MALLA REDDY ENGINEERING COLLEGE (AUTONOMOUS)

Course Structure for M.Tech. Thermal Engineering

MR24 Regulations - Effective from Academic Year 2024 – 25

	SEMESTER-I						
Sl. No.	**Category**	**Course Code**	**Name of the Subject**	**Contact Hours**			**Credits**
				L	**T**	**P**	
1.	PCC	D3101	Advanced Thermodynamics	3	-	-	3
2.	PCC	D3102	Advanced Heat and Mass Transfer	3	-	-	3
3.	PEC- I	D3109	Fuels & Combustion	3	-	-	3
		D3110	Electric & Hybrid Vehicles				
		D3111	Experimental Methods in Thermal Engineering				
		D3112	Thermal & Nuclear Power Plant Engineering				
		D3113	Nano Fluids				
4.	PEC- II	D3114	Advanced I.C. Engines	3	-	-	3
		D3115	Gas Turbines & Jet Propulsion				
		D3116	Fuel Cell Technology				
		D3117	PDF & Numerical Techniques				
		D3118	Computer Simulations in S.I & C.I Engines				
5.	HSMC	D0H18	Research Methodology and IPR	2	-	-	2
6.	PCC	D3103	Advanced Thermal Engineering lab	-	-	4	2
7.	PCC	D3104	Advanced Heat Transfer Lab	-	-	4	2
8.	AC		Audit Course-I	2	-	-	-
			Total	**16**	**0**	**8**	**18**

SEMESTER-II							
Sl. No	**Category**	**Course Code**	**Name of the Subject**	**Contact Hours**			**Credits**
				L	**T**	**P**	
1.	PCC	D3105	Advanced Refrigeration & Air Conditioning	3	-	-	3
2.	PCC	D3106	Finite Element Analysis	3	-	-	3
3.	PEC- III	D3119	Computational Fluid Dynamics	3	-	-	3
		D3120	Energy Conservation and Management				
		D3121	Utilization Of Solar Energy				
		D3122	Jet Propulsion & Rocket Engineering				
		D3123	Turbulence Modeling				
5.	PEC- IV	D3124	Cogeneration & Waste Heat Recovery Systems	3	-	-	3
		D3125	Renewable Energy Sources				
		D3126	Optimization Techniques & Applications				
		D3127	Exergy Analysis of Thermal Systems				
		D3128	Alternate Fuels & Pollutions				
6.	PROJ	D31P1	Mini Project With Seminar	-	-	4	2
7.	PCC	D3107	Computational Methods Lab	-	-	4	2
8.	PCC	D3108	Advanced Refrigeration & Air Conditioning Lab	-	-	4	2
9.	AC		Audit Course-II	2	-	-	-
			Total	**14**	**-**	**12**	**18**

SEMESTER-III							
Sl. No.	**Category**	**Course Code**	**Name of the Subject**	**Contact Hours**			**Credits**
				L	**T**	**P**	
1.	PEC- V	D3129	Refrigeration & HVAC	3	-	-	3
		D3130	Gas Dynamics				
		D3131	Equipment Design for Thermal Systems				
		D3132	Thermal Measurement & Process Control				
		D3133	Advanced Materials For Thermal Systems				
2.	OE-I		Open Elective	3	-	-	3
3.	PROJ	D31P2	Dissertation Work Review- I	-	-	12	6
			Total	**6**	**-**	**12**	**12**

SEMESTER-IV							
Sl. No.	**Category**	**Course Code**	**Name of the Subject**	**Contact Hours**			**Credits**
				L	**T**	**P**	
1.	PROJ	D31P3	Dissertation Work Review- II	-	-	12	16
2.	PROJ	D31P4	Dissertation Viva-Voce	-	-	28	14
			Total	**-**	**-**	**40**	**20**

AUDIT COURSES I & II		
S.No	**Course Code**	**Name Of The Subject**
1	D00A1	English For Research paper writing
2	D00A2	Disaster Management
3	D00A3	Sanskrit For Technical Knowledge
4	D00A4	Value Education
5	D00A5	Constitution Of India
6	D00A6	Pedagogy Studies
7	D00A7	Stress Management By Yoga
8	D00A8	Personality Development Through Life Enlightenment Skills

OPEN ELECTIVES		
S.No	**Course Code**	**Name Of The Subject**
1	D0134	Business Analytics
2	D0135	Waste To Energy
3	D0136	Basics Of Refrigeration Systems
4	D0137	Introduction To Thermal Systems

<table>
<tr><td rowspan="1">2024-25 Onwards (MR-24)</td><td>ALLA REDDY ENGINEERING COLLEGE (Autonomous)</td><td colspan="3">M.Tech. (Thermal Engg) I Semester</td></tr>
<tr><td>Code: D3101</td><td rowspan="2">ADVANCED THERMODYNAMICS</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credits: 3</td><td>3</td><td>-</td><td>-</td></tr>
</table>

Prerequisites: Engineering Thermodynamics

Course Objectives: The objectives of this course are to understand the advances in thermodynamics, real gases& mixtures, Combustion, statistical thermodynamics and sources of pollution.

Module I: First Law of Thermodynamics and Gas Mixtures

First law of Thermodynamics – Equations of State for Ideal and Real Gases – Mass and Mole Fractions for Gas Mixture – Properties of Gas Mixtures – Fuels and Combustion – Theoretical and Actual Combustion Processes – Enthalpy of Formation and Enthalpy of Combustion – First Law Analysis of Reacting Systems – Adiabatic Flame Temperature.

Module II: Second Law of Thermodynamics

Second Law of Thermodynamics – Entropy Change of Reacting Systems – Second Law Analysis of Reacting Systems – Criterion for Chemical Equilibrium – Equilibrium Constant for Ideal-Gas Mixtures – Chemical Equilibrium for Simultaneous Reactions – Gibbs Free Energy for Chemical Reactions

Module III: **Statistical Thermodynamics**

Part – A: Some Useful Results from Classical Thermodynamics – Energy Levels – Boltzmann Distribution Law.
Part – B: Fermi-Dirac Statistics – Bose-Einstein Statistics – Chemical Statistics

Module IV: **Fuels and Combustion**

Fuels – Classification on the basis of chemical structure and Properties – Alternative Fuels – Combustion – Determination of Flame Velocity and Length – Flammability Limits and their use – Burning of Solid Particles – Diffusion and Kinetically Controlled Combustion – Combustion in Fluidized Beds

Module V: **Pollution**

Pollutants from different Sources – Estimation of Pollutants Emissions (HC, CO and NO_x) – Emission Indices – Emission Standards – Pollution Control Measures

TEXT BOOKS

1. Brian E. Milton, **“Thermodynamics, Combustion and Engines”**, School of Mechanical and Manufacturing Engineering, University of New South Wales, 3rd Edition, 2005

