## Quiz Questions and answers

### Unit-1

1. Unit of thermal Conductivity in M.K.S. units is

- A)  $\text{kCal/kg m}^2 \text{ }^\circ\text{C}$
- B)  $\text{kCal-m/hr m}^2 \text{ }^\circ\text{C}$
- C)  $\text{kCal/hr m}^2 \text{ }^\circ\text{C}$
- D)  $\text{kCal-m/hr }^\circ\text{C}$
- E)  $\text{kCal-m/m}^2 \text{ }^\circ\text{C}$ .

ANSWER: B

2. Unit of thermal Conductivity in S.I. units is

- A)  $\text{J/m}^2 \text{ s}^\circ\text{C}$
- B)  $\text{J/m }^\circ\text{K s}^\circ\text{C}$
- C)  $\text{W/m }^\circ\text{K}$
- D) A) And C) Above
- E) B) And C) Above.

ANSWER: E

3. thermal Conductivity of solid metals with rise in temperature normally

- A) increases
- B) decreases
- C) remains constant
- D) may increase or decrease depending on temperature
- E) unpredictable.

ANSWER: B

4. Thermal conductivity of non-metallic Amorphous solids with decrease in temperature

- A) increases
- B) decreases
- C) remains constant
- D) may increase or decrease depending on temperature
- E) unpredictable.

ANSWER: B

5. Heat transfer takes place As per

- A) zeroth law of thermodynamics
- B) first law of thermodynamic
- C) second law of the thermodynamics
- D) kirchhoff law E) stefan's law.

ANSWER: C

### Unit-2

6. A steel rod ( $k = 30 \text{ W/m degree}$ ) 1 cm in diameter and 5 cm long protrudes from a wall which is maintained at 10 degree Celsius. The rod is insulated at its tip and is exposed to an environment with  $h = 50 \text{ W/m}^2 \text{ degree}$  and  $t_a = 30 \text{ degree Celsius}$ . Calculate the fin efficiency

- A) 56.57%

- B) 66.57%
- C) 76.57%
- D) 86.57%

ANSWER: B

7. If the fin is sufficiently thin, so heat flows pertain to

- A) One dimensional heat conduction
- B) Two dimensional heat conduction
- C) Three dimensional heat conduction
- D) No heat flow is there

ANSWER: A

8. If heat dissipation for one fin is given by 377.45 k J/hour, then what is the heat dissipation for 12 fins?

- A) 7529.4 k J/hour
- B) 6529.4 k J/hour
- C) 5529.4 k J/hour
- D) 4529.4 k J/hour

ANSWER: D

9. In order to achieve maximum heat dissipation, the fin should be designed in such a way that has a

- A) Maximum lateral surface towards the tip side of fin
- B) Minimum lateral surface near the center line
- C) Maximum lateral surface at the root side of fin
- D) Maximum lateral surface near the center of fin

ANSWER: C

10. A steel rod ( $k = 30 \text{ W/m degree}$ ) 1 cm in diameter and 5 cm long protrudes from a wall which is maintained at 10 degree Celsius. The rod is insulated at its tip and is exposed to an environment with  $h = 50 \text{ W/m}^2 \text{ degree}$  and  $t_a = 30 \text{ degree Celsius}$ . Calculate the rate of heat dissipation

- A) 2.658 W
- B) 3.658 W
- C) 4.658 W
- D) 5.658 W

ANSWER: B

11. On a heat transfer surface, fins are provided to

- A) Increase turbulence in flow for enhancing heat transfer
- B) Increase temperature gradient so as to enhance heat transfer
- C) Pressure drop of the fluid should be minimized
- D) Surface area is maximum to promote the rate of heat transfer

ANSWER: D

12. The value of Biot number and Fourier number, as used in the Heisler charts, are evaluated on the basis of a characteristic parameter  $s$  which is the thickness in case of plates and the surface radius in case of cylinders and spheres.

- A) True
- B) False

ANSWER: A

#### Unit-3

13. Bulk of the convective heat transfer resistance from a hot tube surface to the fluid flowing in it, is

- A) in the central core of the fluid.
- B) uniformly distributed throughout the fluid.
- C) mainly confined to a thin film of fluid near the surface.
- D) none of these.

Answer: C

14. The thermal diffusivities for solids are generally

- A) less than those for gases
- B) less than those for liquids
- C) more than those for liquids and gases
- D) more or less same as for liquids and gases

Answer: c

15. thermal diffusivity of a substance is

- A) directly proportional to thermal conductivity
- B) inversely proportional to density of substance
- C) inversely proportional to specific heat
- D) all of the above
- E) none of the above.

Answer: d

16. in free convection heat transfer, nusselt number is function of

- A) GRASHOFF NO. AND REYNOLD NO.
- B) GRASHOFF NO. AND PRANDTL NO.
- C) PRANDTL NO. AND REYNOLD NO.
- D) GRASHOFF NO., PRANDTL NO. AND REYNOLD NO.
- E) none of the above.

Answer: b

17. which of the following property of air does not increase with rise in temperature

- A) thermal conductivity
- B) thermal diffusivity
- C) density
- D) dynamic viscosity
- E) kinematic viscosity.

Answer: c

#### Unit-4

18. The reciprocal of heat transfer co-efficient is \_\_\_\_\_

- A) Conductance
- B) Resistance
- C) Density
- D) Temperature difference

ANSWER: B

19. A cylindrical resistor element on a circuit board dissipates 0.6 W of power. The resistor is 1.5 cm long, and has a diameter of 0.4 cm. Assuming heat to be transferred uniformly from all surfaces, determine (A) the amount of heat this resistor dissipates during a 24-hour period, (B) the heat flux

- A) 21.84 kJ, 0.4809 W/cm<sup>2</sup>
- B) 51.84 kJ, 0.4809 W/cm<sup>2</sup>
- C) 51.84 kJ, 0.2809 W/cm<sup>2</sup>
- D) 21.84 kJ, 0.2809 W/cm<sup>2</sup>

ANSWER: C

20. An aluminum pan whose thermal conductivity is 237 W/m · °C has a flat bottom with diameter 20 cm and thickness 0.4 cm. Heat is transferred steadily to boiling water in the pan through its bottom at a rate of 800 W. If the inner surface of the bottom of the pan is at 105°C, determine the temperature of the outer surface of the bottom of the pan.

- A) 100.43 °C
- B) 103.43 °C
- C) 101.43 °C
- D) 105.43 °C

ANSWER: D

21. A 50-cm-long, 800-W electric resistance heating element with diameter 0.5 cm and surface temperature 120°C is immersed in 60 kg of water initially at 20°C. Determine how long it will take for this heater to raise the water temperature to 80°C. Also, determine the convection heat transfer coefficients at the beginning and at the end of the heating process.

