JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D11101	Energy Management of Thermal Systems	PC	3	0	0	3
2.	21D11102	Advanced Thermodynamics	PC	3	0	0	3
3.	21D11103a 21D11103b 21D11103c	**Program Elective Course – I** Renewable Energy Sources Design of Air-Conditioning Systems Energy Conservation Technologies	PE	3	0	0	3
4.	21D11104a 21D11104b 21D11104c	**Program Elective Course – II** Fuels & Combustion Technology Instrumentation For Thermal Engineering Refrigeration and Cryogenics	PE	3	0	0	3
5.	21D11105	Thermal Science Laboratory	PC	0	0	4	2
6.	21D11106	Energy Systems Laboratory	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
Total							**18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1	21D11201	Advanced Heat & Mass Transfer	PC	3	0	0	3
2	21D11202	Advanced Energy Techniques	PC	3	0	0	3
3.	21D11203a 21D11203b 21D11203c	**Program Elective Course – III** Energy Auditing and Management Modeling & Analysis of Energy Systems Optimization Techniques and Its Applications	PE	3	0	0	3
4.	21D11204a 21D11204b 21D11204c	**Program Elective Course – IV** Computational Fluid Dynamics Design of Heat Transfer Equipment Advanced IC Engines	PE	3	0	0	3
5	21D11205	Advanced Heat & Mass Transfer Laboratory	PC	0	0	4	2
6	21D11206	Energy Utilization Laboratory	PC	0	0	4	2
7	21D11207	Technical seminar	PR	0	0	4	2
8.	21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
Total							**18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.		**Program Elective Course – V**	PE	3	0	0	3
	21D11301a	Solar Passive Architecture					
	21D11301b	Advanced Power Plant Engineering					
	21D11301c	Cogeneration and Waste Heat Recovery					
2.		**Open Elective**	OE	3	0	0	3
	21DOE301c	Business Analytics					
	21DOE301g	Internet Of Things					
	21DOE301h	Mechatronics					
3.		Dissertation Phase – I	PR	0	0	20	10
4.		Co-curricular Activities					2
Total							**18**

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D11401	Dissertation Phase – II	PR	0	0	32	16
Total							**16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ENERGY MANAGEMENT IN THERMAL SYSTEMS	L	T	P	C
21D11101		3	0	0	3
	Semester	I			

Course Objectives: Student will be able

- To learn the present energy scenario and the need for energy conservation
- To learn the instruments suitable for energy auditing.
- To study the various measures for energy conservation and financial implications for various thermal utilities

Course Outcomes (CO): Student will be able to

- Having basic understanding of combustion process and knowledge of on-site thermal energy generation systems, insulation and typical thermal utilities and services of organizations.
- Becoming aware of the structure and functioning of thermal energy systems of industrial units and organizations.
- Student acquired the techniques and skills of thermal energy analysis and identification of opportunities and options for the thermal energy conservation and management.

UNIT - I — Lecture Hrs:9

INTRODUCTION

Energy Scenario – world and India. Energy Resources Availability in India. Energy consumption pattern. Energy conservation potential in various Industries and commercial establishments. Energy intensive industries – an overview. Energy conservation and energy efficiency – needs and advantages. Energy auditing – types, methodologies, barriers. Role of energy manager – Energy audit questionnaire – energy Conservation Act 2003.

UNIT - II — Lecture Hrs:9

INSTRUMENTS FOR ENERGY AUDITING

Instrument characteristics – sensitivity, readability, accuracy, precision, hystersis. Error and calibration. Measurement of flow, velocity, pressure, temperature, speed, Lux, power and humidity. Analysis of stack, water quality, power and fuel quality.

UNIT - III — Lecture Hrs:9

THERMAL UTILITIES: OPERATION AND ENERGY CONSERVARTION

(i) Boilers (ii) Thermic Fluid Heaters (iii) Furnaces (iv) Waste Heat Recovery Systems (v) Thermal Storage

UNIT - IV — Lecture Hrs:9

THERMAL ENERGY TRANSMISSION / PROTECTION SYSTEMS

Steam traps – refractories – optimum insulation thickness – insulation – piping design

UNIT - V — Lecture Hrs:9

FINANCIAL MANAGEMENT

Investment – need, appraisal and criteria, financial analysis techniques – break even analysis – simple payback period, return on investment, net present value, internal rate of return, cash flows, DSCR, financing options, ESCO concept.

Textbooks:

1. Smith, CB Energy Management Principles, Pergamon Press, NewYork, 1981
2. Hamies, Energy Auditing and Conservation; Methods Measurements, Management and Case study, Hemisphere, Washington, 1980

Reference Books:

1. Trivedi, PR, Jolka KR, Energy Management, Commonwealth Publication, New Delhi, 1997
2. Write, Larry C, Industrial Energy Management and Utilization, Hemisphere Publishers, Washington, 1988
3. Diamant, RME, Total Energy, Pergamon, Oxford, 1970
4. Handbook on Energy Efficiency, TERI, New Delhi, 2001

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

5 .Guide book for National Certification Examination for Energy Managers and Energy Auditors (Could be downloaded from www.energymanagertraining.com)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED THERMODYNAMICS	L	T	P	C
21D11102		3	0	0	3
	Semester	I			

Course Objectives:

- The objective of this course is to prepare students to effectively solve theoretical and applied thermodynamics problems that are directly applicable to situations faced in research and industry.
- Significant emphasis is placed on the integration of recent thermodynamics-related research into the traditional resources in order to foster critical analysis of current work as it relates to fundamental principles.

Course Outcomes (CO): Student will be able to

- Describe and calculate thermodynamic properties of single-phase and multi-phase systems.
- Apply the laws of statistical and classical thermodynamics to chemically reactive systems, kinetics, and combustion.
- Relate course principles to solve problems regarding gas turbines, combustion, refrigeration, and solar energy.
- 4. Communicate engineering knowledge of thermodynamics through written and verbal means.

UNIT – I	Lecture Hrs:9

AVAILABILITY ANALYSIS AND THERMODYNAMIC PROPERTY RELATIONS

Reversible work - availability - irreversibility and second – law efficiency for a closed system and steady – state control volume. Availability analysis of simple cycles. Thermodynamic potentials. Maxwell relations. Generalized relations for changes in entropy - internal energy and enthalpy - generalized relations for Cp and CV Clausius Clay person equation, Joule – Thomson coefficient. Bridgeman tables for thermodynamic relations.

UNIT – II	Lecture Hrs:9

REAL GAS BEHAVIOUR AND MULTI – COMPONENT SYSTEMS

Different equations of state – fugacity – compressibility - principle of corresponding States - Use of generalized charts for enthalpy and entropy departure - fugacity coefficient, Lee – Kesler generalized three parameter tables. Fundamental property relations for systems of variable composition. Partial molar properties. Real gas mixtures - Ideal solution of real gases and liquid - activity - equilibrium in multi phase systems - Gibbs phase rule for non – reactive components

UNIT – III	Lecture Hrs:9

CHEMICALTHERMODYNAMICSANDEQUILIBRIUM

Thermo chemistry-Firstlawanalysisofreactingsystems-Adiabaticflametemperature–entropy change of reacting systems- Second law analysis of reacting systems- Criterion for reaction equilibrium. Equilibriumconstantforgaseousmixtures-evaluationofequilibriumcomposition.

UNIT – IV	Lecture Hrs:9

Analysis of vapour power & Vapour compression refrigeration cycles:
Rankine cycle with superheat, reheat and refrigeration - Exergy analysis, Super –critical and ultra-super-critical Rankine cycle.
Vapour compression refrigeration Systems, Analysis of vapour refrigeration systems, Commonly used refrigerants.

UNIT – V	Lecture Hrs:8

Analysis of Gas power cycles:
IC Engines : Air standard Otto, Diesel and Dual cycle
Gas turbines: Air standard Brayton cycle, Effect of reheat, inter cooling and regeneration , Combined gas and vapour power cycles.

