JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTHAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING
M.Tech (ENERGY SYSTEMS)
(4 SEMESTER COURSE STRUCTURE AND SYLLABUS)

EFFECTIVE FROM THE YEAR 2015-16

I SEMESTER:

Subject Code	SUBJECT	L	P	C
15D32101	Energy Management	4	-	4
15D32102	Direct Energy Conversion Systems	4	-	4
15D32103	Renewable Energy Sources	4	-	4
15D32104	Applied Solar Energy Engineering	4	-	4
	ELECTIVE – I	4	-	4
15D32105	Energy Ecology & Environment			
15D32106	Design of Heat Transfer Equipment			
15D32107	Thermal & Nuclear Power Plants			
15D32108	Rapid Prototyping Technologies			
	ELECTIVE – II	4	-	4
15D32109	Reliability & Safety Engineering			
15D31110	Total Quality Management			
15D32110	Data Acquisition and Processing System			
15D32111	Creativity and Innovations in Design			
15D32112	Energy Utilization Lab	0	4	2
TOTAL		**24**	**4**	**26**

II SEMESTER :

Subject Code	SUBJECT	L	P	C
15D32201	Energy Conservation and Audit	4	-	4
15D32202	Waste Heat Recovery Systems	4	-	4
15D32203	Energy Efficient Electrical Systems	4	-	4
15D32204	Design of Wind Energy Systems	4	-	4
	ELECTIVE – III	4	-	4
15D32205	Optimization of Engineering Design			
15D32206	Refractory Systems			
15D32207	Solar Refrigeration & Air Conditioning			
15D32208	Product Planning and Marketing			
	ELECTIVE – IV	4	-	4
15D32209	Concurrent Engineering			
15D32210	Reverse engineering			
15D32211	Energy Resources			
15D32212	Maintenance Management			
15D54201	Research Methodology (Audit Course)	3	-	-
15D32213	Energy Operations Lab	0	4	2
TOTAL		**24**	**4**	**26**

Code	Subject	T	P	C
15D32301	**III Semester Seminar - I**	**0**	**4**	**2**
15D32401	**IV Semister Seminar - II**	**0**	**4**	**2**
15D32302	**III & IV Semester Project Work**	**--**	**--**	**44**
	Total	**24**	**8**	**48**

Note : All End Examinations (Theory and Practical) are of Three Hours Duration.

T – Tutorial L – Theory P- Practical / Drawing C - Credits

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2015-16

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DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech (ENERGY SYSTEMS)
(I SEMESTER COURSE STRUCTURE AND SYLLABUS)

EFFECTIVE FROM THE YEAR 2015-16

I SEMESTER :

Subject Code	**SUBJECT**	**L**	**P**	**C**
15D32101	Energy Management	4	-	4
15D32102	Direct Energy Conversion Systems	4	-	4
15D32103	Renewable Energy Sources	4	-	4
15D32104	Applied Solar Energy Engineering	4	-	4
	ELECTIVE – I	4	-	4
15D32105	Energy Ecology & Environment			
15D32106	Design of Heat Transfer Equipment			
15D32107	Thermal & Nuclear Power Plants			
15D32108	Rapid Prototyping Technologies			
	ELECTIVE – II	4	-	4
15D32109	Reliability & Safety Engineering			
15D31110	Total Quality Management			
15D32110	Data Acquisition and Processing System			
15D32111	Creativity and Innovations in Design			
15D32112	Energy Utilization Lab	0	4	2
TOTAL		**24**	**4**	**26**

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

I- SEMESTER **L P C**

4 - 4

ENERGY MANAGEMENT
(15D32101)

UNIT - I

ENGINEERING ECONOMICS:

Managerial objectives - steps in planning- Capital budgeting- Classification of costs- Interest- Types- Nominal and effective interest rates Discrete and continuous compounding - discounting - Time value of money - Cash flow diagrams - Present worth factor, Capital recovery factor, Equal annual payments - Equivalence between cash flows.

UNIT - II

DEPRECIATION & COST ANALYSIS:

Aims-Physical depreciation-Functional depreciation- Methods of depreciation-Straight line method, Declining balance method, Sum of years digits method, Sinking fund method, Service output method- Capital recovery with return-Service life estimation- Morality curves. Break even analysis and break even chart- Minimum cost analysis- Benefit cost analysis- Life cycle cost analysis.

UNIT - III

PROJECT MANAGEMENT:

Methods of investment appraisal- Rate of return method, Payback period method, Net present value method (NPV)- Internal Rate of Return method(IRR)- Adoption of the methods in energy conservation campaign- Types of projects- Purpose of project management - Classification – Role and qualities of project manager - Types of budgets - Budget committee – budgeting.

UNIT - IV

ENERGY MANAGEMENT PROGRAMS:

Necessary steps of energy management programmer - Concepts of Energy management - General principles of energy management – Energy management in manufacturing and process industries- Qualities and functions of Energy manager - Language of Energy manager-Checklist for top management.

UNIT - V

ENERGY POLICY, SUPPLY, TRADE& PRICES:

Energy resources in India – level of power generation – transmission & distribution of power. Indian energy policy,Energy trade & its economic impacts – domestic energy production – Energy transformation & distribution & energy self sufficiency. International & National crude oil prices – domestic fuel prices – natural gas, LPG, kerosene and firewood - pricing policy.

BOOKS:

1. Albert Thumann, Handbook of Energy Audits, The Fairmont Press Inc., Atlanta gergia, 1979.
2. Murphy W.R and Mckay G, Energy Management, Butterworths, London, 1982.
3. Albert Thumann, Plant Engineer and Management guide to Energy Conservation, Van Nost and Reinhold Co., Newyork.
4. Energy Audits, E.E.O.-Book-lets, U.K. 1988.
5. Craig B.Smith, "Energy Management Principles", Pergamon Press.
6. The role of Energy Manager, E.E.O., U.K.
7. The Energy conservation Design Resource Hand Book-The Royal architectural Institute of Canada.
8. Energy Management Hand Book-Ed. By Wayne C. Turner, John Wiley and sons, 1982.

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DEPARTMENT OF MECHANICAL ENGINEERING
M.Tech: ENERGY SYSTEMS

I- SEMESTER **L P C**
4 - 4

DIRECT ENERGY CONVERSION SYSTEMS
(15D32102)

UNIT-I

Energy Balance of the earth – The Greenhouse effect – Physical Source of sunlight – Planck's black-body radiation distribution from different black body temperatures – The earth and Solar Constant – Spectral distribution of extra-terrestrial radiation – Basic earth-sun angles – Solar time and equation of time – attenuation of solar radiation by the atmosphere – Direct and diffuse radiation at the ground – Empirical equations for predicting the availability of solar radiation.