2. Yunus A. Cengel & Michael A. Boles, **“Thermodynamics: An Engineering Approach”**, McGraw Hill Education, 8th Edition, 2015
3. Richard E. Sonntag, Claus B., G. J. Van Wylen, **“Fundamentals of Thermodynamics”**, John Wiley & Sons, 6th Edition, 2003

REFERENCES

1. Irvin Glassman,**"Combustion”**, 2nd Edition, Academic Press, Inc. Harcourt Brace Jovanorich Pub., Orlando, 2002
2. Norman M. Laurendeau, **“Statistical Thermodynamics – Fundamentals and Applications”**, Cambridge University Press, 1st Edition, 2015
3. S.R. de Groot, **“Non Equillibrium Thermodynamics”**, Courier corporation, 1st Edition, 2013
4. J. P. Holman, **“Thermodynamics”**, McGraw Hill, 4th Edition, 1988
5. P.L. Dhar, **“Engineering Thermodynamics”**,Elsevier**,** 2008**.**
6. Bejan, A., “**Advanced Engineering Thermodynamics”**, John Wiley and Cons, 1988

E - RESOURCES

1. http://nptel.ac.in/courses/112103016/
2. https://www.journals.elsevier.com/the-journal-of-chemical-thermodynamics
3. http://nptel.ac.in/courses/101104063/
4. http://nptel.ac.in/courses/112105123/

Course Outcomes:

At the end of the course,students should be able to:

1. Apply the fundamentals of combustion.
2. Analyse the process of combustion in the perspective of second law of thermodynamics.
3. Apply the principles of the statistical thermodynamics in research areas.
4. Examine the phenomenon of combustion of fuels
5. Evaluate the level of pollution caused from different sources

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1					
CO2	1		2		1	
CO3	1		3	1	1	2
CO4	1		2	1	1	2
CO5	1		1	1	1	3

2024-25 Onwards (MR-24)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Thermal Engg) I Semester		
Code: D3102	ADVANCED HEAT AND MASS TRANSFER	L	T	P
Credits: 3		3	-	-

Pre-requisites: Thermodynamics, Heat Transfer

Course Objectives: To develop the ability to use the heat transfer concepts for various applications, thermal analysis and sizing of heat exchangers and understanding of the concepts of phase change processes and mass transfer.

Module I Conduction and Radiation Heat Transfer

One dimensional energy equations and boundary condition - three-dimensional heat conduction equations - extended surface heat transfer - conduction with moving boundaries - radiation in gases and vapour. Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media – interaction of radiation with conduction and convection.

Module II Turbulent Convective Heat Transfer

Momentum and energy equations - turbulent boundary layer heat transfer - mixing lengthconcept - turbulence model – k Є model - analogy between heat and momentum transfer – Reynolds, Colburn, Prandtl turbulent flow in a tube - high speed flows.

Module III Phase Change Heat Transfer and Heat Exchanger

A: Phase Change Heat Transfer: Condensation with shears edge on bank of tubes - boiling – pool and flow boiling

B: Heat Exchanger: NTU – effectiveness approach – Design procedure – Compact Heat Exchangers –Compact heat exchangers – Plate Fin and Tubular Fin.

Module IV Numerical Methods in Heat Transfer

Finite difference formulation of steady and transient heat conduction problems – discretization schemes – explicit - Crank Nicolson and fully implicit schemes - control volume formulation steady one-dimensional convection and diffusion problems - calculation of the flow field –SIMPLER Algorithm

Module V Mass Transfer and Engine Heat Transfer Correlation

Mass transfer - vaporization of droplets - combined heat and mass transfers - heat transfer correlations in various applications like I.C. engines, compressors and turbines.

TEXT BOOKS

1. Incropera F.P. and DeWitt. D.P., “Fundamentals of Heat & Mass Transfer”, John Wiley & Sons, 2002.

2. Yunus A.Cengal., “Heat and Mass Transfer – A practical Approach”, 3rd edition, Tata McGraw - Hill, 2007

3. Oziski, M. N. “Heat Transfer – A Basic Approach”, McGraw Hill, N. Y., 2001

REFERENCES

1. Ghoshdastidar. P.S., Heat Transfer, Oxford University Press, 2004.
2. Holman.J.P., Heat Transfer, Tata Mc Graw Hill, 2008.
3. Nag.P.K., Heat Transfer, Tata McGraw-Hill, 2002.
4. Ozisik. M.N., Heat Transfer – A Basic Approach, McGraw-Hill Co., 1985.
5. Yadav, R., Heat and Mass Transfer, Central Publishing House, 1995.
6. Yunus A. Cengal., Heat and Mass Transfer – A practical Approach, 3rd edition, Tata McGraw - Hill, 2007.

Course Outcomes:

At the end of the course, students should be able to:

1. Analyse the systems involving combination of conduction and radiation heat transfer.
2. Apply the convective heat transfer correlations to turbulence models
3. Design heat exchangers using the NTU and Effectiveness methods.
4. Use the numerical methods in heat transfer analysis.
5. Formulate the mass transfer correlations.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1		1			1
CO2	2		3	2		1
CO3	3		3	2		1
CO4	2		1	2	1	2
CO5	1		1			1

<table>
<tr><td>2024-25 Onwards (MR-24)</td><td colspan="1">MALLA REDDY ENGINEERING COLLEGE
(Autonomous)</td><td colspan="3">M.Tech.
(Thermal Engg)
I Semester</td></tr>
<tr><td>Code: D3109</td><td rowspan="2">FUELS & COMBUSTION
[Professional Elective – I]</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credits:3</td><td>3</td><td>-</td><td>-</td></tr>
</table>

Pre-requisites: Thermodynamics, Thermal Engineering I & II

Course Objectives: The course is intended to make a post graduate student to understand

- The fundamental of combustion phenomena in general
- The different combustion process, its thermodynamics and kinetics
- The combustion mechanism in different types of combustion
- The burner design for efficient combustion
- Different combustion models
- The effect of quantity & quality of fuel and engine technology on exhaust emissions
- The concept of laminar and turbulent flame propagation
- Different methods to reduce air pollution

Module I

Fuels: Detailed classification – Conventional and Unconventional Solid, Liquid, gaseous fuels and nuclearfuels – Origin of Coal – Analysis of coal.

Coal – Carborisation, Gasification and liquification – Lignite: petroleum-based fuels – problems associated with very low calorific value gases: Coal Gas – Blast Furnace Gas Alcohols and Biogas

Module II

Principles of Combustion: Chemical composition – Flue gas analysis – dew point of products – Combustion stoichiometry.

Chemical kinetics – Rate of reaction – Reaction order – Molecularity – Zeroth, first, second and third orderreactions - complex reactions – chain reactions. Theories of reaction Kinetics – General oxidation behaviorof HC's.

Module III

Detonation and Deflagration waves of premixed gasses, Rankine Hygienist relation, Hygienist curve, laminar and turbulent flame propagation and structure**,** Burning velocity of fuels – Measurement of burningvelocity – factors affecting the burning velocity.