Textbooks:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

1. Kenneth Wark Jt. m, Advanced Thermodynamics for Engineers, McGrew – Hill Inc.,1995.
2. Bejan,A.,AdvancedEngineeringThermodynamics,JohnWileyandCons,1988.
3. Holman, J.P., Thermodynamics, Fourth Edition, McGraw–HillInc.,1988.
4. Fundamentals of Engineering Thermodynamics by V.Babu

Reference Books:

1. Smith,J.M.and VanNess., H.C.,Introductionto Chemical Engineering Thermodynamics, Fourth Edition, McGraw– HillInc.,1987.
2. Sonntag, R.E., and Van Wylen, G, Introduction to Thermodynamics, Classical and StatisticalThemodynamics,ThirdEdition,JohnWileyandSons, 1991.
3. Sears,F.W.andSalingerG.I.,Thermodynamics,KineticTheoryandStatisticalThermodynamics, ThirdEdition,NarosaPublishingHouse,NewDelhi,1993.
4. DeHotf, R.T., Thermodynamics in Materials Science, McGraw – Hill Inc., 1993. Rao,Y.V.C.Postulational and Statistical Thermodynamics, Allied Publisher Limited, NewDelhi,1999

Online Learning Resources:

1. https://nptel.ac.in/courses/103/103/103103162/
2. https://onlinecourses.nptel.ac.in/noc20_ch03/preview

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	RENEWABLE ENERGY SOURCES (RES)	L	T	P	C
21D11103a	Program Elective Course – I	3	0	0	3
	Semester	I			

Course Objectives: Student will be able

- To provide an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application.
- To explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy.
- To focus on alternate, renewable energy sources such as solar, biomass (conversions),

Course Outcomes (CO): Student will be able to

- List and generally explain the main sources of energy and their primary applications in the US, and the world.
- Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
- Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.
- List and describe the primary renewable energy resources and technologies.

UNIT - I		Lecture Hrs:9

SOLAR RADIATION AND COLLECTING DEVICES:
Solar Incident Flux, Extraterrestrial Radiation, Clear Sky Irradiation, Solar Radiation Measurement, Monthly Average Radiation on Tilted Surfaces.
Cover plates, Collector Plate Surfaces, Collector Performance, Collector Improvement, Effect of Incident Angle, Heat Transfer to Fluids, Heat Transfer Factors, Concentrating Collectors, and Reflectors.

UNIT - II		Lecture Hrs:9

SOLAR SYSTEM DESIGN AND ECONOMIC EVALUATION
Hot water heating , heating and hot water systems , pumps and fans, sizing pipe and duct work, fundamentals of economic analysis, systems optimization

UNIT - III		Lecture Hrs:9

WIND ENERGY SYSTEMS:
Orientation systems and Regulating devices, Types of Wind Turbines, Operating Characteristics, Basics of Airfoil Theory, Wind energy for water pumping and generation of electricity, Installation operation and maintenance of small wind energy conversion systems.

UNIT - IV		Lecture Hrs:9

ENERGY FROM WATER:
OTEC–Principle of operation, Open and Closed OTEC cycles,
Wave energy: Wave energy conversion machines and recent advances
Tidal Energy: Single basin and double basin tidal systems
Small-Mini-Micro hydro system: Concepts, Types of turbines, Hydrological analysis

UNIT - V		Lecture Hrs:8

GEOTHERMAL ENERGY:
Introduction, Classification of Geo-thermal areas, Applications of Geo-thermal energy for power generation, Economics of Geo-thermal energy.
MHD POWER GENERATION:
Principles of MHD Power Generation, Ideal MHD–Generator Performance, Practical MHD Generator: Faraday and Hall Configurations, MHD Technology.

Textbooks:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

1. Peter J.Lunde Solar Thermal Engineering , John Wiley & Sons
Reference Books:
1. G.N Tewari ,"Solar Thrmal Engineerng , TMH 2. H.P Garg, Solar Energy Fundamentals and Applications, , TMH 3. S.P sukhatme, Solar Energy Principles of thermal storage,TMH
Online Learning Resources:
1. https://www.edx.org/course/sustainable-energy 2. https://nptel.ac.in/courses/121/106/121106014/

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	DESIGN OF AIR CONDITIONING SYSTEMS (DACS)	L	T	P	C
21D11103b	Program Elective Course – I	3	0	0	3
	Semester	I			

Course Objectives: Student will be able

- To estimate different heat loads
- To design different air conditioning systems.

Course Outcomes (CO): Student will be able to

- Have a good understanding of the principles of air conditioning design, and consideration that influence the design including human comfort, weather and environmental parameters and building structure;
- Be equipped with basic design skills to be able to estimate life-cycle costing and choose the right type of system;
- Have a deep understanding of load estimation and analysis, psychometric analysis of a system and climate data and its use.

UNIT - I Lecture Hrs:9

PSYCHROMETRY:
Psychrometry and psychrometric properties – Psychrometric relations – Psychrometric processes
HEATING AND COOLING LOAD CALCULATIONS:
Introduction – Thermal comfort – Estimation of heat loss and heat gain – Design conditions – Infiltration and ventilation loads.

UNIT - II Lecture Hrs:9

Procedure for estimating heating loads and cooling loads.
AIR CONDITIONING SYSTEMS:
Thermal distribution systems – Single zone system – Design calculations.

UNIT - III Lecture Hrs:9

Multi zone system – Water systems – Variable air volume systems – Unitary system.

UNIT - IV Lecture Hrs:9

FAN AND DUCT SYSTEMS:
Pressure drop in straight and rectangular ducts – Sudden enlarge and contraction – Design of duct systems – Velocity method – Equi-friction method – Fan laws – Air distribution in rooms

UNIT - V Lecture Hrs:9

COOLING AND DEHUMIDIFYING COILS:
Types of cooling and dehumidifying coils – Calculating the surface area of the coil – Actual coil condition curves – Solving for outlet conditions

AIR CONDITIONING CONTROLS:
Pneumatic control hardware, Direct and reverse acting thermostat – Temperature transmitter with receiver controller – Dampers – Out door air control –Summer, winter changeover – Humidistat and humidifiers

Textbooks:

1. C.P.Arora, Refrigeration & Air-Conditioning , TMH .
2. Stoecker W.F., and Jones, J.W., Refrigeration & Air-Conditioning, McGraw Hill

Reference Books:

1. Manohar Prasad, Refrigeration, Air-Conditioning , New Age
2. Domkunduwar and Arora, Refrigeration & Air-Conditioning, Dhanpatrai & Sons

Online Learning Resources:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

1. https://www.usbr.gov/tsc/techreferences/mands/mands-pdfs/HVACManl.pdf
2. https://www.free-education.in/hvac-design-and-drafting-course-online-free/

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ENERGY CONVERSION TECHNOLOGIES (ECT)	L	T	P	C
21D11103c	Program Elective Course – I	3	0	0	3
	Semester	I			

Course Objectives: Student will be able to

- Study the different ways of converting energy resources into useful energy services.

Course Outcomes (CO): Student will be able to

- Describe the major processes for producing electricity
- Give the typical sizes of the technologies
- Explain the influence major parameters that influence the efficiency of the power plants.

UNIT - I — Lecture Hrs:9

ENERGY CLASSIFICATION, SOURCES, UTILIZATION, ECONOMICS AND TERMINOLOGY:
Introduction, Mass-Energy Dependence, Energy, Mass and Power Units, Energy Types and Classifications, Energy Sources, Energy Reserves.
Energy Utilization, Energy Economics, Power Generation Terminology.

UNIT - II — Lecture Hrs:9

PRINCIPAL FUELS FOR ENERGY CONVERSION :
Introduction , Biomass Fuels , Fossil Fuels , Nuclear Fuels , Solar Energy .

UNIT - III — Lecture Hrs:9

PRODUCTION OF THERMAL ENERGY :
Introduction , Conversion of Mechanical Energy , Conversion of Electrical Energy , Conversion of Electromagnetic Energy , Conversion of Chemical Energy ,Conversion of Nuclear Energy .
PRODUCTION OF MECHANICAL ENERGY :
Introduction , Conversion of Thermal Energy , Turbines , Electro mechanical Conversion

UNIT - IV — Lecture Hrs:9

PRODUCTION OF ELECTRICAL ENERGY :
Introduction, Conversion of Thermal Energy into Electricity, Conversion of Chemical Energy into Electricity.
Conversion of Electromagnetic energy into Electricity, Conversion of Nuclear Energy into Electricity, Conversion of Mechanical Energy into Electricity.

UNIT - V — Lecture Hrs:8

ENERGY STORAGE :
Introduction, Storage of Mechanical Energy , Storage of Electrical Energy, Storage of Chemical Energy , Storage of Nuclear Energy , Storage of Thermal Energy .

Textbooks:

1. Archie W.Culp , Jr, Principles of Energy Conversion , Tata McGraw –Hill

Reference Books:

1. H.A.Sorenson , *Energy Conversion Systems* , John Willey & sons.
2. Bansal, K.Leeman, Renewable Energy sources & Conversion Technology, & Meliss.