UNIT-II

Photovoltaics (PV): Semiconductor physics and Operating principle – Silicon as PV material - Direct and indirect band-gap material – Flow of Silicon material – Single crystal Silicon Solar cell – Structure – Important electrical parameters – Ideal and approximate equivalent circuits - Manufacturing processes (wafer and cell) of single crystal, multi-crystalline and Edge Defined Film Fed Growth Silicon - Temperature and Irradiation effects – Absorption coefficient and reflectance - Silicon film, Cadmium telluride (cdTe), Copper Indium Gallium Diselenide, amorphous silicon – Comparison of 'Thin film' and 'Bulk crystal' technology – manufacturing (module making) processes of amorphous silicon on glass, stainless steel and plastic substrates – Typical materials used - Concentrator technology and the importance of tracking – Comparison of efficiencies of various technologies – Recent trends in PV technology and manufacturing.

UNIT-III

PV modules and Arrays – Design requirements of PV modules – Rating of PV modules – Standard Test Conditions (STC), Normal Operating Cell Temperature (NOCT) and Standard Operating Conditions (SOC) – Output curves ('Current-Voltage' or 'I-V' and 'Power-Voltage' or 'P-V') under various irradiance and temperature conditions – Mounting structure for PV modules/arrays – Orientation and array layout – Effects of shading - Other balance of systems (BOS) and protective devices: blocking and bypass diodes, movistors – Roof mounted arrays – Building integrated PV (BIPV) – Typical faults and diagnosis – Hot Spot problem in a PV module and safe operating area - Performance measurement of typical parameters of cells/modules under natural and simulated light – Indoor sun simulators - Outdoor PV array testers – ASTM and IEEE standards for Class A and Class B simulators – Pulsed, steady state and single flash types – Determination of temperature coefficients, series and shunt resistances, curve correction factor - Computation of efficiency and fill factor – Translation of parameters actually measured to STC – Reliability Testing: Qualification tests, IEC Standards 61215 & 61646 – Reliability test – Field stress testing

UNIT-IV

PV Systems – Stand alone and grid connected – Load estimation – Daily load demand – Solar radiation/irradiance table for a particular location - Sizing of the PV array, battery, inverter and other BOS – Maximizing efficiency of sub-systems – Balance of systems – Single axis and two axis tracking at optimum inclination of the PV array – Power conditioning and control – Maximum Power Point Trackers, Charge controllers/regulators, AC/DC Converters, DC/AC inverters – Alarms, indicators and monitoring equipment – Energy Storage: Batteries, Deep cycle lead acid type, Battery Design and construction, Other types of batteries, Battery Selection criteria, Safety issues – Typical applications of PV – Hybrid systems: PV-Wind, PV-Diesel engine, PV-Mains - System Sizing examples: Domestic loads, Water pumping, Lighting (using CFLs, White LEDs) - hybrid systems, village power packs – Installation practices – Trouble shooting – Economic analysis: Life Cycle Cost analysis – Environment impacts of PV – Green buildings – Potential for GHG emission reduction of installed PV systems

UNIT-V

The Hydrogen Economy – Advantages of hydrogen as an energy carrier – Components of the hydrogen economy - Generation of hydrogen - Transport and storage of hydrogen: physical and chemical - Fuel Cells – Classification of fuel cells based on (a) Type of electrolyte (b) Type of the fuel and oxidant (c) operating temperature (d) application and (e) chemical nature of electrolyte

Reference Books:

a. Solar Electricity /Edited by Tomas Markvart/John Wiley and Sons
b. Solar Cells – Operating Principles, Technology and System Applications /Martin A. Green/Prentice Hall Inc
c. Modelling Photovoltaic Systems using P Spice/Luis Castaner and Santiago Silvestre/John Wiley and Sons
d. Solar Energy – Fundamentals and Applications/H.P. Garg and J. Prakash/Tata McGraw-Hill
e. Generating Electricity from the Sun/Edited by Fred C. Treble/Pergamon Press
f. Amorphous Silicon Solar Cells/K.Takahashi and M.Konagai/North Oxford Academic
g. Photovoltaic Systems Engineering/Roger Messenger/CRC Press
h. Fuel Cells/Livin Oniciu/Abacus Press 1976

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DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

I- SEMESTER **L P C**

4 - 4

RENEWABLE ENERGY SOURCES
(15D32103)

UNIT – I

SOLAR ENERGY:

Availability of solar energy, Measurement of sunshine, solar radiation data, estimation of average solar radiation, the black body, absorptance and emittance, Kirchoff's law. Reflection from surfaces, Solar energy selection, selective surfaces, Construction of solar flat plate and evacuated tube collectors, Performance of solar energy collectors, Solar heating and cooling.

UNIT – II

WIND ENERGY:

Wind mills and wind turbine systems, Classification of wind machines: Horizontal & Vertical axis configuration. High and low solidity rotors, Elements of wind mills and wind turbine systems, Aerodynamic models, Rankine Froud Actuator disc model, Betz limit, angular momentum wake rotation theory, Aerofoil sections and their characteristics, Estimation of power output and energy production.

UNIT – III

OCEAN THERMAL ENERGY:

Ocean thermal energy sources, Ocean thermal energy power plant development, Closed and open cycles. Advantages and operating difficulties.

TIDAL & WAVE ENERGY

Tidal power sources, Conventional and latest design of tidal power system, The ocean wave, Oscillating water column (Japanese) and the Dam, Atol design.

UNIT – IV

GEOTHERMAL ENERGY :

Earth as source of heat energy, stored heat and renewability of earth's heat, Nature and occurrence of geo thermal field, Classification of thermal fields, Model of Hyper thermal fields & Semi thermal fields, drilling hot water measurements.

UNIT – V

FUEL CELL ENERGY:

Description, properties and operation of fuel cells, Major components & general characteristics of fuel cells, Indirect methanol fuel cell systems. Phosphoric acid fuel cell systems and molten carbonate fuel cell systems.

BIOMASS ENERGY:

Types of conversion techniques for the production of solid, liquid and gaseous fuels by chemical and biochemical methods, and Biomass gasifiers- Selection of a model and size, Technical, Climatic, geographical and economic issues.

BOOKS:

1. Principles of Solar Engineering: F.Kreith&J.F.Krieder/Mc.Graw Hill Book Co
2. Wind Energy conversion Systems: L.C.Freris, Prentice Hall, Inc..
3. Non-conventional Energy Sources: G.D. Rai
4. Energy Technology: S. Rao & B.B. Parulekar
5. Geo thermal energy: H.Christopher&H.Armstead.
6. Photo Voltaic Energy Systems, Design&Applications: Mathew Buresch, Mc Graw Hill Book Co..
7. Bio Gas Technology, A Practical Hand Book: K.C.Khendelwal&S.S.Mahdi Mc Graw Hill Book Co..
8. Hand Book of Batteries and Fuel cells: David Linden, Mc Graw Hill Book Co..
9. Energy Conversion Systems: H.A.Sorenson: John Wiely & S.jons
10. Renewable Energy Sources & Conversion technology: Bansal.K: Leemann&Meliss
11. Energy technology Hand Book: EdD.M.Considine
12. Principles of energy conversion AW.Culp

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DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

I- SEMESTER **L P C**

4 - 4

APPLIED SOLAR ENERGY ENGINEERING
(15D32104)

UNIT – I

SOLAR RADIATION:

Sources of radiation –sun earth relationship, Solar Time and angles, day length, angle of incidence on tilted surface; Sun path diagram, Solar Radiation: Extraterrestrial Radiation; Effect of earth atmosphere; Estimation of solar radiation on horizontal and tilted surfaces.
Geographic Distribution of solar radiation, Phyrellio, pyranometer, equation of time-estimation of average radiation falling on tilled.