Module IV

Flame Stability, Combustion of fuel, Theory of diffusion flames, droplets and sprays – Combustion systems

– Pulverized fuel furnaces – fixed, Entrained and Fluidised Bed Systems.

Module V

Environmental Considerations: Air pollution – Effects on Environment, Human Health etc. Principal pollutants – Legislative Measures – Methods of Emission control.

TEXT BOOKS

1. Combustion Fundamentals by Roger A Strehlow, Mc Graw Hill
2. Fuels and combustion by Sharma and Chander Mohan, Tata Mc Graw Hill

REFERENCES

1. J Combustion Engineering and Fuel Technology by Shaha A.K., Oxford and IBH.
2. Principles of Combustion by Kanneth K. Kuo, Wiley and Sons.
3. Fuels & Combustion by Sameer Circar, Mc. Graw Hill.
4. An Introduction to Combustion by Stephen R. Turns, Mc. Graw Hill International Edition.
5. Combustion Engineering by Gary L. Berman & Kenneth W. Ragland, Mc. Graw Hill InternationalEditio

Course Outcomes:

At the end of the course, students will be able to:

1. Understand the concepts of combustion phenomena in energy conversion devices
2. Apply the knowledge of adiabatic flame temperature in the design of combustion devices
3. Identify the phenomenon of flame stabilization in laminar and turbulent flames
4. Analyze the pollution formation mechanisms in combustion of solid, liquid and gaseous fuels

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2		2	2		
CO2	1			1		1
CO3			1	2		2
CO4			1	1		2
CO5	2		2	2		2

<table>
<tr><td>2024-25 Onwards (MR-24)</td><td colspan="1">MALLA REDDY ENGINEERING COLLEGE (Autonomous)</td><td colspan="3">M.Tech. (Thermal Engg) I Semester</td></tr>
<tr><td>Code: D3110</td><td rowspan="2">ELECTRIC & HYBRID VEHICLES
[Professional Elective – I]</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credit: 3</td><td>3</td><td>-</td><td>-</td></tr>
</table>

Pre-requisites: Nil

Course Objectives:

1. Explain the history of Electric vehicles and development
2. Discuss the Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies
3. Explore to basic concept of electric traction, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives etc.
4. Analyse the Fuel Cell based energy storage and Super Capacitor based energy storage etc.
5. Explore to types of Driving Cycles, Range modelling for Battery Electric Vehicle, Hybrid (ICE & others) etc.

Module I:

Introduction To Electric Vehicle: History of Electric Vehicles, Development towards 21st Century, Types of Electric Vehicles in use today – Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Motion and Dynamic Equations of the Electric Vehicles: various forces acting on the Vehicle in static and dynamic conditions.

Module II: Induction To Hybrid Electric Vehicle: Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid Drive-train topologies, power flow control in hybrid drive-traintopologies, fuel efficiency analysis.

Module III: Electric Drive Trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive systemefficiency.

Module IV: Numerical Methods for Unstructured Grids

Types of Storage Systems: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles,Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Calculation for the rating.

Module V: Modelling Of Hybrid Electric Vehicle Range: Driving Cycles, Types of Driving Cycles, Range modelling for Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar

Powered Vehicles. Case study of 2 wheeler, 3 wheeler and 4 wheeler vehicles.

TEXT BOOKS

1. James Larminie, J. Lowry, “Electric Vehicle Technology Explaned”, John Wiley & Sons Ltd. 2003.
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel CellVehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.

REFERENCES

1. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”,Springer, 2015.
2. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.

Course Outcomes:

At the end of the course, students will be able to:

1. Choose the appropriate source of energy for the hybrid electric vehicle based on driving cycle.
2. Analyze the power and energy need of the various hybrid electric vehicle and Measure and Estimatethe energy consumption of the Hybrid Vehicles
3. Evaluate energy efficiency of the vehicle for its drive trains
4. Elaborate the types of storage systems such as battery based, fuel cell based etc.
5. Explain the types of Driving Cycles, Fuel Cell EV, Solar Powered Vehicles

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2	1	3	1	
CO2	1	1	2	1	1	1
CO3	1	1	2	1	1	1
CO4	1	1	2	1	1	1
CO5	1	1	2	1	1	1

2024-25 Onwards (MR-24)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Thermal Engg) I Semester		
Code: D3111	**EXPERIMENTAL METHODS IN THERMAL ENGINEERING [Professional Elective – I]**	**L**	**T**	**P**
Credits: 3		**3**	**-**	**-**

Prerequisites: Thermodynamics

Course Objectives: The objectives of the course to understand different experimental methods of Thermal Engineering.

Module I:

Introduction – Generalized measurement system – standards – calibration – Dynamic measurements – System response – Distortion – Impedance matching – Fourier analysis – Experiment planning – causes and types of errors – Error analysis – Uncertainty analysis – Evaluation – Statistical analysis of experimental data – Probability distribution

Module II:

Data Acquisition – Data transmission – data storage and display Variable resistance transducers, capacitive transducers, piezoelectric transducers, photoconductive transducers, photovoltaic cells, ionization transducers, Hall effect transducers.

Module III:

Dynamic response considerations, Bridgman gauge, McLeod gauge, Pirani thermal conductivity gauge, Knudsen gauge, Alphatron.

Module IV:

Flow measurement by drag effects; hot-wire anemometers, magnetic flow meters, flow visualization methods, interferometer, Laser Doppler anemometer. Temperature measurement by mechanical effect, temperature measurement by radiation, transient response of thermal systems, thermocouple compensation, temperature measurements in high- speed flow.

Module V:

Thermal conductivity measurement of solids, liquids, and gases, measurement of gas diffusion, convectionheat transfer measurements, humidity measurements, heat-flux meters. Detection of thermal radiation, measurement of emissivity, reflectivity and transmissivity, solar radiation measurement

TEXT BOOKS:

1. J. P. Holman, Experimental Methods for Engineers, 7th Edition, Tata Mc Graw-Hill 2001.
2. T.G. Beckwith, J.H. Lienhard V, R. D. Marngoni, Mechanical Measurements, 5th Edition, PearsonEducation, 2010.

REFERENCES:

1. E.O. Doebelin, Measurement systems, Application and Design, 5th Edition, Tata McGraw-Hill,2008

Course Outcomes:

At the end of the course,students will be able to:

1. Understand the concepts of errors in measurements, statistical analysis of data, regressionanalysis, correlation and estimation of uncertainty.
2. Understand conceptual development of zero, first and second order systems.
3. Describe the working principles in the measurement of field and derived quantities.
4. Analyze sensing requirements for measurement of thermo-physical properties, radiationproperties of surfaces, and vibration.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	1		1	1	1
CO2	2		2	2	1	2
CO3	2		2	2	1	2
CO4	2		2	2	1	2
CO5	2		2	2	1	2

<table>
<tr><td>2024-25
Onwards
(MR-24)</td><td colspan="1">MALLA REDDY ENGINEERING COLLEGE
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I Semester</td></tr>
<tr><td>Code: D3112</td><td rowspan="2">THERMAL AND NUCLEAR POWER PLANT ENGINEERING
[Professional Elective – II]</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credits: 3</td><td>3</td><td>-</td><td>-</td></tr>
</table>

Prerequisite: Thermal Engineering

Course Objectives: The objective of the course is to provide detailed knowledge of steam power plants, gas turbine power plants and nuclear power plants and of different aspects of power plant economics and instrumentation.