Online Learning Resources:

- https://nptel.ac.in/courses/112/105/112105221/
- **https://ocw.mit.edu/courses/mechanical-engineering/2-60-fundamentals-of-advanced-energy-conversion-spring-2004/**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	FUELS AND COMBUSTION TECHNOLOGY	L	T	P	C
21D11104a	Program Elective Course – II	3	0	0	3
	Semester	I			

Course Objectives: Student will be able

- To learn about types of fuels and their characteristics, and combustion systems with emphasis on engineering applications.

Course Outcomes (CO): Student will be able to

- Ability to characterize the fuels
- Understanding of thermodynamics and kinetics of combustion
- Understand and analyze the combustion mechanisms of various fuels

UNIT - I Lecture Hrs:9

CHARACTERIZATION

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination - Calorific Value - Gross & Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation - Flue gas Analysis - Orsat Apparatus - Fuel & Ash Storage & Handling - Spontaneous Ignition Temperatures.

UNIT - II Lecture Hrs:9

SOLID FUELS & LIQUID FUELS

(a) Solid Fuels

Types - Coal Family - Properties - Calorific Value - ROM, DMMF, DAF and Bone Dry Basis - Ranking - Bulk & Apparent Density - Storage - Washability - Coking & Caking Coals – Renewable Solid Fuels - Biomass - Wood Waste - Agro Fuels - Manufactured Solid Fuels.

(b) Liquid Fuels

Types - Sources - Petroleum Fractions - Classification - Refining - Properties of Liquid Fuels - Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number etc, - Alcohols - Tar Sand Oil - Liquefaction of Solid Fuels.

UNIT - III Lecture Hrs:9

GASEOUS FUELS

Classification - Composition & Properties - Estimation of Calorific Value - Gas Calorimeter. Rich & Lean Gas - Wobbe Index - Natural Gas - Dry & Wet Natural Gas - Stripped NG - Foul & Sweet NG - LPG - LNG - CNG - Methane - Producer Gas - Gasifiers - Water Gas - Town Gas - Coal Gasification - Gasification Efficiency - Non - Thermal Route - Biogas - Digesters - Reactions - Viability - Economics.

UNIT - IV Lecture Hrs:8

COMBUSTION : STOICHIOMETRY & KINETICS

Stoichiometry - Mass Basis & Volume Basis - Excess Air Calculation - Fuel & Flue Gas Compositions - Calculations - Rapid Methods - Combustion Processes - Stationary Flame - Surface or Flameless Combustion - Submerged Combustion - Pulsating & Slow Combustion Explosive Combustion. Mechanism of Combustion - Ignition & Ignition Energy - Spontaneous Combustion – Flame Propagation - Solid, Liquid & Gaseous Fuels Combustion - Flame Temperature - Theoretical, Adiabatic & Actual - Ignition Limits - Limits of Inflammability.

UNIT - V Lecture Hrs:8

COMBUSTION EQUIPMENTS

Coal Burning Equipments - Types - Pulverized Coal Firing - Fluidized Bed Firing - Fixed Bed & Recycled Bed - Cyclone Firing - Spreader Stokers - Vibrating Grate Stokers - Sprinkler Stokers, Traveling Grate Stokers. Oil Burners - Vaporizing Burners, Atomizing Burners - Design of Burners. Gas Burners - Atmospheric Gas Burners - Air Aspiration Gas Burners - Burners Classification according to Flame Structures - Factors Affecting Burners & Combustion.

Textbooks:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Longman, 1990
2. Bhatt, Vora Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1984
3. Blokh AG,Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corpn, 1988.

Reference Books:

1. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966
2. Sharma SP, Mohan Chander, Fuels & Combustion, Tata Mcgraw Hill, 1984

Online Learning Resources:

1. https://nptel.ac.in/content/syllabus_pdf/112106299.pdf
2. https://nptel.ac.in/courses/103/105/103105110/

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	INSTRUMENTATION FOR THERMAL	L	T	P	C
21D11104b	ENGINEERING (PE-II)	3	0	0	3
Semester		I			

Course Objectives: Student will be able

- To provide knowledge on various measuring instruments.
- To provide knowledge on advance measurement techniques.
- To understand the various steps involved in error analysis and uncertainty analysis.

Course Outcomes (CO): Student will be able to

- Knowledge of field instrumentations
- Dynamic modeling and system behavior study
- Design of controllers • Application of control systems in processes

UNIT - I	MEASURMENT CHARACTERISTICS	Lecture Hrs:8

Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

UNIT - II	MICROPROCESSORS AND COMPUTERS IN MEASURMENT	Lecture Hrs:8

Data logging and acquisition – use of sensors for error reduction, elements of micro computer interfacing, intelligent instruments in use.

UNIT - III	MEASURMENT OF PHYSICAL QUANTITIES	Lecture Hrs:8

Measurement of thermo-physical properties, instruments for measuring temperature, pressure and flow, use of sensors for physical variables.

UNIT - IV	ADVANCE MEASURMENT TECHNIQUES	Lecture Hrs:8

Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, heat flux sensors, Telemetry in measurement.

UNIT - V	MEASURMENT ANALYSERS	Lecture Hrs:8

Orsat apparatus, Gas Analysers, Smoke meters, gas chromatography, spectrometry.

Textbooks:

1. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 1988.
2. Barnery, Intelligent Instrumentation, Prentice Hall of India, 1988.
3. Prebrashensky, V., Measurements and Instrumentation in Heat Engineering, Vol. 1 and 2, MIR Publishers, 1980.

Reference Books:

1. Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw- Hill, New Delhi, 1983.
2. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 1958.
3. Barney, Intelligent Instrumentation, Prentice Hall of India, 1988

Online Learning Resources:

1. www.asme.org/thermal_science, nptel.ac.in
2. https://mech.at.ua/HolmanICS.pdf

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	REFRIGERATION AND CRYOGENICS Program Elective Course – II	L	T	P	C
21D11104c		3	0	0	3
Semester		I			

Course Objectives: Student will be able to

- Study about the history and applications of cryogenic engineering, properties of cryogenic liquids and solids, refrigeration technologies, air liquefaction process, industrial gas separation and purification system, low power cryo coolers, adiabatic and vacuum technologies, cryogenic liquid storage and transportation , as well as cryogenic measurements
- To understand different refrigeration systems and their applications.
- Introduce cryogenics and its applications

Course Outcomes (CO): Student will be able to

- Introduce the working principles of three basic methods to achieve low temperature by using adiabatic expansion, provide a thorough understanding of applications of classical thermodynamics to different cryogenic technologies, gas separation and purification system, and low power cryocoolers
- Understand the structures of different cryogenic systems and the analytical method for cryogenic thermodynamic cycle, and cryogenic gases and liquids and their mixtures
- Understand the measurement equipment and basic experimental skills, in particular of cryogenic heat transfer, superconducting magnetic levitation, as well as low power cryocoolers
- Provide design experiences for practical cryogenic systems requiring significant consideration of thermodynamics cycles

UNIT - I		Lecture Hrs:9

VAPOUR COMPRESSION REFRIGERATION SYSTEMS:
Analysis of vapour compression refrigeration cycle – effect of suction temperature and condensing temperature on cycle performance – actual refrigeration cycle – effect of sub cooling the liquid – the effect of super heating the suction vapour- the effect of wet suction.

UNIT - II		Lecture Hrs:9

COMPOUND VAPOUR COMPRESSION SYSTEM
Removing of flash gas – inter cooling – compound compression ultra water inter cooler- liquid flash cooler – flash inlet cooler.
MULTIPLE EVAPORATOR AND COMPRESSION SYSTEMS
One compressor system – individual compressors – compound compression – cascade systems.

UNIT - III		Lecture Hrs:9

ABSORPTION REFRIGERATION SYSTEMS
Elementary properties of binary mixtures – simple theoretical absorption refrigeration systems – the practical ammonia absorption system- Three fluid absorption systems – the lithium bromide water absorption system.
ABSOPTION SYSTEM WITH MULTIPLE EVOPARATORS
Three fluid absorption systems-the Lithium Bromide water absorption system.

UNIT - IV		Lecture Hrs:9

OTHER REFRIGERATION SYSTEMS:
Steam jet water vapour systems – thermoelectric refrigeration systems – vortex refrigeration system – pulse tube refrigeration.