- A) 1.225 h, 2020 W/m · °C, 3550 W/m · °C
- B) 5.225 h, 1020 W/m · °C, 2550 W/m · °C
- C) 7.225 h, 2020 W/m · °C, 4550 W/m · °C
- D) 4.225 h, 2020 W/m · °C, 2550 W/m · °C

ANSWER: B

22. Heat transfer and temperature are

- A) both scalars
- B) both vectors
- C) scalar and vector respectively
- D) vector and scalar respectively

ANSWER: D

23. In a solar pond, the absorption of solar energy can be modeled as heat generation and can be approximated by  $q \cdot \exp(-bx)$  i.e. "q multiplied by exponent of  $(-bx)$ ", where q is the rate of heat absorption at the top surface per unit volume, b is a constant and x is thickness or depth. Obtain a relation for the total rate of heat generation in a water layer of surface area A and thickness L at the top of the pond.

- A)  $2 \times A \times q \times [1 + \exp(-bL)]/b$
- B)  $A \times q \times [1 + \exp(-bL)]/b$
- C)  $A \times q \times [1 - \exp(-bL)]/b$
- D)  $1.2 \times A \times q \times [1 - \exp(-bL)]/b$

ANSWER: C

24. Consider a large 3-cm-thick stainless steel plate in which heat is generated uniformly at a rate of  $5 \times 10^6 \text{ W/m}^3$ . Assuming the plate is losing heat from both sides, determine the heat flux on the surface of the plate during steady operation.

- A)  $75000 \text{ W/m}^2$
- B)  $150000 \text{ W/m}^2$
- C)  $300000 \text{ W/m}^2$
- D)  $37500 \text{ W/m}^2$

ANSWER: A

25. which of the following has least value of conductivity

- a) glass
- b) water
- c) plastic
- d) rubber
- e) air.

ANSWER: E

#### Unit-5

26. Air is best heated with steam in a heat exchanger of

- A) plate type.
- B) double pipe type with fin on steam side.
- C) double pipe type with fin on air side.
- D) shell and tube type.

ANSWER: C

27. Which of the following is generally considered as opaque surface towards radiations?

- A) Gases
- B) Solids
- C) Liquids
- D) Both (b) and (c)

ANSWER: D

28. Black liquor generated during paper manufacture is concentrated in a

- A) single effect evaporator.

- B) single effect evaporator followed by a crystalliser.
- C) multiple effect evaporator.
- D) multiple effect evaporators followed by a crystalliser.

ANSWER: C

29. When vaporisation takes place directly at the heating surface, it is called

- A) film boiling
- B) nucleate boiling
- C) vapour binding
- D) none of these

ANSWER: B

30. Steam consumption in kg/hr in case of an evaporator is given by (where, C & E are capacity the economy of the evaporator respectively)

- A)  $C/E$
- B)  $E/C$
- C)  $CE$
- D)  $1/CE$

ANSWER: A

31. With increase in temperature, the thermal conductivity of non-metallic amorphous solids

- A) decreases
- B) increases
- C) remains constant
- D) first decreases upto certain temperature and then increases

ANSWER: B

32. Fourier's law applies to the heat transfer by

- A) convection
- B) radiation
- C) conduction
- D) all (a), (b) & (c)

ANSWER: C

33. Shell side pressure drop in a shell and tube heat exchanger does not depend upon the

- A) baffle spacing & shell diameter.
- B) tube diameter & pitch.
- C) viscosity, density & mass velocity of shell side fluid
- D) none of these.

ANSWER: D

34. According of kirchhoff law,

- A) radiant heat is proportional to fourth power of absolute temperature
- B) emissive power depends on temperature
- C) emissive power and absorptivity are constant for all bodies
- D) ratio of emissive power to absorptive power is maximum for perfectly black body
- E) ratio of emissive power to absorptive power for all bodies is same and is equal to the emissive power of a perfectly black body.

Answer: e

35. all radiations in a black body are

- A) reflected
- B) refracted
- C) transwermitted
- D) absorbed
- E) partly reflected and partly absorbed.

Answer: d

36. according to kirchhoff's law, the ratio of emissive power to absorptivity for all bodies is equal to the emissive power of a

- A) grey body
- B) brilliant white polished body
- C) red hot body
- D) black body
- E) none of the above.

Answer: d

37. the concept of overall coefficient of heat transwerfer is used in case of heat transwerfer by

- A) conduction
- B) convection
- C) radiation
- D) conduction and convection
- E) convection and radiation.

Answer: d

38. the unit of overall coefficient of heat transwerfer is

- A) kcal/m<sup>2</sup>
- B) kcal/hr °c
- C) kcal/m<sup>2</sup> hr °c
- D) kacl/m hr °c
- E) kcal/m<sup>3</sup> hr °c.

Answer: c

39. joule sec is the unit of

- A) universal gas constant
- B) kinematic viscosity

- C) thermal conductivity
- D) planck's constant
- E) none of the above.

Answer: d

40. the value of portland number for air is about

- A) 0.1
- B) 0.3
- C) 0.7
- D) 1.7
- E) 10.5.

Answer: c

41. the value of the wavelength for maximum emissive power is given by

- A) wien's law
- B) planck's law
- C) stefan's law
- D) fourier's law
- E) kirchhoff's law.

Answer: a



# ADITYA COLLEGE OF ENGINEERING & TECHNOLOGY

ADB ROAD, ADITYA NAGARA, SURAMPALEM-533437

Academic Year – 2020-21

## Department of Mechanical Engineering

III B.TECH - II SEMESTER (2020-21), I MID EXAMINATION

Subject Name: HEAT TRANSFER

Time: 01:30 Hrs.

Date: 05.08.2021

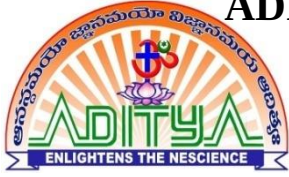
Max. Marks: 45

All Questions Compulsory; All Questions carry Equal Marks

| Q.No | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Marks | CO No. | Knowledge Level |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------|-----------------|
| 1    | a) A furnace wall is made of 25 cm fire brick, 20 cm common brick, 6 cm of magnesia and 4mm of steel plate on the outside. The inside and the outside surface temperatures are 1200 °C and 100 °C respectively. Calculate the temperature between layers and rate of heat transfer. Assume the thermal conductivities of fire brick, common brick, Magnesia and steel are 1.2 W/m-K, 0.75 W/m-K, 0.07 W/m-K and 71 W/m-K respectively.                                                                                      | 12    | 1      | 3               |
|      | b) Write a short note on modes of heat transfer                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3     | 1      | 2               |
| 2    | a) In quenching process, a copper plate of 3 mm thickness is heated up to 350 °C and is suddenly dipped into water bath and cooled to 25 °C. Calculate the time required for the plate to reach the temperature of 50 °C. The heat transfer coefficient on the surface of the plate is 28 W/m <sup>2</sup> -K. The length and width of the plates are 40 cm and 30 cm respectively. The properties of copper are as follows: specific heat=380.9 J/Kg-K, density 8800 kg/m <sup>3</sup> and thermal conductivity 385 W/m-K. | 10    | 2      | 3               |
|      | b) Define effectiveness and efficiency of a fin                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 5     | 2      | 2               |
| 3    | Show by dimensional analysis that data for forced convection may be correlated by an equation of the form $Nu=f(Re, Pr)$ .                                                                                                                                                                                                                                                                                                                                                                                                  | 15    | 3      | 5               |