UNIT-II

SOLAR ENERGY TECHNOLOGIES:

Performance analysis of a liquid Flat-plate collector, Total loss coefficient and heat losses: Top loss coefficient, Bottom loss coefficient, Side loss coefficient. Solar concentrating collectors, types of concentrating collectors, Parabolic Dish System, The central power tower system, The Parabolic Trough System, Tracking CPC and Solar Swing, Performance analysis of cylindrical parabolic collector, Compound parabolic concentrator (CPC).

UNIT-III

SOLAR CELLS:

Solar cell fundamentals, solar cell classification, solar cell, module, panel array construction, maximum power pint trackers(MPPT), solar PV applications, The Recent developments in Solar cells, Role of Nano-Technology in Solar cells.

UNIT – IV

ECONOMICS:

Discounted Cash Flow-light cycle, coasting of solar system, production function and optimization

UNIT – V

THERMAL POWER:

The power concepts- design aspects, thermo-chemical reactor.

SOLAR POND AND SOLAR STILLS:

Working Principle-Construction-operating difficulties and remedies, Agriculture and Domestic applications: Still, timber drying, crop drying, cooker.

Reference Books:

1. Solar Energy Thermal Process Diffice and Beckman
2. Solar Heating and Cooling by Kreith and Kreider
3. Solar Energy Utilization by G.D.Rai
4. Solar Energy Utilization by G.D.Rai , Khanna Publishers.
5. Renewable Energy Sources and Emerging Technologies- By D.P. Kothari, PHI Pub.,
6. Applied Solar Energy by Meinel and Meinel
7. Non-Conventional Energy Resources by B.H . Khan, Tata McGraw Hill
8. Energy Resources Utilization and Technologies By Anjaneyulu, BS Pub.,

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

I- SEMESTER **L P C**

4 - 4

ENERGY ECOLOGY & ENVIRONMENT (Elective – I)
(15D32105)

UNIT-I

Energy source for earth – sun – its radiation – its absorption and reflection. Various renewable and non-renewable resources.

UNIT-II

Boisphere – Energetics of the biosphere – Concepts of Ecology – Components of Ecosystems.

UNIT-III

Energy transactions in biosphere – photo synthesis and producers – Herbivones – Carnivones – decomposers – Energy transfers & food wells.

UNIT-IV

Dependence on abiotic systems – biogeochemical cycles. Elements of Environment – Interrelationships in environmental components.

UNIT-V

Concepts of pollution and affecting the natural balances in energy systems. Energy concepts for a sustainable world bio – systems.

REFERENCE BOOKS:

1. Renewable Energy, Environment and Development, Maheshwar Dayal, Konark Publishers Pvt. Ltd.,
2. Ecology and Environment, P.D. Sharma Rastogi Publications.
3. Energy for a sustainable world, J.Goldenberg, T.B. Johnson, Amulya K.Reddy & Robert Williams Willey Eastern Ltd.,

Concepts of Ecology, E.J.Kormondal , Prentice Hall India Ltd.,

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

I- SEMESTER **L P C**

4 - 4

DESIGN OF HEAT TRANSFER EQUIPMENT (ELECTIVES-I)
(15D32106)

UNIT - I

DESIGN OF HEAT EXCHANGERS:

Heat Exchangers-mean temperature differences for parallel and counter flow- effectiveness method (N.T.U)

DESIGN OF CONDENSERS:

Overall heat transfer coefficients- temperature distribution and heat flow in a condenser-pressure drop in a condenser –extended fin surfaces-consideration of fouling factor-L.M.T.D. correction factor.

UNIT - II

DESIGN OF EVAPORATORS:

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-volumetric efficiency-factors affecting total volumetric efficiency –compound compression with inter cooling- rotary compressors-surging.

UNIT - III

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

DESIGN OF DUCTS:

Continuity equation-Bernoulli’s equation-pressure losses-frictional charts- coefficient of resistance for fillings- duct sizing methods.

DESIGN OF FANS:

Standard air-fan horsepower-fan efficiency-similarity laws-fan laws-performance coefficients- theoretical expression for total pressure drop by a fan-centrifugal fan- axial flow fan-system resistance.

UNIT - V

PIPING SYSTEM:

Requirements of a good piping system-pressure drop in pipes-moody chart-refrigerant piping-discharge line-liquid line-suction line-piping arrangement

REFERENCE BOOKS:

1. Heat and mass transfer by Arora & Domkundwar.
2. Refrigeration & Air-Conditioning by P.L.Ballaney
3. .Refrigeration & Air-Conditioning by C.P.Arora.
4. .Refrigeration & Air-Conditioning by Stoecker

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

I- SEMESTER **L P C**

4 - 4

THERMAL AND NUCLEAR POWER PLANTS (ELECTIVES: I)
(15D32107)

UNIT - I:

Introduction:

Steam Power Plants: Introduction – General Layout of Steam Power Plant, Basic Steam Cycles: Rankine cycle, Mean temperature of heat addition, Regeneration, Reheat cycles, cogeneration, Efficiencies and Optimization, Modern Coal-fired Steam Power Plants, Power Plant cycles.

Fuel handling, Combustion Equipment, Ash handling, Dust Collectors.

Steam Generators: Types, Accessories, Feed water heaters, Performance of Boilers, Water Treatment, Cooling Towers, Steam Turbines, Compounding of Turbines, Steam Condensers, Jet & Surface Condensers.

UNIT - II:

Gas Turbine Power Plant: Cogeneration, Combined cycle Power Plants, Analysis and Performance of Gas Turbine Plant, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion – Advantages & Disadvantages, Principle components of Gas Turbine plant, Fuels and Materials Used for Gas Turbine Power plant.

UNIT -III:

Nuclear Power Plants: Nuclear Physics, Nuclear Reactors, Classification – Types of Reactors, Site Selection, Methods of enriching Uranium, Applications of Nuclear Power Plants.

Nuclear Power Plants Safety: By-Products of Nuclear Power Generation, Economics of Nuclear Power Plants, Nuclear Power Plants in India, Future of Nuclear Power.

UNIT -IV:

Economics of Power Generation: Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic Load Sharing, Depreciation, Energy Rates, Criteria for Optimum Loading, Specific Economic energy problems.