UNIT - V	**REFRIGERANTS and CRYOGENICS**	Lecture Hrs:9

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Desirable properties – designation of refrigerants – inorganic, halo carbon refrigerants – inorganic halo carbon reactions- secondary refrigerants – reaction of refrigerants with moisture and oil – properties of mixtures of refrigerants – ozone depletion potential and global warming potential of CFC refrigerants – substitutes for CFC refrigerants. Cryogenic liquefaction and refrigeration systems- low temperature insulations-typical applications of refrigeration and cryogenics.
Textbooks:
1. C.P. Arora, Refrigeration & Air-Conditioning by , TMH 2. R.F Barron ,Cryogenic Systems , Oxford University Press .
Reference Books:
1. Stoecker W.F.Refrigeration & Air-Conditioning, and Jones, J.W., McGraw Hill 2. Manohar Prasad, Refrigeration & Air-Conditioning , New Age . 3. Domkunduwar, Refrigeration & Air-Conditioning and Arora , Dhanpatrai & Sons
Online Learning Resources:
1. https://nptel.ac.in/courses/112/101/112101004/ 2. https://nptel.ac.in/courses/112/105/112105128/

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	THERMAL SCIENCE LABORATORY	L	T	P	C
21D11105		0	0	4	2
	Semester	I			

Course Objectives: Student will be able

- To become familiar with the instruments and equipment for the measurement of exhaust emissions.
- To become familiar with heat transfer measurement.
- To become familiar with solar parameters.

Course Outcomes (CO):

- Students will be become familiar with the measurement equipments and procedure for exhaust emission, heat transfer and solar parameters

List of Experiments:

1. To find the exhaust emissions of an automobile (HC, CO, NOX) .
2. Analysis of exhaust gases on IC engine.
3. Combustion analysis of CI engine
4. To find Octane number of given blends of fuel.
5. Performance analysis of Heat Pipe
6. Two Phase flow heat transfer estimation.
7. To estimate the COP of a vapour compression refrigeration system (Refrigerator).
8. To find the solar flat plate collector efficiency.
9. To find direct solar incident flux absorbed by using Pyranometer or concentratic parabolic collector.
10. Case study for energy audit.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ENERGY SYSTEMS LABORATORY	L	T	P	C
21D11106		0	0	4	2
	Semester	I			

Course Objectives: Student will be able

- To become familiar with the measurement using heat pipes.
- To become familiar with the measurement of performance of fan and blowers.
- To become familiar with the measurement of the performance of solar plate collectors and fuel cell.

Course Outcomes (CO):

- Students will be become familiar with the measurement equipments and procedure for heat pipes, fans, blowers, and solar plate collectors.
- Evaluate the heat transfer characteristics in conduction, convection and radiation.
- Evaluate the performance of Gas Turbine components.
- Analyze the performance of Solar system

List of Experiments:

1. Heat Pipe Demonstrator: Demonstration of near isothermal characteristics exhibited by a heat pipe in comparison to stainless steel and copper pipes.
2. Double Pipe Heat Exchanger: To determine the LMTD and effectiveness of the double pipe heat exchanger in parallel and counter flow modes.
3. Stefan-Boltzmann Apparatus: Determination of the Stefan-Boltzmann constant and comparison with the theoretical value.
4. Axial flow fan: Constant speed performance test on an axial flow fan.
5. Centrifugal blower: Constant speed performance test on a centrifugal blower.
6. Measurements and Calibration: To calibrate the instruments for the measurement of Torque, Pressure, Flow rate and Velocity.
7. Solar flat plate collectors: Performance evaluation of solar flat plate collectors in natural and forced circulation modes.
8. Parabolic concentric solar collector: Performance evaluation of parabolic concentric solar collector
9. Solar PV Module: ○ Identifying and measuring the parameters of a solar PV Module in the field ○ Series and Parallel connection of PV Modules ○ Estimating the effect of Sun tracking on energy generation by solar PV modules
10. Solar Simulator: ○ Dark and Illuminated Current-Voltage characteristics of solar cell ○ Solar cells connected in series and in parallel ○ Dependence of Solar cell I-V characteristics on light intensity and temperature
11. Fuel Cells: ○ Performance evaluation of DMFC ○ Performance evaluation of PEM fuel cells.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
21DRM101		2	0	0	2
	Semester	I			

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I		Lecture Hrs:

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

UNIT - II		Lecture Hrs:

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.

UNIT - III		Lecture Hrs:

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

UNIT - IV		Lecture Hrs:

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

UNIT - V		

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.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED HEAT AND MASS TRANSFER	L	T	P	C
21D11201		3	0	0	3
	Semester	II			

Course Objectives: Student will be able

- To develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.
- To analyse the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchanges**.**
- To achieve an understanding of the basic concepts of phase change processes and mass transfer.

Course Outcomes (CO): Student will be able to

- On successful completion of this course the student will be able to apply the law of thermodynamics to engines.

UNIT - I Lecture Hrs:9

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.

UNIT - II Lecture Hrs:9

TURBULENT FORCED CONVECTIVE HEAT TRANSFER

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

UNIT - III Lecture Hrs:9

PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER

Condensation with shears edge on bank of tubes - boiling – pool and flow boiling – heat exchanger –Є – NTU approach and design procedure - compact heat exchangers.

UNIT - IV Lecture Hrs:9

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.

UNIT - V Lecture Hrs:9

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.

Textbooks:

1. Yunus A.Cengal, Heat and Mass Transfer – A practical Approach, 3rd edition, Tata McGraw - Hill, 2007.
2. Holman.J.P, Heat Transfer, Tata Mc Graw Hill, 2002.

Reference Books:

3. Ozisik. M.N., Heat Transfer – A Basic Approach, McGraw-Hill Co., 1985
4. Incropera F.P. and DeWitt. D.P., Fundamentals of Heat & Mass Transfer, John Wiley & Sons, 2002.
5. Nag.P.K, Heat Transfer, Tata McGraw-Hill, 2002
6. Ghoshdastidar. P.S., Heat Transfer, Oxford University Press, 2004
7. Yadav, R., Heat and Mass Transfer, Central Publishing House, 1995.

Online Learning Resources:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

- https://nptel.ac.in/courses/112/101/112101097/
- http://dl.iranidata.com/ (J.P. Holman)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED ENERGY TECHNOLOGIES (AET)	L	T	P	C
21D11202		3	0	0	3
	Semester	II			

Course Objectives: Student will be able

- To provide a detailed engineering treatment of various emerging energy technologies, Engineering design, thermodynamic performance, environmental impacts and economic considerations.

Course Outcomes (CO): Student will be able to

- Students understand holistically energy systems, their components and interaction outside the system boundaries. Students understand renewable energy integration into energy systems. Students understand economics of energy systems and basics of energy markets. Students are able to develop and calculate example cases related to renewable energy and its integration into energy systems.

UNIT - I — Lecture Hrs:9

HIGH PRESSURE BOILERS

Introduction , Advantages of High Pressure Boilers, LaMont Boiler , Benson Boiler, Loeffler Boiler , Supercharged Boilers , Waste Heat Boilers , Corrosion in Boilers and its Prevention , Causes of Boiler Tube Failures and Prevention

UNIT - II — Lecture Hrs:9

FLUIDIZED BED COMBUSTION (FBC)

Introduction , Principle of FBC , Types of FBC , FBC for low grade fuels , Corrosion of FBC system , Control of FBC system , Starting of Fluid-Bed Firing system.
Erosion and Corrosion and its prevention in FBC Boilers , Advantages of Fluidized Bed Systems

UNIT - III — Lecture Hrs:9

COMBINED CYCLE TECHNOLOGY

Introduction , Arrangement of Combined Cycles , Combined Cycle with Gas Production from coal , Combined cycles using PFBC system.
Optimum design of Gas Turbine Unit for Combined cycle plant , Advantages of Combined Cycle , Performance of Combined Cycle , Economics of Combined Cycle

UNIT - IV — Lecture Hrs:9

COGENERATION

Concepts, Types of Co generating Systems , Performance Evaluation of Co generating System

UNIT - V — Lecture Hrs:9

WASTE HEAT RECOVERY SYSTEM

Introduction, Sources of Waste Heat and their Grading, Thermodynamic Cycles for Waste Heat Recovery. Heat Recovery Forms and Methods , Other Uses of Heat , Heat Pump Systems , Different Wastes for Power Generation .