Scheme of valuation:  
Mid Examination – 1

| Q No | Sub Question | Marks Division                                                                                                                                                                                                                                                     | Total Marks |
|------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 1    | a)           | Given Data : 1M<br>Diagram : 2M<br>Thermal resistance calculation :3M<br>Overall heat transfer coefficient: 1M<br>Heat transfer rate: 1M<br>Equalizing heat transfer rates :2M<br>Solving equations for Temperatures : 2M                                          | 12          |
|      | b)           | Modes of heat transfer<br>Conduction : 1M<br>Convection : 1M<br>Radiation : 1M                                                                                                                                                                                     | 3           |
| 2    | a)           | Given data : 2M<br>Biot number : 2M<br>Lumped system analysis: 3M<br>Calculation of time : 3M                                                                                                                                                                      | 10          |
|      | b)           | Definition of effectiveness and formula : 2.5M<br>Definition of efficiency and formula : 2.5M                                                                                                                                                                      | 5           |
| 3    |              | Introduction to dimensional analysis : 2M<br>Parameters involved in forced convection: 3M<br>Deriving Nusselt relation: 3M<br>Deriving Reynolds number relation : 3M<br>Deriving Prandtl number relation : 3M<br>Relating Nusselt, Reynolds and Prandtl number: 1M | 15          |



# ADITYA COLLEGE OF ENGINEERING & TECHNOLOGY

ADB ROAD, ADITYA NAGARA, SURAMPALEM-533437

Academic Year – 2020-21

## Department of Mechanical Engineering

III B.TECH - II SEMESTER (2020-21), II MID EXAMINATION

Subject Name: HEAT TRANSFER

Time: 01:30 Hrs.

Date: 05.08.2021

Max. Marks: 45

**All Questions Compulsory; All Questions carry Equal Marks**

| Q.No | Question                                                                                                                                                                                                                                                                                                                                                                                                          | Marks | CO No. | Knowledge Level |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------|-----------------|
| 1    | A flat plate having dimensions 50 cm X 20 cm and at a uniform temperature of 100 °C is kept in air stream at temperature 20 °C. The velocity of air is 3 m/sec. Find out the rate of heat loss from the plate when the flow is (i) parallel to 50 cm (ii) parallel to 20 cm side. The Nusselt number for laminar and turbulent flows are given as $Nu=0.664 Pr^{1/3} Re^{1/2}$ and $Nu=0.037 Re^{0.8} Pr^{1/3}$ . | 15    | 4      | 3               |
| 2    | For heating water from 20 °C to 60 °C an electrically heated tube resulting in a constant heat flux of 10 k/W/m <sup>2</sup> is proposed. The mass flow rate is to be such that $Re_D=2000$ , and consequently the flow must remain laminar. The tube inside diameter is 25 mm. The flow is fully developed (velocity profile). Determine the length of tube required.                                            | 15    | 4      | 2               |
| 3    | a) Derive an expression for effectiveness of a counter flow heat exchanger using NTU method.                                                                                                                                                                                                                                                                                                                      | 8     | 5      | 3               |
|      | b) Explain about the boiling curve in detail                                                                                                                                                                                                                                                                                                                                                                      | 7     | 5      | 3               |

Scheme of valuation:  
Mid Examination – 2

| Q No | Sub Question | Marks Division                                                                                                                                                                                                                                                                                     | Total Marks |
|------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 1    |              | Given data : 2M<br>i. Diagram : 1M<br>Properties of air from data book: 2M<br>Calculating h from Nusselt number: 2M<br>Calculating heat transfer rate : 2M<br>ii. Diagram : 1M<br>Reynolds number calculation : 1M<br>Calculating h from Nusselt number: 2M<br>Calculating heat transfer rate : 2M | 15          |
| 2    |              | Given data : 2M<br>Diagram : 1M<br>Calculation of temperature for properties: 2M<br>Properties from data book : 3M<br>Reynolds number calculation : 2M<br>Calculating h from Nusselt number: 3M<br>Calculating length of the tube : 2M                                                             | 15          |
| 3    | a)           | Diagram for counter flow : 2M<br>Introduction to effectiveness : 3M<br>Derivation using NTU : 3M                                                                                                                                                                                                   | 8           |
|      | b)           | Boiling curve diagram : 5M<br>Explanation of the curve : 2M                                                                                                                                                                                                                                        | 7           |



# Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

## Weak Students as per Mid-I Examinations

Year: III

Semester: II

Academic Year: 2020-21

| Sl.No | Roll.No    | Mid-1<br>30 |
|-------|------------|-------------|
| 1     | 19P35A0320 | 5           |
| 2     | 19P35A0312 | 11          |
| 3     | 19P35A0321 | 12          |
| 4     | 19P35A0322 | 12          |
| 5     | 19P35A0325 | 12          |
| 6     | 19P35A0326 | 12          |
| 7     | 18P31A0323 | 13          |
| 8     | 19P35A0314 | 13          |
| 9     | 19P35A0315 | 13          |
| 10    | 19P35A0324 | 13          |
| 11    | 19P35A0327 | 13          |
| 12    | 19P35A0328 | 13          |
| 13    | 19P35A0330 | 13          |
| 14    | 19P35A0331 | 13          |
| 15    | 19P35A0333 | 13          |
| 16    | 19P35A0335 | 13          |
| 17    | 19P35A0316 | 14          |
| 18    | 19P35A0313 | 14          |
| 19    | 19P35A0319 | 14          |
| 20    | 19P35A0332 | 14          |
| 21    | 18P31A0316 | 15          |
| 22    | 18P31A0317 | 15          |
| 23    | 19P35A0336 | 15          |
| 24    | 19P35A0342 | 15          |