UNIT - V:

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

TEXT BOOKS:

1. Power Plant Engineering / P.K. Nag / TMH.
2. Power Plant Engineering / R.K. Rajput / Lakshmi Publications.
3. Power Plant Engineering / P.C.Sharma / Kotaria Publications.
4. Power Plant Technology / Wakil./TMH

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING
Common to (M.Tech – ENERGY SYSTEMS & PRODUCT DESIGN)

I- SEMESTER	**L**	**P**	**C**
	4	**-**	**4**

RAPID PROTOTYPING TECHNOLOGIES (Elective – I)
(15D32108)

UNIT-I

Introduction: Need for the compression in product development, History of RP systems, Survey of applications, Growth of RP industry and classification of RP systems.

Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, Data files and machine details, Application.
Selective Laser Sintering: Type of machine, Principle of operation, Process parameters, Data preparation for SLS, Applications.

UNIT-II

Fusion Deposition Modelling: Principle, Process parameter,Path generation, Application
Solid Ground Curing: Principle of operation, Machine details, Applications.

UNIT-III

Laminated Object Manufacturing: Principle Of Operation, LOM materials.
Process details, application.

Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer. Genisys Xs printer HP system 5, Object Quadra systems.

UNIT-IV

LASER ENGINEERING NET SHAPING (LENS)

Rapid Tooling: Indirect Rapid tooling -Silicon rubber tooling –Aluminum filled epoxy tooling Spray metal tooling, Cast kirksite, 3Q keltool, etc, Direct Rapid Tooling Direct. AIM, Quick cast process, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft, Tooling vs. hard tooling.

UNIT-V

Rapid Manufacturing Process Optimization: Factors influencing accuracy, Data preparation errors, Part building errors, Error in finishing, Influence of build orientation.

Allied Processes: Vacuum casting, surface digitizing, Surface generation from point cloud, Surface modification-data transfer to solid models.

TEXT BOOKS:

1. Rapid Prototyping and Tooling by Hari Prasad & K.S. Badhrinarayan/ Page Turners
2. Paul F. Jacobs- "**Stereo lithography and other RP & M Technologies**", SME, NY 1996.
3. Flham D.T & Dinjoy S.S - "**Rapid Manufacturing**" Verlog London 2001.
4. Lament wood, "**Rapid automated",** Indus press New York

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

I- SEMESTER **L P C**

4 - 4

RELIABILITY & SAFETY ENGINEERING (ELECTIVES: II)
(15D32109)

UNIT - I

Elements of probability theory, probability of union and intersection of events, mutually exclusive events, statistical independence, random variables, PDF and CDF, binomial, Poisson and Gaussian distributions.

Component reliability-definition of reliability and hazard functions, failure distributions, exponential Weibull and gama distributions, uniform distribution, bath tub curve.

UNIT - II

Reliability of non-repairable systems, reliability network, series, parallel and rout of configurations, decomposition method, cut set & tie set method , methods of improving reliability.

UNIT - III

Maintainability and availability, MTBF and MTTR, probability and frequency of failure, state space analysis, Markov process, steady state probability, and dependent failures.

Failure types and causes of failure- failure classification, case studies, human factors analysis of different causes of failures.

UNIT - IV

Fault detection, non-destructive testing, X-ray and Gamma ray radiography, Xerography, Electro magnetic methods, ultrasonic methods.

UNIT - V

Monitoring techniques Signature analysis-vibration and noise monitoring, faults and vibration modes, permissible limits of vibrations, temperature monitoring, infrared camera. Wear monitoring, analysis of wear partials, ferography, spectroscopic analysis, performance trend monitoring.

BOOKS:

1. “Reliability engineering” By Balaguruswamy.
2. “Testing and inspection of materials” by H.E.Davies.
3. “Instrumentation, Measurement and analysis” by Prof.B.C.NaKra
4. “Mechanical fault diagnosis” By R.A.Collacolt.

REFERENCE:

1. Maintenance Engineering Hand Book

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DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

I- SEMESTER **L P C**

4 - 4

TOTAL QUALITY MANAGEMENT (ELECTIVES: II)
(15D31110)

UNIT – I

TQM – Overview, Concepts, Elements – History-Quality Management Philosophies-Juran, Deming, Crosby , Feigenbaum, Ishikawa– Stages of Evolution– Continuous Improvement – Objectives – Internal and External Customers. Quality Standards – Need for Standardization - Institutions – Bodies of Standardization, ISO 9000 series – ISO 14000 series – Other Contemporary Standards – ISO Certification Process-Third Party Audit

UNIT – II

Process Management- Quality Measurement Systems (QMS) – Developing and Implementing QMS –TQM Tools & Techniques- 7 QC Tools- 7 New QC Tools.
Problem Solving Techniques - Problem Solving Process – Corrective Action – Order of Precedence– System Failure Analysis Approach – Flow Chart – Fault Tree Analysis – Failure Mode Assessment and Assignment Matrix – Organizing Failure Mode Analysis – Pedigree Analysis.

UNIT – III

Quality Circles – Organization – Focus Team Approach – Statistical Process Control – Process Chart – Ishikawa Diagram – Preparing and using Control Charts.

UNIT – IV

Quality Function Development (QFD) – Elements of QFD – Benchmarking-Types-Advantages & Limitations of Benchmarking – Taguchi Analysis – Loss function - Taguchi Design of Experiments, Robust Design, Poka-yoke, Kaizen, Deming Cycle.

UNIT – V

Value Improvement Elements – Value Improvement Assault – Supplier Teaming; Business Process Reengineering & Elements of Supply Chain Management. Six Sigma Approach – Application of Six Sigma Approach to various Industrial Situations.

TEXT BOOKS:

1Total Quality Management,DakhBesterfield, Pearson Edu.
2. Total Quality Management, K.ShridharBhat, Himalaya.

REFERENCE BOOKS:

1. Quality management, Howard Giltow-TMH
2. Quality management, Evans.
3. Quality management, Bedi

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

I- SEMESTER **L P C**

4 - 4

DATA ACQUISITION & PROCESSING SYSTEMS (ELECTIVES: II)
(15D32110)

UNIT - I

TRANSDUCERS:

Basic requirements of a transducer- principle of operation, application of strain gauges, capacitive, Inductive, Photoelectric, piezoelectric & Potentiometer transducers. Resistance thermometers, thermocouples, hermistors, photoconductive & photovoltaiccells, and Electromagnetic& Turbine type flow meters.

UNIT - II

DATA REPRESENTATION:

Number systems: Decimal, Binary, Octal, Hexadecimal and conversion from one One system to the others; Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR gates; Logic circuit Implementation: 'Sum of products and product of sums' Boolean equations; Boolean algebra: postulates, theorems and simplification of Boolean equations; Binary arithmetic: Addition, subtraction Circuits; Digital codes: BCD, XS-3, Gray, 2421 and ASCII codes, BCD to decimal decoders; parity checkers and generators.

DIGITAL CIRCUITS

Flip Flops: R-S, JK ,D, Master-slave, Latches – Timing Diagrams – Registers, Buffer, shift and controlled shift registers- Counters-ripple, synchronous, ring and Presettable counters; Astable and monostable multivibrators.