Textbooks:

1. .S.Rao &B.B. Parulekar, *Energy Technology* Khanna Publishers

Reference Books:

1. D.A. Reay, Waste heat recovery systems, Pergmon Press
2. Arora and Domukundwar, Power Plant Engineering, Dhanapat Rai & Co.,

Online Learning Resources:

- https://nptel.ac.in/courses/112/103/112103277/
- https://nptel.ac.in/courses/112/107/112107291/

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ENERGY AUDITING AND MANAGEMENT (EAM)	L	T	P	C
21D11203a	Program Elective Course – III	3	0	0	3
	Semester	II			

Course Objectives: Student will be able to

- A growing worldwide concern for conservation of energy has reawakened interest in ecologically sustainability, processes and sources of energy.
- Understand different types of industries are consisted of various energy intensive processes. Hence, Energy efficiency and energy conservation in industries are as important as finding new energy sources.

Course Outcomes (CO): Student will be able to

- This course is designed to aware the students concerning various energy intensive process in different industries and to find out the energy conservation opportunities.
- Understand various methods of energy management and energy auditing on the site are also incorporated.

UNIT - I Lecture Hrs:9

ENERGY CONSERVATION

Rules for efficient energy conservation, Technologies for energy conservation, Load management, Energy use patterns, Necessary steps of energy management programme, Concepts of energy management, General principles of energy management, Energy management in manufacturing and process industries – Qualities and functions of energy managers

UNIT - II Lecture Hrs:9

ENERGY AUDITING

Definition &objectives, level of responsibility, Control of energy, Check lists, Energy conservation schemes, Energy index, Cost index, Pie charts, Sankey diagrams, Load profiles.

Types of energy audits – Questionnaire ,Energy audit of industries, General energy audit , Detailed energy audit ,Energy saving potential

UNIT - III Lecture Hrs:9

THERMAL INSULATION & REFRACTORS

Heat loss through un insulated surfaces effect of insulation on current carrying wires- economic thickness of insulation – critical radius of insulation –properties of thermal insulators – classification of insulation materials.

classification of refractors – properties of refractors- criteria of good refractory material – applications of insulating & refractory materials.

UNIT - IV Lecture Hrs:9

ENGINEERING ECONOMICS

Steps in planning- efficiency of organization – capital budgeting – classification of cost– interest- types – time value of money – cash flow diagrams – present worth factor, capital recovery factor, equal annual payments – nominal and effective interest rates- discrete and continuous compounding- equivalent between cash flows.

PROJECT MANAGEMENT

Method of investment appraisal – rate of return method, pay back method, net present value method(NPV) – adoption of the methods in energy conservation campaign – types of projects – types of budgets –propose of project management – managerial objectives – Classification – role and qualities of project manager – budget committee – budgeting – capital budgeting

UNIT - V Lecture Hrs:9

ENERGY CONSERVATION IN ELECTRIC UTILITY

Energy conservation in utility by improving load factor, Load curve analysis, Energy efficient motors, Energy conservation in illumination systems, Importance of Power factor in energy conservation - Power factor improvement method

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Textbooks:
1. W.R. Murphy & G. Mickay, Energy Management, Butterworths 2. P.W.O' Callghan, Energy Conservation, Pargamon Press 1981
Reference Books:
1. D.A. Reay, Waste heat recovery systems, Pergmon Press 2. Albert Thumann, Hand book of energy audits- 3. Craig B. Smithm, Energy Management Prinicples,Pergarmon Press 4. S.C.Tripathy, "Electric Energy Utilization and onservation", TMGDelhi,1991
Online Learning Resources:
• https://nptel.ac.in/courses/112/105/112105221/ • https://iare.ac.in/sites/default/files/iare_EAM_lecture%20notes.pdf

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	MODELING AND ANALYSIS OF ENERGY SYSTEMS	L	T	P	C
21D11203b	Program Elective Course – III	3	0	0	3
	Semester	II			

Course Objectives: Student will be able to

- Give an introduction to effective modeling methods applicable for assessing the dynamic behaviors of complex systems for energy supply and conversion.

Course Outcomes (CO): Student will be able to

- Assess the capabilities and limitations of various modeling methods.
- Apply innovative modeling and simulation to solve complex multi-disciplinary energy system problems individually and in teams.
- Demonstrate knowledge and comprehension of theoretical principles and operational skills underlying modeling programs.

UNIT - I Lecture Hrs:9

INTRODUCTION:
Overview of various technologies and conventional methods of energy conversion, Designing a Workable System: Workable and optimum systems, Steps in arriving a workable system, Creativity in concept selection, Workable Vs Optimum system

EQUATION FITTING:
Mathematical modeling, Polynomial representation, Functions of two variables, Exponential forms, Best fit Method of least squares

UNIT - II Lecture Hrs:9

MODELING OF THERMAL EQUIPMENT:
Counter flow heat exchanger, Evaporators and Condensers, Heat exchanger effectiveness, Effectiveness of a counter flow heat exchanger, NTU, Pressure drop and pumping power

SYSTEM SIMULATION:
Classes of simulation, Information flow diagrams, Sequential and simultaneous calculations, Successive substitution, Newton Raphson method

UNIT - III Lecture Hrs:9

OPTIMIZATION TECHNIQUES:
Mathematical representation of optimization problems, A water chilling system, Optimization procedure, Setting up the mathematical statement of the optimization problem, Dynamic Programming: Characteristic of the Dynamic programming solution, Apparently constrained problem, Application of Dynamic programming to energy system problems, Geometric Programming: One independent variable unconstrained, Multivariable optimization, Constrained optimization with zero degree of difficulty ,Linear Programming: Simplex method, Big-M method, Application of LP to thermal systems

UNIT - IV Lecture Hrs:9

LAGRANGE MULTIPLIER'S METHOD: The Lagrange multiplier equations, Unconstrained optimization, Constrained optimization, Sensitivity coefficients

UNIT - V Lecture Hrs:9

SEARCH METHODS: Single variable – Exhaustive, Dichotomous and Fibonacci, Multivariable unconstrained - Lattice, Univariable and Steepest ascent

MATHEMATICAL MODELING:
Thermodynamic properties-Need for mathematical modeling, Criteria for fidelity of representation, Linear regression analysis, Internal energy and enthalpy, Pressure temperature relationship at saturated conditions, Specific heat, P-V-T equations

Textbooks:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

1) W.F.Stoecker (1989), *"Design of Thermal Systems"* McGraw Hill, 3rd Ed.
2) B.K.Hodg(1990), *"Analysis and Design of Thermal Systems",*Prentice Hall Inc.,.

Reference Books:

3) I.J.Nagrath & M.Gopal, *"Systems Modelling and Analysis",* Tata McGraw Hill.
4) D.J. Wide(1978), *"Globally Optimal Design",* Wiley- Interscience,

Online Learning Resources:

https://www.researchgate.net/publication/332109240_Design_of_thermal_systems

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	OPTIMIZATION TECHNIQUES AND ITS	L	T	P	C
21D11203c	APPLICATIONS (PE-III)	3	0	0	3
	Semester	II			

Course Objectives: Student will be able

- To introduce the fundamental concepts of Optimization Techniques;
- To make the learners aware of the importance of optimizations in real scenarios.
- To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.

Course Outcomes (CO): Student will be able to

- Formulate optimization problems;
- Understand and apply the concept of optimality criteria for various type of optimization problems.
- Solve various constrained and unconstrained problems in single variable as well as multivariable
- Apply the methods of optimization in real life situation.

UNIT - I Lecture Hrs:9

Introduction: Engineering Applications of optimization- statement of an optimization problem – Classification of optimization problems.

Single Variable Non-Linear Unconstrained Optimization: One dimensional Optimization methods:- Uni-modal function, elimination methods, Fibonacci method, golden section method, interpolation methods – quadratic and cubic interpolation methods.

UNIT - II Lecture Hrs:9

Multi variable non-linear unconstrained optimization: Direct search method – Univariant method - pattern search methods – Powell's- Hook -Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

Linear Programming – Graphical method-Simplex method- Dual simplex method-Revised simplex method- Parametric linear programming- Goal Programming

Simulation- types of simulations- Applications of simulations to inventory, queuing and thermal systems.

UNIT - III Lecture Hrs:9

Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

UNIT - IV Lecture Hrs:9

Stochastic Programming: Basic concepts of probability theory, random variables- distributions- mean, variance, correlation, co variance, joint probability distribution- stochastic linear, dynamic programming.

Geometric Programming: Posynomials – arithmetic - geometric inequality – unconstrained G.P-constrained G.P

UNIT - V Lecture Hrs:8

Non Traditional Optimization Algorithms: Genetics Algorithm-Working Principles, Similarities and Differences between Genetic Algorithm and Traditional Methods. Simulated Annealing-Working Principle-Simple Problems. Application in production problems.