Faculty

Head-ME



# Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

## Remedial class schedule for weak learners:

| Sl. No. | Roll Number | 25.05.21                            | 27.05.21                              | 01.06.21                           | 03.06.21                  | 08.06.21                          | 10.06.21               | 15.06.21                    | 17.06.21               |
|---------|-------------|-------------------------------------|---------------------------------------|------------------------------------|---------------------------|-----------------------------------|------------------------|-----------------------------|------------------------|
| 1       | 19P35A0320  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 2       | 19P35A0312  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 3       | 19P35A0321  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 4       | 19P35A0322  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 5       | 19P35A0325  | P                                   | P                                     | P                                  | P                         | P                                 | A                      | P                           | P                      |
| 6       | 19P35A0326  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 7       | 18P31A0323  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 8       | 19P35A0314  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 9       | 19P35A0315  | P                                   | P                                     | A                                  | P                         | P                                 | P                      | A                           | P                      |
| 10      | 19P35A0324  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 11      | 19P35A0327  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 12      | 19P35A0328  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 13      | 19P35A0330  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 14      | 19P35A0331  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 15      | 19P35A0333  | P                                   | P                                     | P                                  | P                         | A                                 | P                      | P                           | P                      |
| 16      | 19P35A0335  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 17      | 19P35A0316  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 18      | 19P35A0313  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 19      | 19P35A0319  | P                                   | P                                     | P                                  | A                         | P                                 | P                      | P                           | P                      |
| 20      | 19P35A0332  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 21      | 18P31A0316  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 22      | 18P31A0317  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 23      | 19P35A0336  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
| 24      | 19P35A0342  | P                                   | P                                     | P                                  | P                         | P                                 | P                      | P                           | P                      |
|         | Topic       | Conduction In cartesian coordinates | Conduction in cylindrical coordinates | Conduction in spherical coordinate | Extended surfaces problem | Short fin with insulation problem | Lumped system analysis | Semi-infinite solid problem | Infinite solid problem |
|         | Signature   |                                     |                                       |                                    |                           |                                   |                        |                             |                        |

Head-ME



# Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

## Department of Mechanical Engineering

|               |                          |                        |    |    |          |            |               |        |          |                        |    |    |                   |                  |               |        |               |             |                         |  |
|---------------|--------------------------|------------------------|----|----|----------|------------|---------------|--------|----------|------------------------|----|----|-------------------|------------------|---------------|--------|---------------|-------------|-------------------------|--|
|               | <b>Course Assessment</b> |                        |    |    |          |            |               |        |          |                        |    |    |                   |                  |               |        |               |             |                         |  |
| Course Name:  |                          | HEAT TRANSFER          |    |    |          |            |               |        |          |                        |    |    |                   | Academic Year:   |               |        | 2020 – 21     |             |                         |  |
| Faculty Name: |                          | K VIJAY                |    |    |          |            |               |        |          |                        |    |    |                   | Year & Semester: |               |        | III YR II SEM |             |                         |  |
| Course Code:  |                          | R163 2034              |    |    |          |            |               |        |          |                        |    |    | Branch & section: |                  |               | ME-A   |               |             |                         |  |
|               |                          | Internal Examination-1 |    |    |          |            |               |        |          | Internal Examination-2 |    |    |                   |                  |               |        |               |             |                         |  |
| S . No        | ROL NO                   | 1                      | 2  | 3  | T o t al | Av er ag e | Assi gn me nt | Q u iz | T o t al | 1                      | 2  | 3  | T o t al          | Av er ag e       | Assi gn me nt | Q u iz | T o t al      | In ter na l | En d Se me ste r gra de |  |
| Maximum Marks |                          | 15                     | 15 | 15 | 45       | 15         | 5             | 10     | 30       | 15                     | 15 | 15 | 45                | 15               | 5             | 10     | 30            | 30          |                         |  |
| 1             | 17A81A0334               | 15                     | 12 |    | 27       | 9          | 5             | 6      | 20       | 15                     | 14 | 3  | 32                | 11               | 5             | 6      | 22            | 22          | C                       |  |
| 2             | 18P31A0301               | 13                     | 12 | 3  | 27.5     | 10         | 5             | 5      | 20       | 13.5                   | 14 | 4  | 32                | 11               | 5             | 5      | 21            | 21          | B                       |  |
| 3             | 18P31A0302               | 15                     | 13 | 6  | 34       | 12         | 5             | 5      | 22       | 15                     | 10 | 3  | 28                | 10               | 5             | 5      | 20            | 21          | B                       |  |
| 4             | 18P31A0303               | 15                     | 7  |    | 22       | 8          | 5             | 9      | 22       | 14                     | 9  | 3  | 26                | 9                | 5             | 9      | 23            | 23          | C                       |  |
| 5             | 18P31A0304               | 14.5                   | 12 | 2  | 28.5     | 10         | 5             | 9      | 24       | 14                     | 9  | 4  | 27                | 9                | 5             | 9      | 23            | 24          | B                       |  |
| 6             | 18P31A0305               | 8                      |    | 4  | 12       | 4          | 5             | 9      | 18       | 14                     | 10 | 3  | 27                | 9                | 5             | 9      | 23            | 22          | F                       |  |
| 7             | 18P31A0306               | 15                     | 13 | 7  | 35       | 12         | 5             | 9      | 26       | 15                     | 10 | 2  | 27                | 9                | 5             | 9      | 23            | 25          | F                       |  |
| 8             | 18P31A0307               | 10                     |    |    | 10       | 4          | 5             | 9      | 18       | 11                     | 9  | 1  | 21                | 7                | 5             | 9      | 21            | 20          | F                       |  |
| 9             | 18P31A0308               | 13                     | 9  | 3  | 25       | 9          | 5             | 9      | 23       | 12                     | 10 |    | 22                | 8                | 5             | 9      | 22            | 23          | F                       |  |
| 10            | 18P31A0309               | 14                     | 5  |    | 19       | 7          | 5             | 9      | 21       | 13                     | 10 | 3  | 26                | 9                | 5             | 9      | 23            | 23          | F                       |  |