UNIT - III

MEMORIES &PROCESSORS:

Memories: ROMs, PROMs, EPROMs and RAMs, expanding memory size; Processors: arithmetic Logic Unit, register array- control unit, memory, input/output, system concepts, hardware & software, and low-level& high-level languages.

INSTRUMENTATION SYSTEMS:

Representation of generalized data acquisition system; single and multi channel data acquisition systems; microprocessor based data logger; microprocessor control of petrol engine.

UNIT - IV

COMPUTING SYSTEMS:

Simple computing: architecture, instruction set. Fetch & execution cycles, and Microprogramming-Advanced computing- architecture, memory & reference instructions. register instructions, jump& call instruction. Arithmetic instructions, Increments/decrements & rotates, logic instructions. Arithmetic & logic immediates, jump instructions. Extended register instructions indirect instructions. -Simple programming.

INTEL 8085 MICROPROCESSOR:

The 8085:block diagram:pinout diagram. additional instructions. minimum system and timing diagrams; I/O operations: programmed I/O, interrupt driven I/O and Direct memory access

UNIT - V

DATA CONVERSION:

Digital to analog conversion: weighted resistor; and R-2Rladder D/A converters; Analog to digital conversion: successive approximation. Single dual slope integration, and parallel conversion A/D converters, A/D converters using voltage to frequency &voltage to time conversion; sample and hold circuits; multiplexing: D/A and A/D multiplexing; de multiplexing.

BOOKS:

1. Electronic Instrumentation & Measurement Techniques: Willman David Cooper, Prentice-Hall of India pvt-ltd.,
2. Instrumentation Devices and Systems: Csrangan, OR Sharma and V.S.V Muni; Tata McGraw-Hill Publishing CO. Ltd..
3. Integrated Digital Electronics; Walter A.Triebel; Printice Hall..Iinc..
4. Modern Digital Electronics: R.P. Jain,Tata Mc Graw-Hill Publishing Co., ltd..
5. Digital Computer Electronics, An Introduction To Microcomputers: Albert.Paull, Malvino;Tata Mc Graw-Hill Publishing Co.,Ltd.,

JNTUACEA **R15**

2015-16

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU

DEPARTMENT OF MECHANICAL ENGINEERING

Common To M.Tech – PRODUCT DESIGN & ENERGY SYSTEMS

I- SEMESTER **L P C**

4 - 4

CREATIVITY AND INNOVATIONS IN DESIGN (Elective – II)

(15D32111)

UNIT I INTRODUCTION

Need for design creativity – creative thinking for quality – essential theory about directed creativity

UNIT II MECHANISM OF THINKING AND VISUALIZATION

Definitions and theory of mechanisms of mind heuristics and models : attitudes, Approaches and Actions that support creative thinking - Advanced study of visual elements and principles- line, plane, shape, form, pattern, texture gradation, color symmmetry.Spatial relationships and compositions in 2 and 3 dimensional space - procedure for genuine graphical computer animation – Animation aerodynamics – virtual environments in scientific Visualization – Unifying principle of data management for scientific visualization – Unifying principle of data management for scientific visualization - Visualization benchmarking

UNIT III CREATIVITY

Methods and tools for Directed Creativity – Basic Principles – Tools of Directed Creativity – Tools that prepare the mind for creative thought – stimulation of new ideas – Development and Actions: - 16 Processes in creativity ICEDIP – Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation The Bridge between man creativity and the rewards of innovativeness – Applying Directed Creativity to the challenge of quality management

UNIT IV DESIGN

Process Design, Emotional Design – Three levels of Design – Viceral, Behavioral and Reflective-Recycling and availability-Creativity and customer needs analysis – Innovative product and service designs, future directions in this application of creativity thinking in quality management

UNIT V INNOVATION

Achieving Creativity – Introduction to TRIZ methodology of Inventive Problem Solving - the essential factors – Innovator‟s solution – creating and sustaining successful growth – Disruptive Innovation model – Segmentive Models – New market disruption - Commoditation and DE-commoditation – Managing the Strategy Development Process – The Role of Senior Executive in Leading New Growth – Passing the Baton

REFERENCES

1. Rousing Creativity: Think New NowFloydHurr, ISBN 1560525479, Crisp Publications Inc. 1999
2. Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999
3. Donald A. Norman," Emotional Design", Perseus Books Group New York , 2004
4. Clayton M. Christensen Michael E. Raynor," The Innovator‟s Solution", Harvard Business School Press Boston, USA, 2003
5. Semyon D. Savransky," Engineering of Creativity – TRIZ", CRC Press New YorkUSA," 2000

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

I- SEMESTER **L P C**
0 4 2

ENERGY UTILIZATION LABORATORY
(15D32112)

List of Experiments

S.No.	Experiment Name
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

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

L	P	C
4	-	4

EFFECTIVE FROM THE YEAR 2015-16

II SEMESTER:

Subject Code	SUBJECT	L	P	C
15D32201	Energy Conservation and Audit	4	-	4
15D32202	Waste Heat Recovery Systems	4	-	4
15D32203	Energy Efficient Electrical Systems	4	-	4
15D32204	Design of Wind Energy Systems	4	-	4
	ELECTIVE – III	4	-	4
15D32205	Optimization of Engineering Design			
15D32206	Refractory Systems			
15D32207	Solar Refrigeration & Air Conditioning			
15D32208	Product Planning and Marketing			
	ELECTIVE – IV	4	-	4
15D32209	Concurrent Engineering			
15D32210	Reverse engineering			
15D32211	Energy Resources			
15D32212	Maintenance Management			
15D54201	Research Methodology (Audit Course)	3	-	-
15D32213	Energy Operations Lab	0	4	2
TOTAL		**24**	**4**	**26**

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

II- SEMESTER **L P C**
4 - 4

ENERGY CONSERVATION AND AUDIT
(15D32201)

UNIT - I

THERMODYNAMICS

Availability, energy and Anergy-Exergy, energy, entropy relationship- Degradation of energy – exergy analysis- exergy conservation- combustion, thermal efficiency, thermal losses; thermal balance sheets.

HEAT EXCHANGER THEORY:

Types Of heat exchangers - overall heat transfer coefficient – fouling factor - Design of heat Exchangers, L.M.T.D. and N.T.U. methods.

UNIT - II

ENERGY CONSERVATION:

Rules for efficient energy conservation – technologies for energy conservation – outline of waste heat and material reclamation, load management.

ENERGY AUDITING:

A definition- Level of responsibility- Control of Energy- Uses of Energy - Energy index - Cost index - Pie charts-sankey diagrams Load profiles - Types of energy audits- General energy audit- Detailed energy audit.

UNIT - III

THERMAL INSULATION & REFRACTORIES:

Heat loss through un insulated and 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 refractories – properties of refractories – Criteria for good refractory material – application of insulating & refractory materials.

UNIT - IV

WASTE HEAT RECOVERY SYSTEMS:

Guideline to identify waste heat – feasibility study of waste heat – shell and tube heat exchangers – Thermal wheel – heat pipe heat exchanger – Heat pump – waste heat boilers – Incinerators.