Textbooks:

1. Optimization theory and Applications,S.S.Rao,New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

Reference Books:

1. Operations Research, S.D.Sharma,
2. Operation Research, H.A.Taha ,TMH
3. Optimization in operations research, R.LRardin

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

4. Optimization Techniques, Belagundu & Chandraputla, Pearson Asia.
5. Optimization Techniques theory and practice, M.C.Joshi, K.M.Moudgalya, Narosa Publications

Online Learning Resources:

- https://nptel.ac.in/courses/112/101/112101298/
- https://downloads.hindawi.com/journals/specialissues/893072.pdf

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
21D11204a	Program Elective Course – IV	3	0	0	3
	Semester	II			

Course Objectives: Student will be able

- To develop finite difference and finite volume discredited forms of the CFD equations.
- To formulate explicit & implicit algorithms for solving the Euler Eqns & Navier Stokes Eqns.

Course Outcomes (CO): Student will be able to

- Understand solution of aerodynamic flows. Appraise & compare current CFD software. Simplify flow problems and solve them exactly Define and setup flow problem properly within CFD context, performing solid modelling using CAD package and producing grids via meshing tool Understand both flow physics and mathematical properties of governing Navier-Stokes equations and define proper boundary conditions for solution Use CFD software to model relevant engineering flow problems. Analyse the CFD results. Compare with available data, and discuss the findings

UNIT - I Lecture Hrs:9

GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD

Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT - II Lecture Hrs:9

CONDUCTION HEAT TRANSFER

Steady one-dimensional conduction, Two and Three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

UNIT - III Lecture Hrs:9

INCOMPRESSIBLE FLUID FLOW

Governing Equations, Stream Function – Verticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and spalding, Computation of Boundary layer flow, Finite difference approach.

UNIT - IV Lecture Hrs:9

CONVECTION HEAT TRANSFER AND FEM

Steady One-Dimensional and Two-Dimensional Convection – Diffusion, Unsteady one-dimensional convection – Diffusion, Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – Solution of steady heat conduction by FEM – Incompressible flow – Simulation by FEM.

UNIT - V Lecture Hrs:9

TURBULENCE MODELS

Algebraic Models – One equation model, K - Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes

Textbooks:

1. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
2. Ghoshdasdidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw Hill Publishing Company Ltd., 1998.

Reference Books:

1. Subas, V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980.
2. Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier Stock Equation",

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Pineridge Press Limited, U.K., 1981.
3. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanic and Heat Transfer " Hemisphere Publishing Corporation, Newyork, USA, 1984.
4. Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics 1" Fundamental and General Techniques, Springer – Verlag, 1987.
5. Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics 2" Specific Techniques for Different Flow Categories, Springer – Verlag, 1987.
6. Bose, T.X., "Numerical Fluid Dynamics" Narosa Publishing House, 1997.

Online Learning Resources:

- https://nptel.ac.in/courses/112/107/112107079/
- https://www.cfd-online.com/Links/education.html

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	DESIGN OF HEAT TRANSFER EQUIPMENT	L	T	P	C
21D11204b	Program Elective Course – IV	3	0	0	3
Semester		II			

Course Objectives: Student will be able

- To learn the basics and advanced concepts of heat transfer and design methodologies involved in various types of heat transfer devices.

Course Outcomes (CO): Student will be able to

- Understanding of various types of heat transfer process and devices
- Ability to analyze and select the heat transfer device
- Ability to solve the problems of heat transfer related to nano-fluids, micro-channels and heat pipes
- Ability to use software tools for solving heat transfer problems

UNIT - I Lecture Hrs:9

DESIGN OF HEAT EXCHANGERS
Heat Exchangers-mean temperature differences for parallel and counter flow- effectiveness method (NTU).
DESGIN OF CONDERSERS
Overall heat transfer co-efficient –temperature distribution and heat flow in a condenser-pressure drop in a condenser-extended fin surfaces-consideration of fouling factors-LMTD correction factor.

UNIT - II Lecture Hrs:9

DESIGN OF EVOPORATORS
Temperature distribution and heat flow in an evaporator – pressure drop-factor to be consider in the design of heat transfer equipment – types of heat consideration of fouling factor-correction factor.
DESIGN OF COMPRESSORS
Types – equivalent shaft work- volume metric efficiency- factors affection total volume metric efficiency – compound compression with inter cooling – rotary compressors surging.

UNIT - III Lecture Hrs:9

DESIGN OF COOLING TOWERS AND SPRAY PONDS
Classification-performance of cooling towers-analysis of counter flow cooling towers – enthalpy – temperature diagram of air and water- cooling ponds- types of cooling ponds- cross flow cooling towers – procedure for calculation of outlet conditions

UNIT - IV Lecture Hrs:9

DESIGN OF DUCTS
Continuity equation – Bernoulli's equation – pressure losses – frictional charts – co efficient of resistance for fillings – duct sizing methods.
DESIGN OF FANS
Standard air –fan horse power – fan efficiency – similarity laws-fan laws – performance co efficient – theoretical expressions for total pressure drop by a fan- centrifugal fan- axial flow fan – system resistance.

UNIT - V Lecture Hrs:8

PIPING SYSTEM
Requirements of a good piping system- pressure drop in pipe-Moody chart-
refrigerant piping – discharge line- liquid line-suction line – piping arrangement

Textbooks:

1. Heat and Mass Transfer by - Arora and Domkundwar.
2. Refrigeration and Air conditioning – PL Ballaney.

Reference Books:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

3. Refrigeration and Air conditioning – CP Arora.
4. Refrigeration and Air conditioning- Stoecker.

Online Learning Resources:

https://www.researchgate.net/publication/332109240_Design_of_thermal_systems

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED IC ENGINES	L	T	P	C
21D11204c	Program Elective Course – IV	3	0	0	3
	Semester	II			

Course Objectives:

- The course aims to develop the students with the knowledge about the advanced theory and working of I.C engines and the phenomena of combustion and modelling.

Course Outcomes (CO): Student will be able to

- Explain the various working cycles of engine
- Describe the various types of combustion in IC engines.
- Illustrate the engine combustion parameters.
- Describe the different types of modern engines.
- Explain the modern electronic engine management system (EMS) of I.C engines.

UNIT - I	Lecture Hrs:9

COMBUSTION IN SPARK IGNITION ENGINES

Spark ignition Engine mixture requirements – Fuel – Injection systems – Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and abnormal combustion – factors affecting knock – Combustion chambers.

UNIT - II	Lecture Hrs:9

COMBUSTION IN COMPRESSION IGNITION ENGINES

States of combustion in C.I. Engine – Direct and indirect injection systems – Combustion chambers – Fuel spray behaviour – spray structure, spray penetration and evaporation – air motion – Introduction to Turbo charging.

UNIT - III	Lecture Hrs:9

POLLUTANT FORMATION AND CONTROL

Pollutant – Sources – Formation of carbon monoxide, Unburnt hydrocarbon, NOx, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters and Particulate Traps – Methods of measurements and Introduction to emission norms and Driving cycles.

UNIT - IV	Lecture Hrs:9

ALTERNATIVE FUELS

Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas- Properties, Suitability, Merits and Demerits as fuels, Engine Modifications.

UNIT - V	Lecture Hrs:9

RECENT TRENDS

Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition engines – Plasma Ignition – Measurement techniques – laser Doppler, Anemometry.

Textbooks:

1. K.K. Ramalingam, Internal Combustion Engine Fundamentals, Scitech Publications, 2002.
2. R.B.Mathur and R.P. Sharma, Internal combustion Engines

Reference Books:

1. V. Ganesan, Int. Combustion Engines, II Edition, TMH, 2002.
2. Duffy Smith, auto fuel Systems, The Good Heart Willox Company, Inc., 198
3. Edward Frederic Obert , Internal Combustion Engines and Air Pollution

Online Learning Resources:

- https://nptel.ac.in/courses/112/103/112103262/

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED HEAT AND MASS TRANSFER LABORATORY	L	T	P	C
21D11205		0	0	4	2
	Semester	II			

Course Objectives: Student will be able

- To become familiar with the instruments and equipment for the measurement of thermal conductivity, heat transfer coefficient and other heat transfer parameters.

Course Outcomes (CO):

- Students will be become familiar with the measurement equipments and procedure for the measurement of thermal conductivity, heat transfer coefficient and other heat transfer parameters.