|        |                    |          |             |        |              |    |   |   |        |                  |        |        |        |    |   |   |        |    |   |  |
|--------|--------------------|----------|-------------|--------|--------------|----|---|---|--------|------------------|--------|--------|--------|----|---|---|--------|----|---|--|
| 1<br>1 | 18P31<br>A031<br>0 | 15       | 9           |        | 2<br>4       | 8  | 5 | 9 | 2<br>2 | 1<br>3           | 1<br>0 | 3      | 2<br>6 | 9  | 5 | 9 | 2<br>3 | 22 | F |  |
| 1<br>2 | 18P31<br>A031<br>1 | 15       | 1<br>5      | 1<br>4 | 4<br>3.<br>5 | 15 | 5 | 9 | 2<br>9 | 1<br>3<br>.<br>5 | 1<br>0 | 3      | 2<br>7 | 9  | 5 | 9 | 2<br>3 | 28 | C |  |
| 1<br>3 | 18P31<br>A031<br>3 | 12       | 1<br>1      | 2      | 2<br>5       | 9  | 5 | 9 | 2<br>3 | 1<br>0           | 1<br>1 | 1      | 2<br>2 | 8  | 5 | 9 | 2<br>2 | 23 | F |  |
| 1<br>4 | 18P31<br>A031<br>4 | 15       | 9<br>.<br>5 | 2      | 2<br>6.<br>5 | 9  | 5 | 9 | 2<br>3 | 1<br>5           | 1<br>1 | 5      | 3<br>1 | 11 | 5 | 9 | 2<br>5 | 25 | F |  |
| 1<br>5 | 18P31<br>A031<br>5 | 15       | 1<br>1      | 1<br>3 | 3<br>9       | 13 | 5 | 9 | 2<br>7 | 1<br>5           | 1<br>1 | 4      | 3<br>0 | 10 | 5 | 9 | 2<br>4 | 26 | C |  |
| 1<br>6 | 18P31<br>A031<br>6 | 3        |             |        | 3            | 1  | 5 | 9 | 1<br>5 | 1<br>5           | 1<br>0 | 1      | 2<br>6 | 9  | 5 | 9 | 2<br>3 | 21 | F |  |
| 1<br>7 | 18P31<br>A031<br>7 | 1        |             |        | 1            | 1  | 5 | 9 | 1<br>5 | 1<br>0           | 9      | 1      | 2<br>0 | 7  | 5 | 9 | 2<br>1 | 20 | F |  |
| 1<br>8 | 18P31<br>A031<br>8 | 15       | 1<br>0      | 2      | 2<br>7       | 9  | 5 | 9 | 2<br>3 | 1<br>1           | 1<br>0 | 7      | 2<br>8 | 10 | 5 | 9 | 2<br>4 | 24 | B |  |
| 1<br>9 | 18P31<br>A031<br>9 | 15       | 8<br>.<br>5 |        | 2<br>3.<br>5 | 8  | 5 | 7 | 2<br>0 | 1<br>5           | 1<br>2 | 3      | 3<br>0 | 10 | 5 | 7 | 2<br>2 | 22 | C |  |
| 2<br>0 | 18P31<br>A032<br>0 | 15       | 7           |        | 2<br>2       | 8  | 5 | 9 | 2<br>2 | 1<br>3<br>.<br>5 | 1<br>0 | 6      | 3<br>0 | 10 | 5 | 9 | 2<br>4 | 24 | C |  |
| 2<br>1 | 18P31<br>A032<br>1 | 15       | 1<br>2      |        | 2<br>7       | 9  | 5 | 9 | 2<br>3 | 1<br>4           | 1<br>0 | 6      | 3<br>0 | 10 | 5 | 9 | 2<br>4 | 24 | C |  |
| 2<br>2 | 18P31<br>A032<br>2 | 8        | 4           |        | 1<br>2       | 4  | 5 | 9 | 1<br>8 | 1<br>3<br>.<br>5 | 9      | 1      | 2<br>4 | 8  | 5 | 9 | 2<br>2 | 21 | C |  |
| 2<br>3 | 18P31<br>A032<br>3 | 2        |             |        | 2            | 1  | 5 | 7 | 1<br>3 | 1<br>4           | 9      | 1      | 2<br>4 | 8  | 5 | 7 | 2<br>0 | 18 | D |  |
| 2<br>4 | 18P31<br>A032<br>4 |          | 6           |        | 6            | 2  | 5 | 9 | 1<br>6 | 1<br>5           | 1<br>0 | 8      | 3<br>3 | 11 | 5 | 9 | 2<br>5 | 23 | C |  |
| 2<br>5 | 19P35<br>A030<br>1 | 15       | 1<br>4      | 1<br>4 | 4<br>2.<br>5 | 15 | 5 | 4 | 2<br>4 | 1<br>2           | 1<br>0 | 1<br>2 | 3<br>4 | 12 | 5 | 4 | 2<br>1 | 23 | D |  |
| 2<br>6 | 19P35<br>A030<br>2 | 15       | 1<br>2      | 1<br>5 | 4<br>1.<br>5 | 14 | 5 | 9 | 2<br>8 | 1<br>5           | 1<br>0 | 8      | 3<br>3 | 11 | 5 | 9 | 2<br>5 | 27 | A |  |
| 2<br>7 | 19P35<br>A030<br>3 | 15       | 1<br>4      | 1<br>5 | 4<br>3       | 15 | 5 | 9 | 2<br>9 | 1<br>5           | 1<br>0 | 1<br>3 | 3<br>8 | 13 | 5 | 9 | 2<br>7 | 29 | C |  |
| 2<br>8 | 19P35<br>A030<br>4 | 14<br>.5 | 1<br>2      | 1<br>5 | 4<br>1.<br>5 | 14 | 5 | 9 | 2<br>8 | 1<br>3           | 1<br>0 | 1<br>5 | 3<br>8 | 13 | 5 | 9 | 2<br>7 | 28 | A |  |