UNIT - V

HEAT RECOVERY SYSTEMS:

Liquid to liquid heat exchangers – regenerators, recuperaters, rotating regenerators – selection of materials for heat exchangers, U- tube heat exchanger, fluidized bed heat exchanger –economizer.

References :

1. The role of Energy Manager, E.E.O., U.K.
2. The Energy conservation Design Resource Hand Book-The Royal architectural Institute of Canada.
3. Conduction Heat Transfer- -Schneder Addition Wieslthy
4. Conduction of Heat in Solids -Carslaw & Jaeger.
5. Fundamentals of heat and mass transfer -R.C. Sachdev New Age International Publishers
6. Heat Transfer By R.K. Rajput/ laxmi publication

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

II- SEMESTER **L P C**
4 - 4

Waste Heat Recovery Systems
(15D32202)

UNIT-I

Introduction

Rankine Cycle, Coupled cycles and combined plants, Energy resources and use, Potential for energy conservation, Optimal utilization of fossil fuels. Total energy approach.

UNIT-II

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-III

Prime Mover Exhausts; incineration plants; heat pump systems; thermoelectric devices. Utilization of low grade reject heat from power plants, Utilization of waste heat in refrigeration, heating, ventilation and air conditioning systems. Thermoelectric system to recover waste heat.

UNIT-IV

Energy Storage Systems:

Need for energy storage, Thermal, electrical, magnetic and chemical storage systems.

UNIT-V

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

REFERENCES:

[1] Goswami, D. Y., and Kreith, F. Energy Conversion . CRC Press, 2007.
[2] Hewitt, G. F., Shires, G. L., and Bott, T. R. Process Heat Transfer . CRC Press, Florida, 1993.
[3] Li, K. W., and Priddy, A. P. Power Plant System Design . John Wiley and Sons, New York, 1985.
[4] Nag, P. K. Power Plant Engineering . Tata McGraw-Hill, New Delhi, 2001.
[5] El-Wakil, Power Plant Engineeirng, Mcgraw-Hill
[6] HoSung Lee, Thermal Design
[7] Dincer, Rosen, Thermal Energy Storage Systems

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

II- SEMESTER **L P C**
4 - 4

ENERGY EFFICIENT ELECTRICAL SYSTEMS
(15D32203)

UNIT - I

THREE PHASE INDUCTION MOTROS:

Cage motors-equivalent circuit-speed-torque characteristics-performance characteristics-voltage unbalance-over motoring-slip ring induction motor characteristics multi speed motors.

SINGLE PHASE INDUCTION MOTORS:

Starting & running performance-split phase-capacitor type motor-characteristics-reluctance motor.

UNIT - II

ENERGY EFFICIENT MOTORS:

Constructional details-factors affecting efficiency-losses distribution-characteristics-calculation of pay back period.

ECONOMICS OF POWER FACTOR IMPROVEMENT:

Simple pay back method-return on investment-life cycle analysis.

UNIT - III

ENERGY EFFICIENT LIGHTING:

Terminology-cosine law of illumination-types of lamps-characteristics-design of illumination systems-good lighting practice-lighting control-steps for lighting energy conservation.

UNIT - IV

ECONOMICS OF ELECTRICAL ENERGY GENERATION:

Definitions-connected load, maximum demand-demand factor-curve-base load and peck load.

UNIT - V

ECONOMICS OF ELECTRICAL ENERGY DISTRIBUTION:

Electrical load analysis-type of consumers& tariffs-line losses-corner losses-types of distribution systems- Kevin's law-loss load factor.

ECONOMICS OF ELECTRICAL DRIVES:

Selection of motors-types of loads-energy consumption during starting of ac and dc motors-braking of motors-plugging-regenerative braking.

BOOKS:

1. Electrical Machinery: Fitzerland, Kingsley, Kusko-MC Graw Hill Ltd.
2. Energy-Efficient Electrical motors: John C.Andreas-Marcel Decker Inc.
3. Electrical Technology: Edward Hughes-ElLBS.

Energy Management and good lighting practice: Fuel Efficiency Booklet 12-eeo.

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

II- SEMESTER **L P C**
4 - 4

DESIGN OF WIND ENERGY SYSTEMS

(15D32204)

UNIT-I

Historical developments, latest developments, state of art of wind energy technology, turbine rating, cost of energy, wind power plant economics, installation and operation costs, decommissioning, Indian scenario and worldwide developments, present status and future trends

UNIT-II

Nature of atmospheric winds; wind resource characteristics and assessment; anemometry; wind statistics; speed frequency distribution, effect of height, wind rose, Weibull distribution, atmospheric turbulence, gust wind speed, effect of topography.

UNIT-III

Design of wind turbine blade; effect of stall and blade pitch on coefficient of power vs tip speed ratio and cut-out wind speeds, blade materials, design characteristics, multiple stream tube theory, vortex wake structure; tip losses; rotational sampling, wind turbine design programs, aerodynamic loads, tower shadow, wind shear, blade coning, gyroscopic, transient and extreme loads.

UNIT-IV

Pitch control, yaw control, Electrical and Mechanical aerodynamic braking, teeter mechanism. Wind turbine dynamics with DC and AC generators: induction and synchronous generators, variable speed operation, effect of wind turbulence. Power electronics Converter and Inverter interfaces for wind energy utilization system for isolated and grid connected system.

UNIT-V

Wind farm electrical design, Planning of wind farms, special application for developing countries, maintenance and operation, wind farm management, site selection. Environmental assessment; noise, visual impact etc. Instrumentation, data loggers, remote monitoring and control.

REFERENCES:

1. Paul Gipe, Wind Energy Comes of Age, John Wiley & Sons Inc.
2. Ahmed: Wind Energy Theory and Practice, PHI, Eastern Economy Edition, 2012
3. L.L. Freris, Wind Energy Conversion System, Printice Hall.
4. Tony Burton et al, Wind energy Hand Book, John Wiley & Sons Inc.
5. Directory, Indian Wind Power 2004, CECL, Bhopal.

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2015-16

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

II- SEMESTER	**L**	**P**	**C**
	4	**-**	**4**

OPTIMIZATION OF ENGINEERING DESIGN (Elective – III)

(15D32205)

UNIT I

SINGLE VARIABLE NON-LINEAR UNCONSTRAINED OPTIMITION:

One dimensional Optimization methods:- Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation methods- quadratic & cubic interpolation methods.

UNIT II

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.

UNIT III

GEOMETRIC PROGRAMMING:

Polynomials – arithmetic – geometric inequality – unconstrained G.P – constrained G.P

DYNAMIC PROGRAMMING:

Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory. Allocation, scheduling replacement.

UNIT IV

Linear programming – formulation – Sensivity analysis. Change in the constrints, cost coefficients , coefficients of the constraints, addition and deletion of variable, constraints.

Simulation – Introduction – Types – Steps – application – inventory – queuing – thermal system.