List of Experiments:

1. Thermal conductivity of insulating powder material through Concentric Sphere apparatus.
2. Thermal conductivity of insulating material through lagged pipe apparatus
3. Overall heat transfer co-efficient through Composite Slab Apparatus
4. Thermal Conductivity of metal (conductor).
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer coefficient in forced convection.
8. Heat transfer coefficient in natural convection
9. Experiment on Parallel and counter flow heat exchanger.
10. Emissivity of a gray body through Emissivity apparatus.
11. Experiment on Stefan Boltzman Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Experiment on Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.
15. Study of Two – Phase flow

References:

Online learning resources/Virtual labs:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ENERGY UTILIZATION LABORATORY	L	T	P	C
21D11206		0	0	4	2
	Semester	II			

Course Objectives: Students able to

- Understand Alternative Energy Sources
- Estimate Energy Saving by Solar water Heating ,Discharge of Centrifugal Pump
- Calculate Flat plate Collector requirements
- Study Biomass plant ,Bio- Gasifier
- Understand of Solar Cocker.

Course Outcomes (CO):

- Conduct Survey Alternative Energy Sources
- Calculate Energy Saving by Solar water Heating ,Discharge of Centrifugal Pump
- Calculate Flat plate Collector requirements
- Modelling of Biomass plant ,Bio- Gasifier
- Understand of Solar Cocker.

List of Experiments:

1. Survey of alternative Energy Sources
2. Estimation of energy Saving by Solar Water Heating
3. Flat-Plate Collector Requirement Calculations
4. Estimation of Discharge of Centrifugal pump using Solar Power
5. Demonstration of Wind Tunnel
6. Study of Biomass plant
7. Study of Bio-Gasifier
8. Performance of Solar Cocker

References:

Online learning resources/Virtual labs:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	SOLAR PASSIVE ARCHITECTURE	L	T	P	C
21D11301a	Program Elective Course – V	3	0	0	3
	Semester	III			

Course Objectives: Student will be able to

- Provide an understanding of the concept of reduction in energy consumption through low energy building design. It will highlight strategies to integrate daylighting and low energy heating/cooling in buildings.

Course Outcomes (CO): Student will be able to

- Have acquired an understanding of the concept and theoretical background of low energy building design.
- Be able to demonstrate their learning about use of simulation tools to achieve energy efficiency.

UNIT - I Lecture Hrs:9

Introduction

Introduction to architecture; Architecture as the art of science of designing buildings; Building science and its significance; Energy management concept in building

Thermal Analysis And Design For Human Comfort

Thermal comfort; Criteria and various parameters; Psychometric chart; Thermal indices, climate and comfort zones; Concept of sol-air temperature and its significance; Calculation of instantaneous heat gain through building envelope; Calculation of solar radiation on buildings; building orientation.

Introduction to design of shading devices; Overhangs; Factors that effects energy use in buildings; Ventilation and its significance; Air-conditioning systems; Energy conservation techniques in air-conditioning systems

UNIT - II Lecture Hrs:9

Passive Cooling And Heating Concepts

Passive heating concepts: Direct heat gain, indirect heat gain, isolated gain and sunspaces.

Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel.

UNIT - III Lecture Hrs:9

Heat Transmission In Buildings

Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag.

Design of daylighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.

UNIT - IV Lecture Hrs:9

Bioclimatic Classification

Bioclimatic classification of India; Passive concepts appropriate for the various climatic zones in India; Typical design of selected buildings in various climatic zones; Thumb rules for design of buildings and building codes.

UNIT - V Lecture Hrs:9

Energy Efficient Landscape Design

Modification of microclimatic through landscape element for energy conservation; Energy conservation through site selection, planning, and design; Siting and orientation

Textbooks:

1. M.S.Sodha, N.K. Bansal, P.K. Bansal, A. Kumar and M.A.S. Malik(1986), Solar Passive Building, Science and Design, Pergamon Press,.

2. J.R. Williams(1983), Passive Solar Heating, Ann Arbar Science,

Reference Books:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

1. R.W.Jones, J.D. Balcomb, C.E. Kosiewiez, G.S. Lazarus, R.D. McFarland and W.O.Wray(1982), Passive Solar Design Handbook, Vol. 3, Report of U.S. Department of Energy(DOE/CS-0127/3),.
2. J Krieder and A Rabi (1994), Heating and Cooling of Buildings : Design for Efficiency, McGraw-Hill
3. 3.R D Brwon, T J Gillespie (1990), Microclimatic Landscape Design, John Wiley & Sons, NewYork,
4. D.S. Lal(2003), Climatology, Sharda Pustak Bhawan, Allahabad,
5. Majumder Milli, Energy Efficient Buildings, TERI, New Delhi
6. T A Markus, E N Morris(1980)Building, Climate and Energy, Spott woode Ballantype Ltd.London,
7. Sanjay Prakash (et al.)(1991), Solar architecture and earth construction in the
8. NorthWest Himalaya, Vikas, New Delhi,

Online Learning Resources:

- https://pdhonline.com/courses/e274/e274_new.htm

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED POWER PLANT ENGINEERING	L	T	P	C
21D11301b	Program Elective Course – V	3	0	0	3
	Semester	III			

Course Objectives: Student will be able

- To make the students to understand the energy scenario and the environmental issues related to the power plants
- Creating awareness to the students on the various utilities in the power plants and the avenues for optimizing them

Course Outcomes (CO): Student will be able to

- Possible mitigation of anthropogenic emissions by optimizing the power plant cycles/utilities

UNIT - I Lecture Hrs:9

INTRODUCTION

Overview of Indian power sector – load curves for various applications – types of power plants – merits and demerits – criteria for comparison and selection - Economics of power plants.

UNIT - II Lecture Hrs:9

STEAM POWER PLANTS

Basics of typical power plant utilities - Boilers, Nozzles, Turbines, Condensers, Cooling Towers, Water Treatment and Piping system - Rankine Cycle – thermodynamic analysis. Cycle improvements – Superheat, Reheat, Regeneration

UNIT - III Lecture Hrs:9

DIESEL AND GAS TURBINE POWER PLANTS

I.C Engine Cycles - Otto, Diesel & Dual –Theoretical vis-a-vis actual – Typical diesel power plant – Types – Components - Layout - Performance analysis and improvement - Combustion in CI engines - E.C cycles – Gas turbine & Stirling - Gas turbine cycles – thermodynamic analysis – cycle improvements - Intercoolers, Re heaters, regenerators.

UNIT - IV Lecture Hrs:9

ADVANCED POWER CYCLES

Cogeneration systems – topping & bottoming cycles - Performance indices of cogeneration systems – Heat to power ratio - Thermodynamic performance of steam turbine cogeneration systems – gas turbine cogeneration systems – reciprocating IC engines cogeneration systems- Binary Cycle - Combined cycle – IGCC – AFBC / PFBC cycles – Thermionic steam power plant. MHD – Open cycle and closed cycle- Hybrid MHD & steam power plants

UNIT - V Lecture Hrs:9

HYDROELECTRIC & NUCLEAR POWER PLANTS

Hydroelectric Power plants – classifications - essential elements – pumped storage systems – micro and mini hydel power plants General aspects of Nuclear Engineering – Components of nuclear power plants - Nuclear reactors & types – PWR, BWR, CANDU, Gas Cooled, Liquid Metal Cooled and Breeder reactor - nuclear safety – Environmental issues

Textbooks:

1.. Nag, P.K., Power Plant Engineering, Tata Mcgraw Hill Publishing Co Ltd, New Delhi, 1998.
2. Arora and Domkundwar, A course in power Plant Engineering, Dhanpat Rai and CO, 2004.

Reference Books:

3. Haywood, R.W., Analysis of Engineering Cycles, 4th Edition, Pergamon Press, Oxford, 1991.
4. Wood, A.J., Wollenberg, B.F., Power Generation, operation and control, John Wiley, New York,1984.
5. Gill, A.B., Power Plant Performance, Butterworths, 1984.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

6. Lamarsh, J.R., Introduction to Nuclear Engg.2nd edition, Addison-Wesley, 1983.

Online Learning Resources:

https://nptel.ac.in/courses/112/103/112103262/
https://nptel.ac.in/content/storage2/courses/112104033/pdf_lecture/lecture39.pdf

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	COGENERATION AND WASTE HEAT RECOVERY SYSTEMS (PE-V)	L	T	P	C
21D11301c		3	0	0	3
	Semester	**III**			

Course Objectives: Student will be able to

- To analyze the basic energy generation cycles
- To detail about the concept of cogeneration, its types and probable areas of applications
- To study the significance of waste heat recovery systems and carry out its economic analysis

Course Outcomes (CO): Student will be able to

- The student can identify different areas of Cogeneration & Waste Heat Recovery Systems.
- Can find the applications of all the areas in day to day life.