|        |                    |          |        |        |          |    |   |   |        |             |        |        |        |    |   |   |        |    |    |  |
|--------|--------------------|----------|--------|--------|----------|----|---|---|--------|-------------|--------|--------|--------|----|---|---|--------|----|----|--|
| 2<br>9 | 19P35<br>A030<br>5 | 14       | 1<br>0 | 1<br>5 | 3<br>9   | 13 | 5 | 4 | 2<br>2 | 1<br>4      | 1<br>0 | 1<br>1 | 3<br>5 | 12 | 5 | 4 | 2<br>1 | 22 | C  |  |
| 3<br>0 | 19P35<br>A030<br>6 | 14       | 9<br>5 | 1<br>5 | 3<br>8   | 13 | 5 | 4 | 2<br>2 | 1<br>4      | 1<br>1 | 1<br>2 | 3<br>7 | 13 | 5 | 4 | 2<br>2 | 22 | C  |  |
| 3<br>1 | 19P35<br>A030<br>7 | 15       | 1<br>4 | 1<br>5 | 4<br>3.5 | 15 | 5 | 4 | 2<br>4 | 1<br>2<br>5 | 9      | 1<br>4 | 3<br>6 | 12 | 5 | 4 | 2<br>1 | 23 | A  |  |
| 3<br>2 | 19P35<br>A030<br>8 | 15       | 1<br>4 | 1<br>0 | 3<br>9   | 13 | 5 | 9 | 2<br>7 | 1<br>5      | 1<br>1 | 1<br>0 | 3<br>6 | 12 | 5 | 9 | 2<br>6 | 27 | C  |  |
| 3<br>3 | 19P35<br>A030<br>9 | 14<br>.5 | 1<br>4 | 1<br>2 | 4<br>0.5 | 14 | 5 | 9 | 2<br>8 | 1<br>5      | 1<br>0 | 1<br>3 | 3<br>8 | 13 | 5 | 9 | 2<br>7 | 28 | B  |  |
| 3<br>4 | 19P35<br>A031<br>1 | 15       | 1<br>3 | 1<br>0 | 3<br>8   | 13 | 5 | 9 | 2<br>7 | 1<br>5      | 1<br>0 | 1<br>4 | 3<br>9 | 13 | 5 | 9 | 2<br>7 | 27 | B  |  |
| 3<br>5 | 19P35<br>A031<br>2 | 5        | 2      |        | 7        | 3  | 5 | 3 | 1<br>1 | 1<br>2      | 9      | 2      | 2<br>3 | 8  | 5 | 3 | 1<br>6 | 15 | C  |  |
| 3<br>6 | 19P35<br>A031<br>3 | 7        | 2      | 8      | 1<br>7   | 6  | 5 | 3 | 1<br>4 | 7           | 4      | 6<br>5 | 1<br>8 | 6  | 5 | 3 | 1<br>4 | 14 | C  |  |
| 3<br>7 | 19P35<br>A031<br>4 | 6        | 4      |        | 1<br>0   | 4  | 5 | 4 | 1<br>3 | 2           | 2      | 4      | 8      | 3  | 5 | 4 | 1<br>2 | 13 | D  |  |
| 3<br>8 | 19P35<br>A031<br>5 | 8        | 4      |        | 1<br>2   | 4  | 5 | 4 | 1<br>3 | 2           | 8      |        | 1<br>0 | 4  | 5 | 4 | 1<br>3 | 13 | D  |  |
| 3<br>9 | 19P35<br>A031<br>6 | 9        | 2      |        | 1<br>1   | 4  | 5 | 5 | 1<br>4 | 6<br>5      | 8      | 1      | 1<br>6 | 6  | 5 | 5 | 1<br>6 | 15 | C  |  |
| 4<br>0 | 19P35<br>A031<br>7 | 13       | 1<br>0 | 3      | 2<br>6   | 9  | 5 | 5 | 1<br>9 | 1<br>2      | 9      |        | 2<br>1 | 7  | 5 | 5 | 1<br>7 | 18 | D  |  |
| 4<br>1 | 19P35<br>A031<br>8 | 13       | 4      | 1      | 1<br>8   | 6  | 5 | 5 | 1<br>6 | 6           | 3      |        | 9      | 3  | 5 | 5 | 1<br>3 | 15 | B  |  |
| 4<br>2 | 19P35<br>A031<br>9 | 11       | 2      | 2      | 1<br>5   | 5  | 5 | 4 | 1<br>4 |             | 3      | 5      | 8      | 3  | 5 | 4 | 1<br>2 | 14 | D  |  |
| 4<br>3 | 19P35<br>A032<br>0 |          |        |        | 0        | 0  | 5 | 0 | 5      |             |        |        | 0      | 0  | 5 | 0 | 5      | 5  | AB |  |
| 4<br>4 | 19P35<br>A032<br>1 | 11       | 7      | 2      | 2<br>0   | 7  | 5 | 5 | 1<br>7 | 2           | 7      | 3      | 1<br>2 | 4  | 5 | 5 | 1<br>4 | 16 | D  |  |
| 4<br>5 | 19P35<br>A032<br>2 | 13       | 8      |        | 2<br>1   | 7  | 5 | 4 | 1<br>6 | 1<br>0      |        |        | 1<br>0 | 4  | 5 | 4 | 1<br>3 | 15 | D  |  |
| 4<br>6 | 19P35<br>A032<br>3 | 11       | 8      | 1<br>2 | 3<br>1   | 11 | 5 | 5 | 2<br>1 | 1<br>0      | 7      |        | 1<br>7 | 6  | 5 | 5 | 1<br>6 | 20 | D  |  |
| 4<br>7 | 19P35<br>A032<br>4 | 14<br>.5 | 8      | 1      | 2<br>3.5 | 8  | 5 | 9 | 2<br>2 | 1<br>2      | 4      |        | 1<br>6 | 6  | 5 | 9 | 2<br>0 | 22 | F  |  |

|    |                    |      |     |    |      |    |   |   |    |      |    |   |    |   |   |   |    |    |   |  |
|----|--------------------|------|-----|----|------|----|---|---|----|------|----|---|----|---|---|---|----|----|---|--|
| 48 | 19P35<br>A032<br>5 | 13   | 7   |    | 20   | 7  | 5 | 3 | 15 | 4    | 3  |   | 7  | 3 | 5 | 3 | 11 | 14 | F |  |
| 49 | 19P35<br>A032<br>6 | 11   | 8   | 1  | 20   | 7  | 5 | 4 | 16 | 4    | 5  |   | 9  | 3 | 5 | 4 | 12 | 15 | D |  |
| 50 | 19P35<br>A032<br>7 | 14.5 | 8.5 |    | 23   | 8  | 5 | 5 | 18 | 10   | 10 |   | 20 | 7 | 5 | 5 | 17 | 17 | C |  |
| 51 | 19P35<br>A032<br>8 | 14   | 8   |    | 22   | 8  | 5 | 5 | 18 | 14   | 4  | 3 | 21 | 7 | 5 | 5 | 17 | 17 | D |  |
| 52 | 19P35<br>A032<br>9 | 14.5 | 11  | 14 | 38.5 | 13 | 5 | 9 | 27 | 14.5 | 9  |   | 23 | 8 | 5 | 9 | 22 | 26 | C |  |
| 53 | 19P35<br>A033<br>0 | 14   | 8.5 | 1  | 23.5 | 8  | 5 | 3 | 16 | 13.5 | 9  |   | 22 | 8 | 5 | 3 | 16 | 16 | C |  |
| 54 | 19P35<br>A033<br>1 | 14.5 | 7   |    | 21.5 | 8  | 5 | 3 | 16 | 5    | 10 | 2 | 17 | 6 | 5 | 3 | 14 | 15 | D |  |
| 55 | 19P35<br>A033<br>2 | 14   | 8.5 | 2  | 24.5 | 9  | 5 | 4 | 18 | 12   | 9  | 1 | 22 | 8 | 5 | 4 | 17 | 18 | B |  |
| 56 | 19P35<br>A033<br>3 | 14   | 9   |    | 23   | 8  | 5 | 5 | 18 | 11   | 8  |   | 19 | 7 | 5 | 5 | 17 | 17 | D |  |
| 57 | 19P35<br>A033<br>5 | 15   | 9   |    | 24   | 8  | 5 | 5 | 18 | 14   | 10 |   | 24 | 8 | 5 | 5 | 18 | 18 | C |  |
| 58 | 19P35<br>A033<br>6 | 14   | 9   | 5  | 28   | 10 | 5 | 9 | 24 | 13.5 | 10 | 1 | 25 | 9 | 5 | 9 | 23 | 24 | C |  |
| 59 | 19P35<br>A033<br>7 | 13   | 9   | 12 | 34   | 12 | 5 | 9 | 26 | 13   | 10 |   | 23 | 8 | 5 | 9 | 22 | 25 | C |  |
| 60 | 19P35<br>A033<br>8 | 12.5 | 14  | 6  | 32.5 | 11 | 5 | 9 | 25 | 13   | 9  |   | 22 | 8 | 5 | 9 | 22 | 24 | B |  |
| 61 | 19P35<br>A033<br>9 | 12   | 14  | 6  | 31.5 | 11 | 5 | 9 | 25 | 12   | 9  |   | 21 | 7 | 5 | 9 | 21 | 24 | C |  |
| 62 | 19P35<br>A034<br>0 | 15   | 13  | 13 | 40.5 | 14 | 5 | 9 | 28 | 12   | 8  |   | 20 | 7 | 5 | 9 | 21 | 27 | B |  |
| 63 | 19P35<br>A034<br>1 | 15   | 14  | 14 | 42.5 | 15 | 5 | 9 | 29 | 12   | 9  |   | 21 | 7 | 5 | 9 | 21 | 27 | C |  |
| 64 | 19P35<br>A034<br>2 | 14.5 |     | 14 | 28.5 | 10 | 5 | 9 | 24 | 11   | 9  |   | 20 | 7 | 5 | 9 | 21 | 23 | F |  |
| 65 | 19P35<br>A034<br>3 | 15   | 9   | 14 | 38   | 13 | 5 | 9 | 27 | 13   | 10 |   | 23 | 8 | 5 | 9 | 22 | 26 | C |  |