Module-I: Introduction andSteam Power Plants [10Periods]

Sources of Energy – Types of Power Plants – Direct energy conversion system –Energy sources in India – Recent developments in power generation – Combustion of coal: Volumetric analysis, Gravimetric analysis, Flue gas analysis.

Steam Power Plant - Introduction – General Layout – Modern coal-fired steam power plants – Power plant cycles – Fuel handling – Combustion equipment – Ash handling – Dust collectors – Steam Generators Types – Accessories – Feed water heaters – Performance of boilers – Water treatment – Cooling towers – Steam turbines – Compounding of turbines – Steam condensers –Jet and Surface condensers.

Module-II: Gas Turbine Power Plant [10 Periods]

Cogeneration – Combined cycle power plants – Analysis – Waste-Heat recovery – IGCC power plants – Fluidized bed combustion: Advantages and Disadvantages.

Module-III: Nuclear Power Plants: **[10Periods]**

Fundamentals: Nuclear Physics – Nuclear Reactors – Classification – Types of Reactors – Site selection – Methods of enriching Uranium – Applications of Nuclear power plants.**Plant Safety:** By-Products of Nuclear power generation – waste disposal -Economics of Nuclear power plants – Nuclear power plants in India – Future of Nuclear power.

Module-IV: Economics of Power Generation: [09Periods]

Factors affecting the economics – Load Factor – Utilization factor – Performance and operating characteristics of power plants – Economic load sharing – Depreciation – Energy rates – Criteria for optimum loading – Specific economic energy problems.

Module- V: Power Plant Instrumentation: [09Periods]

Classification – Pressure measuring instruments – Temperature measurement and Flow measurement – Analysis of combustion gases – Pollution: Types, Methods to Control.

TEXT BOOKS:

1. P.K. Nag, “**Power Plant Engineering”**, TMH, 4th Edition, 2014.
2. R.K. Rajput, “**Power Plant Engineering”**,Lakshmi Publications, 4th Edition, 2015.

REFERENCES:

1. P.C. Sharma, "**Power Plant Engineering"**,9th Edison Kataria Publications, 2013
2. Wakil, "**Power Plant Technology"**, TMH, Edition, 2010.
3. DipakSarkar, **"Thermal Power Plant – Design and Operation"**, Elsevier, 1st Edition, 2015.
4. Robin A. Chaplin, **"Thermal Power Plant; Vol. 1 – 3"**, Encyclopedia of Life Support Systems.
5. BahmanZohuri, Patrick McDaniel, **"Thermodynamics in Nuclear Power Plant Systems"**, Springer Publications, 2015.

E Resources:

1. http://indianpowersector.com/home/power-station/thermal-power-plant/
2. Http://www.nuclear-power.net/nuclear-power plant/
3. http://www.scielo.br/pdf/ea/v21n59/en_a04v2159.pdf
4. https://link.springer.com/journal/11509
5. http://www.scitechnol.com/nuclear-energy-science-power-generation-technology.php
6. http://nuclearengineering.asmedigitalcollection.asme.org

Course Outcomes:

At the end of the course,students will be able to:

1. Analyse the different components of steam power plant.
2. Analyse the performance of the gas turbine power plant.
3. Summarize the principles of operation and safety of nuclear power plant.
4. Analyze the economic considerations of power plants.
5. Examine the instrumentation requirement of power plants

CO- PO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1		2	3	
CO2	2	1	2		3	
CO3	1	1		2		2
CO4	2	2	1	3		
CO5	1			2	3	1

<table>
<tr><td rowspan="1">2024-25
Onwards
(MR-24)</td><td>MALLA REDDY ENGINEERING COLLEGE
(Autonomous)</td><td colspan="3">M.Tech.
(Thermal Engg)
I Semester</td></tr>
<tr><td>Code: D3113</td><td rowspan="2">NANO FLUIDS
[Professional Elective – I]</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credits: 3</td><td>3</td><td>-</td><td>-</td></tr>
</table>

Pre-requisite: Nil

Course Objectives: The objective of the course is to understand the types, properties, boundary layer theory, heat transfer and applications of the Nano fluids

Module-I: Nano Fluids and its Properties

Introduction to nanofluids, nanostructured materials, base fluids, dispersion, sonication and stable suspension. Various types of nanofluids-volumetric concentration Thermophysical properties: Density; principles of measurement and apparatus –Theoretical equations and new empirical correlations to determine the density of different nanofluids – Viscosity: principles of measurement and apparatus – Andrade's and other theoretical equations and new empirical correlations to determine the viscosity of different nanofluids. Effect of volumetric concentration and temperature.Effect of subzero temperature on nanofluid viscosity.

Module-II: Thermal Behavior of Nano Fluids

Thermal conductivity: principles of measurement and apparatus – Hamilton-Crosser and other theoretical equations and new empirical correlations to determine the thermal conductivity of different nanofluids – Effect of volumetric concentration and temperature. Effect of Brownian motion on enhancing the thermal conductivity – Specific heat: principles of measurement and apparatus. Buongeorno's thermal equilibrium equation and other theoretical equations and new empirical correlations to determine the specific heat of different nanofluids – Effect of volumetric concentration and temperature.

Module-III: Boundary Layer theory of Nano Fluids

A: Combined effects of thermophysical properties of nanofluids on the thermal diffusivity, the Prandtl number, the Reynolds number and the Nusselt number – Basic understanding of their effects on frictional loss and Heat transfer – Convective heat transfer: Single-phase fluid equations

B: laminar flow, entry length and fully developed friction factor and heat transfer coefficient. Graetz number effect in the entry region – Correlations for friction factor and Nusselt number for nanofluids – Turbulent flow: Single phase fluid fully developed flow Dittus-Boelter and Glienilski equations – Blasius and other turbulent friction factor correlations, their comparison with nanofluids data. New correlations for turbulent friction factor and Nusselt number for nanofluids.

Module-IV: Convective Heat Transfer and Heat Exchangers

Principles of measurement and apparatus for the nanofluid convective heat transfer coefficient – Recent empirical relations for convection coefficient of various types of nano fluids.Effect of particle Pecletnumber – Effect of volumetric concentration – Application of nanofluids to various types of industrial heat exchangers – Heating capacity, mass flow, heat exchanger surface area, LMTD and pumping power for nanofluids versus conventional heat transfer fluids.