UNIT - I Lecture Hrs:9

INTRODUCTION

Introduction – principles of thermodynamics – cycles – topping – bottoming – combined cycle – organic rankine cycles – performance indices of cogeneration systems – waste heat recovery – sources and types – concept of tri generation.

UNIT - II Lecture Hrs:9

CONGENERATION TECHNOLOGIES

Configuration and thermodynamic performance – steam turbine congeneration systems – gas turbine cogeneration systems – reciprocating IC engines cogeneration systems – combined cycles cogeneration systems – advanced cogeneration systems: fuel cell, Stirling engines etc.,

UNIT - III Lecture Hrs:9

ISSUES AND APPLICATIONS OF COGENERATION TECHNOLOGIES

Cogeneration plants electrical interconnection issues – utility and cogeneration plant interconnection issues – applications of cogeneration in utility sector – industrial sector – building sector – rural sector – impacts of cogeneration plants – fuel, electricity and environment.

UNIT - IV Lecture Hrs:9

WASTE HEAT RECOVERY SYSTEMS

Selection criteria for waste heat recovery technologies – recuperators – Regenerators – economizers – plate heat exchangers – thermic fluid heaters – Waste heat boilers – classification, location, service conditions, design Considerations – fluidized bed heat exchangers – heat pipe exchangers – heat pumps – sorption systems.

UNIT - V Lecture Hrs:9

ECONOMIC ANALYSIS

Investment cost – economic concepts – measures of economic performance – procedure for economic analysis – examples – procedure for optimized system selection and design – load curves – sensitivity analysis – regulatory and financial frame work for cogeneration and waste heat recovery systems.

Textbooks:

1. Charles H. Butler, Cogeneration, McGraw Hill Book Co., 1984.11
2. EDUCOGEN – The European Educational tool for cogeneration, Second Edition, 2001

Reference Books:

1. Horlock JH, Cogeneration - Heat and Power, Thermodynamics and Economics, Oxford,1987.
2. Institute of Fuel, London, Waste Heat Recovery, Chapman & Hall Publishers, London, 1963.
3. Seagate Subrata, Lee SS EDS, Waste Heat Utilization and Management, Hemisphere, Washington, 1983.
4. De Nevers, Noel., Air Pollution Control Engineering, McGrawHill, New York,1995

Online Learning Resources:

https://nptel.ac.in/courses/112/105/112105221/

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

AUDIT COURSE-I

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I	Lecture Hrs:10
1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity	
UNIT - II	Lecture Hrs:10
Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization	
UNIT - III	Lecture Hrs:10
Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.	
UNIT - IV	Lecture Hrs:9
Key skills needed for writing a Title, Abstract, and Introduction	
UNIT - V	Lecture Hrs:9
Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions	

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
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'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	**I**			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluatedisasterriskreduction and humanitarian response policy and practice from
- Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.
Disaster Prone Areas in India:
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics

UNIT - II

Repercussions of Disasters and Hazards:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies
2. "'New Royal book Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHall OfIndia, New Delhi.
3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	**SANSKRITFOR TECHNICAL KNOWLEDGE**	**L**	**T**	**P**	**C**
21DAC101c		**2**	**0**	**0**	**0**
	Semester	**I**			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I
Alphabets in Sanskrit,
UNIT - II
Past/Present/Future Tense, Simple Sentences
UNIT - III
Order, Introduction of roots
UNIT - IV
Technical information about Sanskrit Literature
UNIT - V
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

AUDIT COURSE-II

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

- Students will be able to understand:
- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what
- conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions. Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head
teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections:Researchdesign,Contexts,Pedagogy,Teachereducation, Curriculum and assessment, Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof
3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	**STRESSMANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
21DAC201b		**2**	**0**	**0**	**0**
	Semester	**II**			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I		
Definitions of Eight parts of yog.(Ashtanga)		
UNIT - II		
Yam and Niyam.		
UNIT - III		
Do`sand Don't'sin life. i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan		
UNIT - IV		
Asan and Pranayam		
UNIT - V		
i)Variousyogposesand theirbenefitsformind &body ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam		

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE	L	T	P	C
21DAC201c	ENLIGHTENMENTSKILLS	2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1."SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

OPEN ELECTIVE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	BUSINESS ANALYTICS	L	T	P	C
21DOE301c		3	0	0	3
Semester		III			

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

Course Outcomes (CO): Student will be able to

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT - I — Lecture Hrs:

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT - II — Lecture Hrs:

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT - III — Lecture Hrs:

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT - IV — Lecture Hrs:

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT - V — Lecture Hrs:

Recent Trands in: Embedded and colleborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Textbooks:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	**INTERNET OF THINGS (IOT)**	**L**	**T**	**P**	**C**
21DOE301g		**3**	**-**	**-**	**3**
	Semester	**III**			

Course Objectives: Student will be able

- To study fundamental concepts of IoT
- To understand roles of sensors in IoT
- To Learn different protocols used for IoT design
- To be familiar with data handling and analytics tools in IoT
- Appreciate the role of big data, cloud computing and data analytics in a typical IoT system

Course Outcomes (CO): Student will be able to

- Understand the various concepts, terminologies and architecture of IoT systems.
- Use sensors and actuators for design of IoT.
- Understand and apply various protocols for design of IoT systems
- Use various techniques of data storage and analytics in IoT
- Understand various applications of IoT
- Understand APIs to connect IoT related technologies

UNIT – I	Lecture Hrs:09

Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M

UNIT – II	Lecture Hrs: 09

Sensors Networks : Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.

UNIT – III	Lecture Hrs: 09

Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus.
IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols

UNIT – IV	Lecture Hrs: 09

Data Handling& Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications

UNIT - V	Lecture Hrs: 09

Applications of IoT: Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.

Textbooks:

1.Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Wiley Publications
2.Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", WileyPublications
3.Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
4.J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
5.Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

and Test", Application Note, 2016.
Reference Books:
1.Daniel Minoli, — "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publication 2.Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
Online Learning Resources:
https://onlinecourses.nptel.ac.in/noc17_cs22/course http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Course Code	MECHATRONICS	L	T	P	C
21DOE301h		3	0	0	3
	Semester	III			

Course Objectives: Student will be able

- To study fundamental concepts of Signal condition
- To understand the concepts of precision mechanical systems
- To Learn different electronic interface subsystems
- To be familiar with microcontrollers overview.
- To understand the concepts of programmable logic controllers

Course Outcomes (CO): Student will be able to

- Understand the various concepts, terminologies of Signal condition
- Understand the basics electronic interface subsystems
- Understand and apply various precision mechanical systems
- Understand various applications of microcontrollers overview
- Understand the controlling of programmable logic and programmable motion.

UNIT – I	Lecture Hrs:09

INTRODUCTION : Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) - Applications: SPM, Robot, CNC, FMS, CIM.

SIGNAL CONDITIONING : Introduction – Hardware - Digital I/O, Analog input – ADC, resolution , speed channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps – Software - Digital Signal Processing – Low pass , high pass , notch filtering.

UNIT – II	Lecture Hrs: 09

PRECISION MECHANICAL SYSTEMS : Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Harmonic Transmission - Bearings- Motor / Drive Selection.

UNIT – III	Lecture Hrs: 09

ELECTRONIC INTERFACE SUBSYSTEMS : TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isoation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

ELECTROMECHANICAL DRIVES : Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation

UNIT – IV	Lecture Hrs: 09

MICROCONTROLLERS OVERVIEW: 8051 Microcontroller , micro processor structure - DigitalInterfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly , C (LED Blinking , Voltage measurement using ADC).

UNIT - V	Lecture Hrs: 09

PROGRAMMABLE LOGIC CONTROLLERS : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

PROGRAMMABLE MOTION CONTROLLERS : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices :Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive ,

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN THERMAL SCIENCES AND ENERGY SYSTEMS
COURSE STRUCTURE & SYLLABI

Capacitive ,
Textbooks:
1. A text book of Mechatronics by Er.R.K. RAJPUT ., S.CHAND publications 2. A text book of Mechatronics by Nitalgour Premchand Mahalik ., McGraw Hill publications
Reference Books:
1. A text book of Mechatronics by W.Bolton ., Pearson Publications