|  |                                          |                       |  |                                     |  |  |  |  |  |             |  |  |  |   |   |  |          |   |               |
|--|------------------------------------------|-----------------------|--|-------------------------------------|--|--|--|--|--|-------------|--|--|--|---|---|--|----------|---|---------------|
|  | R163<br>2034<br>.5                       |                       |  |                                     |  |  |  |  |  | 2           |  |  |  | 3 | 2 |  | 2.3<br>3 | 1 | 1.<br>86<br>7 |
|  | R163<br>2034<br>.6                       |                       |  |                                     |  |  |  |  |  | 1           |  |  |  | 3 | 2 |  | 2        | 1 | 1.<br>65      |
|  | Overall Course attainment                |                       |  |                                     |  |  |  |  |  |             |  |  |  |   |   |  |          |   | 1.<br>75<br>8 |
|  | Set target for course attainment         |                       |  |                                     |  |  |  |  |  |             |  |  |  |   |   |  |          |   | 2.<br>16      |
|  | Status of the course attainment (Yes/No) |                       |  |                                     |  |  |  |  |  |             |  |  |  |   |   |  |          |   | N<br>o        |
|  | Base<br>Target<br>taken for<br>CO:       | Class average<br>Mark |  |                                     |  |  |  |  |  |             |  |  |  |   |   |  |          |   |               |
|  | <u>Rubri<br/>cs:</u>                     |                       |  |                                     |  |  |  |  |  |             |  |  |  |   |   |  |          |   |               |
|  | >80%<br>students                         | 3                     |  |                                     |  |  |  |  |  |             |  |  |  |   |   |  |          |   |               |
|  | 55 to<br>80%<br>students                 | 2                     |  | Best performing Course<br>Outcome:  |  |  |  |  |  | C<br>O<br>5 |  |  |  |   |   |  |          |   |               |
|  | <55 %<br>students                        | 1                     |  | Least performing Course<br>Outcome: |  |  |  |  |  | C<br>O<br>6 |  |  |  |   |   |  |          |   |               |

**Faculty**

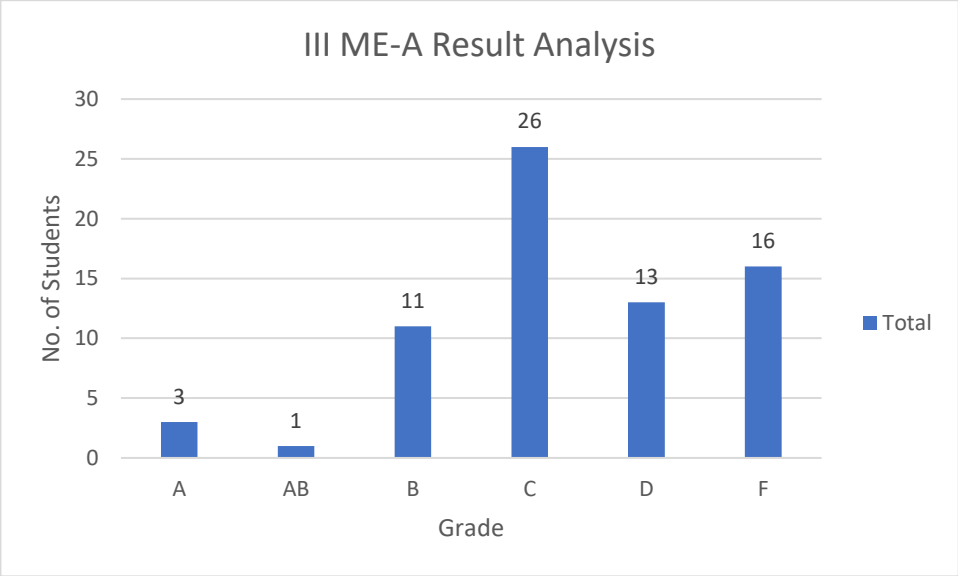
**Head-ME**



# Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

## Result Analysis:



Faculty

Head-ME



# Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

|                                      |                             |                            |           |         |
|--------------------------------------|-----------------------------|----------------------------|-----------|---------|
| <b>CLASS</b>                         | <b>III B.TECH II-SEM ME</b> |                            | <b>AY</b> | 2020-21 |
| <b>NAME OF THE COURSE &amp; CODE</b> | Heat Transfer               | <b>NAME OF THE FACULTY</b> | K Vijay   |         |

## CO-PO MAPPING:

| Course     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| <b>CO1</b> | 3   | 2   |     | 3   |     |     | 1   |     |     |      |      |      |      |      |      |
| <b>CO2</b> | 3   | 3   | 3   | 3   | 3   |     | 1   |     |     |      |      |      | 3    |      |      |
| <b>CO3</b> | 3   | 1   |     |     |     | 1   | 1   |     |     |      |      |      |      |      |      |
| <b>CO4</b> | 3   | 3   |     | 3   | 3   | 2   |     |     |     |      |      |      | 3    | 1    |      |
| <b>CO5</b> | 2   | 3   | 3   | 3   | 3   |     |     |     |     |      |      |      | 3    | 2    | 1    |
| <b>CO6</b> | 2   | 2   |     | 1   | 2   |     |     |     |     |      |      |      | 2    |      |      |