Module-V: Industrial Applications

Application to building heating and cooling Comparison of nanofluids performance with glycol solution in hydronic coils – Application to automobile radiators. Comparison of the performance of nanofluids under arctic and sub-arctic temperatures with glycol solutions – Introduction to electronic cooling in micro channels with nanofluids.

TEXT BOOKS:

1. Sarit K. Das, Stephen U. Choi, Wenhua Yu, T. Pradeep, "**Nanofluids: Science and Technology**", Wiley-Blackwell,2008.
2. incenzo Bianco, Oronzio Manca, Sergio Nardini, Kambiz Vafai, "**Heat Transfer Enhancement with Nanofluids",** CRC Press, 2015.

REFERENCES:

1. C. Sobhan and G. Peterson "**Microscale and Nanoscale Heat Transfer**", CRC Press, 1st Edition,2008
2. F. M. White "**Fluid Mechanic**", 8th Edition, McGraw-Hill,2016
3. Bejan "**Heat Transfer**", John Wiley, 2nd Edition, 2007
4. H.S.Nalwa "**Handbook of Nanostructured Materials and Nanotechnology**" Vol. I and II -, I edition, American Scientific Publishers,2000.
5. Bharat Bhushan "**Springer Handbook of Nanotechnology**", Springer-Verlag publications,3rd edition,2010
6. J. Dutta, H. Hofman, "**Nano materials**" , Tata Mcgraw Hill,1998
7. Mark Ratner, Danier Ratner, "**Nano Technology**", Prentice Hall, 2002

E Resources:

1. http://cordis.europa.eu/result/rcn/58596_en.html
2. https://www.diva-portal.org/smash/get/diva2:712511/FULLTEXT01.pdf
3. http://www.sciencedirect.com/science/article/pii/S1877705814034936
4. https://www.hindawi.com/journals/jnm/2012/435873/
5. https://nanoscalereslett.springeropen.com/articles/10.1186/1556-276X-6-229
6. http://nptel.ac.in/courses/103106103/1
7. http://nptel.ac.in/courses/103106103/2
8. http://nptel.ac.in/courses/103106103/3
9. http://nptel.ac.in/courses/103106103/4

Course Outcomes:

At the end of the course, students should be able to:

1. Evaluate the different types of Nano fluids and their properties
2. Analyze the thermal behaviour of the Nano fluids using theoretical and empirical relations
3. Inspect the flow properties and heat transfer rates of Nano fluids
4. Apply the Nano fluids in heat exchanger and analyse the thermal behaviours
5. Summarize the various applications of the Nano fluids

CO- PO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	1	2	
CO2	1		1	2	1	
CO3	2		2	1	2	1
CO4	2		3	2	2	2
CO5	1		1		1	1

<table>
<tr><td>2024-25 Onwards (MR-24)</td><td colspan="3">MALLA REDDY ENGINEERING COLLEGE (Autonomous)</td><td>M.Tech. (Thermal Engg) I Semester</td></tr>
<tr><td>Code: D3114</td><td rowspan="2">ADVANCED I.C.ENGINES
[Professional Elective – II]</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credits: 3</td><td>3</td><td>-</td><td>-</td></tr>
</table>

Pre-requisite: Thermodynamics, Thermal Engineering I & II

Course Objectives: The course is intended to

- Analyze engine cycles and the factors responsible for making the cycle different from the Idealcycle.
- Apply principles of thermodynamics, fluid mechanics, and heat transfer to influence the engine'sperformance.
- Understand the delay period and fuel injection system.
- Become aware of the relevance of environmental and social issues on the design process of internalcombustion engines

Module-I: Nano Fluids and its Properties

Introduction – Historical Review – Engine Types – Design and operating Parameters.
Cycle Analysis: Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles –Real Engine cycles - differences and Factors responsible for – Computer Modeling.

Module-II:

Gas Exchange Processes: Volumetric Efficiency – Flow through ports – Supercharging and Turbocharging.
Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.

Module-III:

Engine Combustion in SI Engines: Combustion and Speed – Cyclic Variations – Ignition – Abnormalcombustion Fuel factors, MPFI, SI engine testing.
COMBUSTION IN CI ENGINES: Essential Features – Types of Cycle. Pr. Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system.

Module-IV:

Pollutant Formation and Control: Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.

Module-V:

Engine Heat Transfer: Importance of heat transfer, heat transfer and engine energy balance, Convectiveheat transfer, radiation heat transfer, Engine operating characteristics.
Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen.
Modern Trends in IC Engines: Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.Cengines to suit Bio – fuels, HCCI and GDI concepts.

TEXT BOOKS:

1. I.C. Engines by V. Ganesan, TMH

2. I.C. Engines Fundamentals by Heywood, TMH

REFERENCES:

1. I.C. Engines by G.K. Pathak & DK Chevan, Standard Publications
2. Dual-Fuel Diesel Engines by Ghazi A. Karim, CRC Press
3. I.C. Engines by RK Rajput, Laxmi Publications
4. Internal Combustion Engines by S.S. Thipse, Jaico
5. Computer Simulation of C.I. Engine Process by V. Ganesan, University Press
6. Fundamentals of IC Engines by HN Gupta, PHI, 2nd edition
7. I.C. Engines by Fergnson, Wiley.
8. The I.C. Engine in theory and Practice Vol. I /Teylor /IT Prof. And Vol. II.
9. Computer Simulation of Spark-Ignition Engine Processes by V. Ganesan, Universities Press

Course Outcomes:

At the end of the course, students should be able to:

1. Apply thermodynamic analysis to IC engines and describe combustion phenomena in spark ignitionand compression ignition engines.
2. Describe the working of major systems used in conventional and modern engines.
3. Summarize the methods used to improve engine performance and estimate performance parameters.
4. Describe engine emission control techniques and implement viable alternate fuels.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**		**2**	**1**	**2**	
CO2	**1**		**1**	**2**	**1**	
CO3	**2**		**2**	**1**	**2**	**1**
CO4	**2**		**3**	**2**	**2**	**2**
CO5	**1**		**1**		**1**	**1**

<table>
<tr><td rowspan="1">2024-25 Onwards (MR-24)</td><td colspan="1">MALLA REDDY ENGINEERING COLLEGE
(Autonomous)</td><td colspan="3">M.Tech.
(Thermal Engg)
I Semester</td></tr>
<tr><td>Code: D3115</td><td rowspan="2">GAS TURBINES & JET PROPULSION
[Professional Elective – II]</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credits: 3</td><td>3</td><td>-</td><td>-</td></tr>
</table>

Prerequisite: Thermal Engineering

Course Objectives:

1. To present a detailed understanding of the components of a typical turbojet engine.
2. To demonstrate the physical processes involved in the operation of turbojets.
3. To teach students methods to size and design components as well as perform integration of anengine system.
4. Understand of thermodynamic cycles of jet engines.
5. Analyze jet engines; determine propulsion efficiency and design inlets and nozzles.