UNIT V

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

STOCHASTIC PROGRAMMING:

Basic concepts of probability theory, random variables – distributions – mean, variance, Correlation, co variance, joint probability distribution – stochastic linear, dynamic programming.

REFERENCES:

1. Optimization theory & Applications/ S.S Rao/ New Age International
2. Introductory to operation research/Kasan & Kumar/Springar
3. Optimization Techniques theory and practice / M.C Joshi, K.M Moudgalya/ Narosa Publications.
4. S.D Sharma/Operations Research
5. Operation Research/H.A. Taha/TMH
6. Optimization in operations research/R.L Rardin
7. Optimization Techniques/Benugundu & Chandraputla/Person Asia.

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING
M.Tech : ENERGY SYSTEMS

II- SEMESTER **L P C**
4 - 4

REFRACTORY SYSTEMS (Elective – III)

(15D32206)

UNIT-I

INTRODUCTION

Definition – Survey of Refractories and their Uses – Layout of a refractory plant – Classification of Refractories – Fundamental Properties of Refractories namely Physical, Thermal, Mechanical, Chemical and Electrical Properties.

UNIT-II

ALUMINO SILICATE REFRACTORIES

Silica – Raw materials – Manufacturing Steps – Properties – Applications.

Al_2O_3 – SiO_2 Phase diagram – Types of Raw materials – Types of Alumino-Silicate Refractories – Manufacturing Steps – Properties – Applications.

UNIT-III

BASIC REFRACTORIES

Raw materials, Manufacturing Steps, Properties and Applications of Forsterite, Dolomite Magnesite, Magnesia Carbon, and Chrome based refractories.

UNIT-IV

SPECIAL REFRACTORIES AND MONOLITHICS

Carbide based, Nitride based, Zirconia, Thoria, Beryllia Refractories – Raw materials, Manufacturing Steps, Properties and Applications. Fused cast refractories – Ceramic Fibers. Types of Castables – Ramming Mass – Gunning Mixes.

UNIT-V

APPLICATIONS OF REFRACTORIES

Refractories for coke oven, blast furnace, open hearth furnace, LD converter, THF, EAF, IF, Ladle furnace, slide plate system, nozzle, shroud, continuous casting; Monolithic Applications – gunning technique; Refractory, slag and metal interactions.

BOOKS FOR REFERENCE

1. D.N.Nandi, Handbook of Refractories, Tata McGraw Hill Publishing Co, New Delhi, 1991.
2. Chesters J.H, Refractroies: Production & Properties, Iron & Steel Institute, London, 1973.
3. Chester, J.H., Steel Plant Refractories, Second Edition., 1973, The United Steel Companies Ltd., Sheffield, UK.
4. Chester, J.H. Refractories, Production and Properties, 1973, Iron and Steel Institute, London.
5. Robert E.Fisher, Advances in Refractory Technology, Ceramic Transaction, Vol.4, 1990, American Ceramic Society, Westerville,Ohio, USA.
6. Handbook of Monolithics, 1980, Plibrico, Japan.
7. Modern Refractories Practice, 1961, Harbison Walker Comp., Pittsburgh.

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

II- SEMESTER **L P C**

4 - 4

SOLAR REFRIGERATION & AIR CONDITIONING *(Elective III)*
(15D32207)

UNIT - I

Review of Psychometric and (Air-conditioning) cooling load calculations-outline of Vapour Compression Refrigeration Systems – Cycle on p-h and T-o charts – C.O.P – Simple problems using property tables.

UNIT - II

Principle of working of working of vapour Absorption Refrigeration, steam jet refrigeration, thermoelectric refrigeration – classification of refrigerants – Desirable properties of ideal refrigerant - Properties of solvent - Solvent refrigerant combination properties.

UNIT - III

Solar cooling systems: vapour compression systems, Rankine cycle, Striling cycle, using P.V.Modules. Solar operated vapour absorption systems – vapour jet refrigeration systems.

UNIT - IV

Solar thermal energy storage - Active and passive systems TROMBE wall – equivalent thermal circuit - Solar green houses.

Solar cooling and dehumidification: Desiccant cooling - Solid and liquid desiccants - improving desiccant cycles - hybrid systems.

UNIT - V

Non –mechanical systems - Australian Rock system – Solar assisted Heat Pump – Economics of solar cooling systems.

Simulation of solar thermal systems - Salient features of DYNSYS, TRNSYS – model formulation – flow diagram of cooling systems.

REFERENCE BOOKS:

1. A course in Refrigeration & Air –conditioning, S.Domakundwar & S.C.Arora
2. Principles of Solar engineering, F.Kreith &J.F.Kreider, Mc Graw Hill Book company
3. Solar Cooling & Heating Volumes, I,II,III., T.Negat Vezirogulu
4. Entrepreneurship Development in New & Renewable Energy Technologies APPC & IREDA

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING
Common to M.Tech – PRODUCT DESIGN & ENERGY SYSTEMS

II- SEMESTER	**L**	**P**	**C**
	4	**-**	**4**

PRODUCT PLANNING AND MARKETING (Elective-III)
(15D32208)

UNIT-I

Classification of New Products: New products success and failure. Definition of success and failure, the latent Factors Behind the Marketing Success of New Products, Failure of New product, Factors Influencing Failure, Failures preventing new product Failure, New Product Development process and models, Model 1-The Cyclical Approach, Model 11-New product process Management

Concept Development and Statistical Tools Used : Introduction Common Sources for Product Ideas, Concept Development Methods, Idea Screening, idea Screening Approaches, Concept Testing, Definition, Methodology of Data Collection for Concept Testing, Data Analysis Techniques for Concept Testing, Concept Screen Test Method, Weighted Scoring Method, Concept Screening Matrix

UNIT-II

Diffusion of Innovation and Adoption Process : Introduction, Adoption Process, Five Stage Process, Time of Adoption, Characteristics of Adopters, Characteristics Affecting Adoption Rate, Diffusion of Innovation, Product Life Cycle Introduction, Basics of PLC, 3 Types of PLCs, Identification of Stages in a PLCSigma Method of Tracing the Product Life Cycle and Stages Identification.,

Product Mix : Introduction, Width, Length, Depth, And Consistency of Product mix, Product Lines, Product Strategies, Introduction, Types of Naming, Problem Faced due to Linguistic Differences, Branding Naming Strategies, Brand Naming Strategies, The Naming Process, The Dos and Don'ts While Naming Brands, Brand Names, Generalization.

UNIT-III

Test Marketing: Introduction, Objectives of Test Marketing-What to look for?, Pros and Cons of test Marketing, Decision Variables for Test Markets, Test Marketing Approaches, Types of Test Marketing Producers, Statistical Models for Analyzing Test Market Data, Data Project Method, Product Launch and Commercialization, The Product Launch Cycle, The Launch Mix, Issues in Launch, The Product Launch Process, Effective Plan for Product Launch, Product Launch Mistakes

Brand Identity: Introduction, What Identity is not ? Dimensions and Identity, Inner and Outer Identity, The Six Sided Prism, How to find Identity? Multiple Identities, Conclusion, Brand Image, Brand Images of Some of the Indian Brands, Techniques Used for Identifying the Brand Image, Brand Networking Techniques, Focus Groups, Constructive Techniques, Factor Analysis.