## CO ATTAINMENT

| Course Name | Attainment |
|-------------|------------|
| <b>CO1</b>  | 1.87       |
| <b>CO2</b>  | 1.65       |
| <b>CO3</b>  | 1.65       |
| <b>CO4</b>  | 1.87       |
| <b>CO5</b>  | 1.87       |
| <b>CO6</b>  | 1.65       |

## PO ATTAINMENT:

|                       | PO1  | PO2  | PO3  | PO4  | PO5  | PO6  | PO7  | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------------------|------|------|------|------|------|------|------|-----|-----|------|------|------|------|------|------|
| Overall PO Attainment | 1.76 | 1.77 | 1.76 | 1.80 | 1.77 | 1.79 | 1.72 |     |     |      |      |      | 1.77 | 1.87 | 1.87 |

Faculty Signature



# Aditya College of Engineering & Technology

Aditya Nagar, ADB Road, Surampalem - 533437

Department of Mechanical Engineering

III ME-A

| Sl.No | Roll No    | Student Name                       |
|-------|------------|------------------------------------|
| 1     | 17A81A0334 | PINDI NAGA VENKATA SURYA SAI KUMAR |
| 2     | 18P31A0301 | AALAMURI NAGA VENU SATYA BHARGAV   |
| 3     | 18P31A0302 | ABHISHEK SINHA                     |
| 4     | 18P31A0303 | BARU VENKATA SAI SATWIK            |
| 5     | 18P31A0304 | BASWA GANGA AVINASH                |
| 6     | 18P31A0305 | BATCHALA YASWANTH                  |
| 7     | 18P31A0306 | BEJAWADA CHINNA RAJA               |
| 8     | 18P31A0307 | BHOGADI SAI BHANU DEEPAK           |
| 9     | 18P31A0308 | BOBBA VINOD CHOWDARY               |
| 10    | 18P31A0309 | CHILUKURI BHARGAV SRI              |
| 11    | 18P31A0310 | DASARI SIVA DURGA VAMSI            |
| 12    | 18P31A0311 | DESINEEDI YASWANTH KUMAR           |
| 13    | 18P31A0313 | GOPISSETTI SATISH                  |
| 14    | 18P31A0314 | GUNDA SANTHOSH KUMAR               |
| 15    | 18P31A0315 | GUNDUBOGULA RAJESH                 |
| 16    | 18P31A0316 | J V V SRI DURGA MANJUNATH PITTA    |
| 17    | 18P31A0317 | JALLI STANLEY LIVINGSTONE          |
| 18    | 18P31A0318 | KOSIREDDY CHARAN                   |
| 19    | 18P31A0319 | KRITYATIRTHA PAUL                  |
| 20    | 18P31A0320 | MAJETI SAMPATHKUMAR                |
| 21    | 18P31A0321 | MATHSA DURGA PRASAD                |
| 22    | 18P31A0322 | MEKA NARENDRA                      |
| 23    | 18P31A0323 | NAGAMALLA RUDHRA VENKAT            |
| 24    | 18P31A0324 | BHANU PRAKASH NALLAMSETTI          |
| 25    | 19P35A0301 | KEYA DUTTA                         |
| 26    | 19P35A0302 | THOTA ALEKHYA                      |
| 27    | 19P35A0303 | ALLU RAJESH                        |
| 28    | 19P35A0304 | ANGARAPU BHASKAR                   |
| 29    | 19P35A0305 | ATLA SRI AKARSH PRAVEEN            |
| 30    | 19P35A0306 | BASWA RAJESH                       |
| 31    | 19P35A0307 | BHAGAVATHULA SAI UDAY KIRAN        |
| 32    | 19P35A0308 | BODAPATI DURGA PRASAD              |
| 33    | 19P35A0309 | BOMMATHULA JOHN MOSES              |
| 34    | 19P35A0311 | CHEKKA DURGAPRASAD                 |
| 35    | 19P35A0312 | CHEVALA PAL MANI RAJ               |
| 36    | 19P35A0313 | CHIMMALAPUDI SUDHEER               |
| 37    | 19P35A0314 | DEVAGALLA SAIRAM VARAPRAKASH       |
| 38    | 19P35A0315 | DUNNA SASI KISHORE VARMA           |

|    |            |                                  |
|----|------------|----------------------------------|
| 39 | 19P35A0316 | GUDIVADA HARISH                  |
| 40 | 19P35A0317 | GUGGILAPU JAYA KRISHNA           |
| 41 | 19P35A0318 | GUTHULA ARAVIND                  |
| 42 | 19P35A0319 | KALADI MOHAN SASI VARMA          |
| 43 | 19P35A0320 | KETHAVARAPU MADHU                |
| 44 | 19P35A0321 | KINGAM RAVITEJA                  |
| 45 | 19P35A0322 | MEESALA SIVA KRISHNA             |
| 46 | 19P35A0323 | KURAPATI D V V SATYA VARA PRASAD |
| 47 | 19P35A0324 | MARRI RAJ KUMAR                  |
| 48 | 19P35A0325 | NARALASETTI SURESH               |
| 49 | 19P35A0326 | NEELA RAVI TEJA                  |
| 50 | 19P35A0327 | PAMPANA GIRISH KUMAR             |
| 51 | 19P35A0328 | PASALAPUDI MAHESH                |
| 52 | 19P35A0329 | PILLI VEERABABU                  |
| 53 | 19P35A0330 | POLUPARTHI JAGAN                 |
| 54 | 19P35A0331 | PULIDINDI BHANU PRATAP           |
| 55 | 19P35A0332 | PYDIKONDALA JAYA VINAY           |
| 56 | 19P35A0333 | SATHI SAI DURGA REDDY            |
| 57 | 19P35A0335 | SETTIBATHULA PREM SANDEEP        |
| 58 | 19P35A0336 | SHAIK ABDUL KHADAR               |
| 59 | 19P35A0337 | SHAIK NOORMOHAMMAD SHAKEEL       |
| 60 | 19P35A0338 | SIDDANI SAI SANTHOSH             |
| 61 | 19P35A0339 | TAMIRI ABHIRAM                   |
| 62 | 19P35A0340 | TANGETI SRINIVAS                 |
| 63 | 19P35A0341 | THATIKAYALA APUROOP SAMUEL       |
| 64 | 19P35A0342 | TRIDA BALASAI VARAPRASAD         |
| 65 | 19P35A0343 | VALTHERU SRI VENKATA SAI RAJ     |
| 66 | 19P35A0344 | VELUGUBANTI DURGA KALYAN         |
| 67 | 19P35A0345 | VEMPADA DINESH AMBIKA PRASAD     |
| 68 | 19P35A0346 | VUSA NAGA RAMU                   |
| 69 | 19P35A0347 | YADLA PRADEEP KUMAR              |
| 70 | 19P35A0348 | YELUGUBANDI SURENDRA KUMAR       |

**Faculty**

**Head-ME**