Module-I

Introduction, Cycles, Actual and Ideal cycles, merits and demerits, Performance characteristics and improvement.

Module-II

Gas dynamics, Centrifugal, axial and mixed flow compressor, principles and characteristics, Turbine construction.

Module-III

Blade materials, manufacturing techniques, blade fixing, Problems of high temperature operation, blade cooling, practical air-cooled blades Combustion Systems, various fuels and fuel systems,

Module-IV

Theory of jet propulsion, Jet propulsion cycles and their analysis, thrust equation, parameters affecting performance, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines. thrust augmentation, environmental considerations and applications

Module- V

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights

TEXT BOOKS:

1. V. Ganesan, “Gas Turbines”, Tata McGraw Hill, 2003

REFERENCES:

1. **H Cohen, GFC Rogers and HIH Saravanamuttoo, "Gas Turbine Theory", Pearson Education, 2000.**
2. S.M.Yahya "Turbines, Compressors and Fans", Tata McGraw Hill, 1992.
3. **Vincent "The theory and design of Gas Turbine and Jet Engines", McGraw Hill, 1950.**
4. W WBathic, "Fundamentals of Gas Turbines", John Wiley and Sons.

Course Outcomes:

At the end of the course,students will be able to:

1. understand construction and design features of gas turbines as used for power generation.
2. Explore to thermodynamics and fluid mechanics component for enhancing the efficiency andeffectively of gas turbines
3. Develop skills in problem solving for aircraft propulsion systems, in particular gas turbine engines.
4. Analyse the performance enhancement approaches for jet propulsion engines
5. Describe the basic concepts of rocket propulsion.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1		2	3	
CO2	2	1	2		3	
CO3	1	1		2		2
CO4	2	2	1	3		
CO5	1			2	3	1

2024-25 Onwards (MR-24)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Thermal Engg) I Semester		
Code: D3116	FUEL CELL TECHNOLOGY [Professional Elective – II]	L	T	P
Credits: 3		3	-	-

Prerequisite: Nil

Course Objectives:

To present a detailed understanding of the components of fuel cell Technology

Module-I

Overview of Fuel Cells: Description of fuel cell, brief history, classification, working principle,Fuel cell basic chemistry and thermodynamics of fuel cell and performance.

Module-II

Fuel Cell Thermodynamics: Thermodynamic Potentials, Heat Potential of a Fuel: Enthalpy ofreaction, Reaction Enthalpies, Work Potential of a Fuel: Gibbs Free Energy, Relationship between Gibbs Free Energy and Electrical Work, Computing Reversible Voltages, Reversible Voltage. Variation with Temperature, Reversible Voltage Variation with pressure, Reversible Voltage Variation with concentration:Nernst Equation ,Fuel Cell Efficiency-Ideal and real fuel cell efficiency.

Module-III

Fuel cell electrochemistry: electrode kinetics, types of voltage losses,polarization curve, fuel cell efficiency, Tafel equation, exchange currents.

Fuel Cell Modeling: A Basic Fuel Cell Model, 1-D PEM Fuel Cell Model.

Fuels for Fuel Cells: Hydrogen, Hydrocarbon fuels, effect of impurities such as CO, S and others. hydrogen generation and storage; limitations, recent advances

Module-IV

Overview of fuel cell types: Phosphoric acid fuel cell (PAFC), Polymer electrolyte membranefuel cell (PEMFC), Alkaline fuel cell (AFC), Molten carbonate fuel cell (MCFC), Solid-oxidefuelcell (SOFC) and other fuel cells.

PEM Fuel cell components: Main PEM fuel cell components, materials, properties and processes: membrane, electrode, gas diffusion layer, bi-polar plates, flow field plate design, Fuel cell operating conditions: pressure, temperature, flow rates, humidity.

Direct methanol fuel cell : active and passive DMFC, methanol cross over and techniques to reduce, current collectors.

Fuel Cell Vehicles: Basic of fuel cell vehicle, Fuel cell hybrid vehicles, etc.

Module- V

Main components of solid-oxide fuel cells, Cell stack and designs, Electrode polarization, testing of electrodes, cells and short stacks, Cell, stack and system modelling

Fuel processing: Direct and in-direct internal reforming, Reformation of hydrocarbons by steam,

CO_2 and partial oxidation, Direct electro catalytic oxidation of hydrocarbons, carbondecomposition, Sulphur tolerance and removal, Using renewable fuels for SOFCs

TEXT BOOKS:

1. RyanO′Hayre., Fuel Cell Fundamentals,Suk-Won Cha Whitney Colella, second edition,JohnWiley&Sons,2018.
2. Franno.Barbir.,PEM Fuel Cells: Theory and Practice,2nd Ed.Elsevier/Academic Press,2013.

REFERENCES:

1. Karl Kordesch& Gunter Simader., Fuel Cells and Their Applications,VCH Publishers,2001.
2. HoogersG.,Fuel Cell Technology HandBook,CRCPress,2010.

Course Outcomes:

At the end of the course, students will be able to:

1. Understand fuel cell fundamentals
2. Analyse the performance of PEM fuel cell system
3. Demonstrate the operation of different fuel cells
4. Apply the modeling techniques for fuel cell systems

CO- PO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	3	2	2	1
CO2	2	2	2	3	3	2
CO3	1	2	3	3	3	1
CO4	1	2	3	3	2	1
CO5	1	2	3	2	2	1

<table>
<tr><td rowspan="1">2024-25 Onwards (MR-24)</td><td>MALLA REDDY ENGINEERING COLLEGE
(Autonomous)</td><td colspan="3">M.Tech
(Thermal Engg)
I Semester</td></tr>
<tr><td>Code: D3117</td><td rowspan="2">PDF and Numerical Techniques
[Professional Elective – II]</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credits: 3</td><td>3</td><td>-</td><td>-</td></tr>
</table>

Pre-requisite: Numerical Methods

Course Objectives: The objective of this course is to familiarize the prospective engineers with techniques in Multivariate analysis. It deals with acquainting the students with standard concepts to advanced level that will serve them well towards tackling applications that they would find useful in their profession. To understand types of partial differential equations and their applications in Engineering.

Module – I: Approximation Theory

Polynomial and function interpolations, Orthogonal Collocations method for solving ODE-BVPs, Orthogonal Collocations method for solving ODE-BVPs with examples, Orthogonal Collocations method for solving PDEs with examples, Necessary and sufficient conditions for unconstrained multivariate optimization, Least square approximations

Module II: Partial Differential Equations:

Introduction to methods for solving sparse linear systems: Thomas algorithm for tridiagonal and block tri diagonal matrices

Introduction to PDE, Formation by eliminating arbitrary constants and arbitrary functions, Linear PDE(Lagrangian Equation), Non-Linear PDE of First order (Standard forms), Charpit's Method.

Introduction to higher order PDE, Homogeneous Linear equations with constant coefficients, Rules finding Complimentary functions, Rules finding Particular Integrals, Non Homogeneous Linear equations. Equations reducible to PDEs with constant coefficients.

Module III: Applications to Partial Differential Equations:

A: Application to one-dimensional wave equation. Interpolation: Linear Interpolation - Higher order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation -piece-wise and spline Interpolation.

B: Finite Element Analysis implicit and Explicit Methods – ADI Methods Elliptic Equations: Laplace Equation, Poisson Equation, Iterative Schemes Dirchlet's Problem, Neumann Problem, mixed boundary value problem, ADI Methods.

Module - IV:

Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radaua integration method- composite integration method – Double integration using Trapezoidal and Simpson's method.

Module - V:

Projections and least square solution, Function approximations and normal equation in any inner product space, Model Parameter Estimation using linear least squares method, Gauss Newton Method, Gelarkin's method and generic equation forms arising in problem discretization, Errors in Discretization, Generaic equation forms in transformed problems

TEXT BOOKS:

1. J N Reddy,**"An Introduction to Non-Linear Finite Element Analysis"**, Oxford University Press
2. S.S. Shastry, **"Introductory Methods of Numerical Analysis"**, Prentice-Hall India Pvt. Ltd., Fourth Edition, 2006

REFERENCES:

1. Applied numerical analysis by – Curtis I.Gerala- Addission Wasley – published campus.
2. Numerical methods for Engineers Stevan C.Chopra, Raymond P.Canal Mc. Graw Hill book company.
3. C Language and Numerical methods by C.Xavier – New age international publisher.
4. Computer based numerical analysis by Dr. M.Shanta Kumar, Khanna Book publishers, New Delhi.

E Resources:

1. https://www.math.cmu.edu/~wn0g/2ch6a.pdf (Differential Calculus)
2. http://www.sam.math.ethz.ch/~hiptmair/tmp/NPDE10.pdf (Numerical Solution of Partial Differential Equations)
3. http://www.nptel.ac.in/courses/122104018/node120.html
4. https://mat.iitm.ac.in/home/sryedida/public_html/caimna/pde/second/second.html (Partial Differential Equations)
5. http://www.aidic.it/cet/16/51/055.pdf (Differential Calculus)
6. www.unige.ch/~hairer/preprints/coimbra.pdf
7. http://nptel.ac.in/courses/111103021/ (Partial Differential Equations)

Course Outcomes:

At the end of the course, students will be able to:

2. Apply the concept of iteration techniques to solve system of algebraic equations.
3. Use the concept of interpolation method in order to calculate the missed data in data analysis problems..
4. Examine advanced interpolation & Extrapolation techniques to solve some real problems.
5. Validate numerical differentiation and integration to calculate areas of a given data curves.

5.Solve ordinary differential equations of the Initial value problems by using various developed methods.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	1	1	1
CO2	2		2	1	1	1
CO3	3	1	3	2	2	1
CO4	2		1	2		2
CO5				1	1	1

<table>
<tr><td>2024-25
Onwards
(MR-24)</td><td>MALLA REDDY ENGINEERING COLLEGE
(Autonomous)</td><td colspan="3">M.Tech.
(Thermal Engg)
I Semester</td></tr>
<tr><td>Code: D3118</td><td rowspan="2">COMPUTER SIMULATION IN SI AND CI ENGINES
[Professional Elective – I]</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credits: 3</td><td>3</td><td>-</td><td>-</td></tr>
</table>

Prerequisites: Thermodynamics, Automobile Engineering

Course Objectives: The objectives of the course to understand different methods of computer simulation and analysis of IC engine performance.

Module I: Simulation Principles
First and second laws of thermodynamics – Estimation of properties of gas mixtures – Structure of engine models – Open and closed cycle models – Cycle studies – Chemical reactions – First law application to combustion – Heat of combustion – Adiabatic flame temperature – Hess Law-Le chatelier's principle. Heat transfer in engines – Heat transfer models for engines – Simulation models for IC Engines. (Ideal and actual cycle simulation) – Chemical equilibrium and calculation of equilibrium composition.

Module II: Simulation of Combustion in SI Engine

Combustion in SI engines – Flame propagation and velocity – Single zone models – Multi zone models Mass – Burning rate – Turbulence models. One dimensional models – Chemical kinetics modeling – Multidimensional models – Flow chart preparation.

Module III: Simulation of Combustion in CI Engine
A: Combustion in CI engines single zone models – Premixed-Diffusive models – Wiebe model – Whitehouse way model – Two zone models – Multizone models –

B: Meguerdichian and Watson's model – Hiroyasu's model – Lyn's model – Introduction to multidimensional and spray modeling – Flow chart preparation.

Module IV: Simulation of Two Stroke Engine

Thermodynamics of the gas exchange process – Flows in engine manifolds – One dimensional and multidimensional models. Flow around valves and through ports models for scavenging in two stroke engines – Isothermal and non-isothermal models – Heat transfer and friction.

Module V: Simulation of Gas Turbine Combustors
Gas Turbine Power plants – Flame stability – Combustion models for steady flow simulation – Emission models – Flow chart preparation.

TEXT BOOKS:

1. V. Ganesan, "**Computer Simulation of Spark Ignition Engine Processes**", Universities Press, 2000.
2. V. Ganesan, "**Computer Simulation of Compression Ignition Engine Processes**",

Universities Press, 2000.

REFERENCES:

1.Cohen H. Rogers GEC. – “**Gas Turbine Theory”** – Pearson Education India Fifth edition, 2001.
2. Bordon P. Blair, “T**he Basic Design of two-Stroke engines”**, SAE Publications, 1990.
3. Horlock and Winterbone**, “The Thermodynamics and Gas Dynamics of Internal Combustion Engines”**, Vol. I & II, Clarendon Press, 1986.
4. J.I.Ramos, “**Internal Combustion Engine Modeling”**, Butterworth – Heinemann ltd, 1999.
5. J.N.Mattavi and C.A. Amann, “**Combustion Modeling in Reciprocating Engines”**, Plenum Press, 1980
6. Ashley S. Campbell**, “Thermodynamic Analysis of Combustion Engines”**, Krieger Publication Co, 1985

E - RESOURCES

1. https://support.dce.felk.cvut.cz/mediawiki/images/1/14/Dp_2008_lansky_lukas.pdf
2. https://pdfs.semanticscholar.org/c4b5/4979aaec0acc8b563c295446a41154f040d6.pdf
3. http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1097-0363
4. http://journals.sagepub.com/home/jer

Course Outcomes:

At the end of the course, students will be able to:

1. Interpret the principles of computer simulation.
2. Examine the computer simulation of SI engines
3. Evaluate the computer simulation of CI engines.
4. Assess the computer simulation of two stroke cycle engines.
5. Formulate the computer simulation of gas turbine combustors

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	1		1	1	1
CO2	2		2	2	1	2
CO3	2		2	2	1	2
CO4	2		2	2	1	2
CO5	2		2	2	1	2

24-25 Onwards (MR-24)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech (Thermal Engg) I Semester		
Code: D0H18	RESEARCH METHODOLOGY AND IPR (HSMC)	L	T	P
Credits: 2		2	-	-

Prerequisites: NIL

Course Objectives: The objective of the course is to make students familiar with the basics of research methodology and various types of Intellectual Properties, IPR legislations and policies.

MODULE-1 Research Problem

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE – II Technical Writing & Research Proposal

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE – III Intellectual Property Rights

A: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. B: International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE – IV Patent Rights

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE – V Case Studies

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

1. Prabhuddha Ganguli: ‘ Intellectual Property Rights” Tata Mc-Graw –Hill, New Delhi
2. M.Ashok Kumar and Mohd.Iqbal Ali: “Intellectual Property Right” Serials Pub.
3. Carlos M.Correa- **‘‘Intellectual property rights , The WTO and Developing countries”**-Zed books
4. Law relating to patents, trademarks, copyright designs, Wadehra, B.L. & 2 ed. Universal Law Publishing 2000.
5. C.R.Kothari, **“Research Methodology”** New Age International Publishers, Fourth

edition, 2018.

6. Donald Cooper & Pamela Schindler, **“Business Research Methods”,** TMGH, 9th edition.
7. Alan Bryman & Emma Bell, **“Business Research Methods”**, Oxford University Press.

E Resources:

1. https://www.wto.org/english/tratop_e/trips_e/trips_e.htm
2. https://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm7_e.htm
3. http://nptel.ac.in/courses/110999906/
4. http://nptel.ac.in/courses/109105112/

Course outcomes:

At the end of the course, students will be able to:

1. Comprehend the concepts of research methodology and its concepts.
2. Realize the concepts of literature review and developing a research proposal.
3. Outline the basic concepts of Intellectual property rights.
4. Examine the types of patents and their procedures.
5. Recognize the recent developments in IPR administration

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**3**		**2**	**1**	**3**
CO2	**3**	**3**		**1**	**3**	**1**
CO3	**2**	**3**				
CO4	**1**	**1**		**1**	**1**	**1**
CO5	**1**	**1**			**1**	

2024-25 Onwards (MR-24)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Thermal Engg.) I Semester		
Code: D3103	ADVANCED THERMAL ENGINEERING LAB	L	T	P
Credits2		-	-	3

Pre-requisites: Nil

Course Objectives: The objective of this course is to make students learn and understand application and performance of fuels, I.C. Engines, heat exchangers, solar systems, refrigerators and air conditioners.

List of Experiments:

1. Dryness fraction estimation of steam.
2. Flame propagation analysis of gaseous fuels.
3. Performance test and analysis of exhaust gases of an I.C. Engine.
4. Heat Balance test on variable compression ratio engine
5. Performance test on variable compression ratio engine
6. Volumetric Efficiency test and air fuel ratio estimation of an I.C. Engine.
7. Performance estimation of vapour compression refrigeration test rig.
8. Performance analysis of Air conditioning unit.
9. Performance analysis of heat pipe.
10. Performance analysis of solar Flat Plate Collector
11. Performance analysis of Evacuative tube concentrator
12. Performance test on the single cylinder variable compression ratio engine.

Course Outcomes:

At the end of the course,students will be able to:

1. Apply and analyze the fundamental concepts thermodynamics
2. Evaluate the performance of an internal combustion engine
3. Assess the effects of variation of compression ratio on the performance of engine.
4. Simulate the concepts of solar energy for different practical application.
5. Apply and analyze principles of refrigeration and air conditioning system.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1		1	1
CO2	1	2	1		1	2
CO3	2	2	2	2	1	2
CO4	2	2	2	1	1	2
CO5	1	2	1		1	1

2024-25 Onwards (MR-24)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Thermal Engg.) I Semester		
Code: D3104	ADVANCED HEAT TRANSFER LAB	L	T	P
Credits: 2		-	-	3

Pre-requisites: Nil

Course Objectives: The objective of this course is to make students' learn and understand application and performance of fuels, I.C. Engines, heat exchangers, solar systems, refrigerators and air conditioners.

List of Experiments:

1. Determine Effectiveness of Concentric Double Pipe Heat Exchanger
2. Analyze the effect of cooling load on wet bulb temperature
3. To draw the Heat balance sheet.
4. To determine emissivity of radiation surface with different finishers namely polished, gray, and metal black.
5. To Verify Stefan Boltzmann Law
6. To Verify Kirchhoff's Law
7. To determine heat flux & surface heat transfer co efficient at constant pressure for Drop wise and Film wise Condensation
8. Demonstration of flow boiling within the tube of Flow Boiling Unit
9. Calibration of Thermal conductivity Unit in Cartesian Coordinate system
10. Calibration of Thermal conductivity Unit in Cylindrical Coordinate system
11. Calibration of Thermal conductivity Unit in Spherical Coordinate system
12. To determine of thermal conductivity of liquids & gases

Course Outcomes:

At the end of the course,students will be able to:

1. Apply and analyze the fundamental concepts of Heat Exchangers
2. Examine the concepts of Thermal Radiation
3. Assess the fundamental concepts of Condensation
4. Inspect the Principle of Pool Boiling and Film Boiling
5. Calibrate the thermal conductivity unit and measure the thermal conductivity

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1		1	1
CO2	1	2	1		1	2
CO3	2	2	2	2	1	2
CO4	2	2	2	1	1	2
CO5	1	2	1		1	1

<table>
<tr><td>2024-25
Onwards
(MR-24)</td><td colspan="1">MALLA REDDY ENGINEERING COLLEGE
(Autonomous)</td><td colspan="3">M.Tech.
(Thermal Engg)
I Semester</td></tr>
<tr><td>Code: D00A1</td><td rowspan="2">ENGLISH FOR RESEARCH PAPER WRITING
(Audit course)</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credits: Nil</td><td>2</td><td>-</td><td>-</td></tr>
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Prerequisites: Nil

Course objective: The objective of the course is to provide the knowledge on structuring paragraphs, paraphrasing and preparation of research documents related to abstract, literature review, methods and results.

Module I: **[06 Periods]**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Module II: **[07 Periods]**

Clarifying Who Did What, Highlighting Your Findings, Hedging and criticizing, paraphrasing and plagiarism, sections of a paper, abstracts. Introduction.

Module III: **[06 Periods]**

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Module IV: **[06 Periods]**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Module V: **[07 Periods]**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman’s book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course outcomes:

At the end of the course, students should be able to

1. Structure the sentences and paragraphs.
2. Elaborate the various sections of research papers.
3. Explore the check list in research documents.
4. Apply the key skills to coin the title, abstract, introduction and literature review.
5. Inspect the skills required for preparing experimental results and discussions.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Programme Outcomes(POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1		2			2	1
CO2		2			2	1
CO3		2			2	1
CO4		2			2	1
CO5		2			2	1