UNIT-IV

Brand Personality: Introduction, Tools to Build/Understand Brand Personality, Brand personality Scale, Three Models to Build Brand Personality, Building Brand Personality Via the 4P's and Packaging, Building Brand Personality Bottom-up. Brand Positing and Repositioning Introduction, Grabbing the Mind Space, Positioning Statement, Determine the Positioning, The MDS Way, Image and Profile Analysis, Positioning through Correspondence Analysis, By factor Analysis, Positioning Analysis, by Discriminate Mapping, Repositioning, Brand Loyalty, Definition, Brand Loyalty Measurement Models, Preference Behavior Model, Purchase Probability Model, Brand Loyalty Analysis with Markov Chains, Strategies to Build Brand Loyalty, Building Loyalty Through Strategic Differentiation

UNIT-V

Line Extension: Introduction, Why Line Extension is so hard to resist ? A Good Marketing Strategy, Extension, Measuring the Line Extension Success Brand Extension Introduction, Asker and Keller's Success Factors, Internal and External Factors Affecting Firm, Inter Brand Success Factors, Sequential Introduction of Brand Extension, Process of Brand Extension, Brand Harvesting Introduction, Types of Harvesting, Activities Adopted during Harvesting Strategy, Planning the Harvesting Strategy Implementation.

TEXT BOOKS :

1. Gien L. Urban. John R. Hauser – "Design and Marketing of new products"
2. William L. Moore&Edgar – "Product Planning and Management", A. Pessemier AGILE MANUFACTURIN
3. Dr.C. Anandan "Product Management". Tata Mc Graw Hill Education Pvt. Ltd.,
4. Philip Kotler. "Marketing Management " Person Eduction Pvt Ltd.,
5. Dr. Venu Gopal Rao. "Product and Brand Management" Himalaya Publications.

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2015-16

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING
M.Tech : ENERGY SYSTEMS

II- SEMESTER **L P C**
4 - 4

CONCURRENT ENGINEERING (Elective IV)
(15D32209)

UNIT-I

Introduction-Extensive definition of CE, CE design methodologies-Organising for CE- CE Tool box Collaborative product development

Use of Information Technology: IT Support- Solid Modelling-Product Data management-Collaborative product commerce.

UNIT-II

Artificial Intelligence- Expert Systems-Software hardware co-design

Design Stage: Life cycle design of products- opportunity for manufacturing enterprises-modality of concurrent engineering design.

UNIT-III

Automated analysis idealization control- concurrent engineering in optimal structural design-real time constraints

Manufacturing competitiveness- Checking the design process-conceptual design process mechanism –Qualitative, physical approach – an intelligent design for manufacturing for manufacturing system

UNIT-IV

JIT system- low inventory- Modular- Modelling and reasoning for computer based assembly planning-Design of automated manufacturing

Project Management Life Cycle Semi Realisation- Design for Economics- Evaluation of design for manufacturing cost

UNIT-V

Concurrent Mechanical design- Decomposition in concurrent Design-Negotiation in Concurrent Engineering Design studies – Product Realisation Taxonomy –Plan for project management on new product development- bottle neck technology development.

TEXT BOOKS:

1. Anderson M M and Hein, L Berlin, Springer Verlog-“**Integrated Product Development”**
2. Cleetus J Concurrent research Centre, Morgan Town-“**Design for Concurrent Engineering”**

JNTUACEA **R15**

2015-16

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

Common to M.Tech (ENERGY SYSTEMS & PRODUCTION DESIGN)

II- SEMESTER	**L**	**P**	**C**
	4	**-**	**4**

REVERSE ENGINEERING (Elective-IV)
(15D32210)

UNIT I INTRODUCTION
Scope and tasks of RE - Domain analysis- process of duplicating

UNIT II TOOLS FOR RE
Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material- characteristics evaluation -software and application- prototyping - verification

UNIT III CONCEPTS
History of Reverse Engineering – Preserving and preparation for the four stage process – Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation

UNIT IV DATA MANAGEMENT
Data reverse engineering – Three data Reverse engineering strategies – Definition – organization data issues - Software application – Finding reusable software components – Recycling real-time embedded software – Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces – Reverse Engineering of assembly programs: A model based approach and its logical basics

UNIT V INTEGRATION
Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering -–coordinate measurement – feature capturing – surface and solid members

REFERENCES

1. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
2. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
4. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
5. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
6. Co-ordinate Measurment and reverse engineering, Donald R. Honsa, ISBN 1555897, American Gear Manufacturers Association

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JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech : ENERGY SYSTEMS

II- SEMESTER **L P C**
4 - 4

ENERGY RESOURCES (Elective IV)
(15D32211)

UNIT I COMMERCIAL ENERGY
Coal, Oil, Natural Gas, Nuclear power and Hydro - their utilization pattern in the past, present and future projections of consumption pattern - Sector-wise energy consumption – environmental impact of fossil fuels – Energy scenario in India – Growth of energy sector and its planning in India.

UNIT II SOLAR ENERGY
Solar radiation at the earth's surface – solar radiation measurements – estimation of average solar radiation - solar thermal flat plate collectors - concentrating collectors – solar thermal applications - heating, cooling, desalination, drying, cooking, etc – solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells - Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc - solar PV power plant – Net metering concept.

UNIT III WIND ENERGY
Nature of the wind – power in the wind – factors influencing wind – wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications – offshore wind energy – Hybrid systems - safety and environmental aspects – wind energy potential and installation in India - Repowering concept.

UNIT IV BIO-ENERGY
Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - direct combustion – biomass gasification - pyrolysis and liquefaction – biochemical conversion - anaerobic digestion - types of biogas Plants - applications - alcohol production from biomass – bio diesel production – Urban waste to energy conversion - Biomass energy programme in India.

UNIT V OTHER TYPES OF ENERGY
Ocean energy resources - principle of ocean thermal energy conversion (OTEC) - ocean thermal power plants - ocean wave energy conversion - tidal energy conversion – small hydro – geothermal energy - geothermal power plants – hydrogen production and storage - Fuel cell – principle of working - various types - construction and applications.

REFERENCES
1. Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984.
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Peter Gevorkian, Sustainable Energy Systems Engineering, McGraw Hill,2007
5. Kreith, F and Kreider, J. F., Principles of Solar Engineering, McGraw-Hill, 1978.
6. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996

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M.Tech: ENERGY SYSTEMS

II- SEMESTER **L P C**
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MAINTENANCE ENGINEERING AND MANAGEMENT (Elective IV)
(15D32212)

UNIT-I:

Maintenance engineering objectives-Basic principles and approaches-Types of maintenance-Specifications and functions-Systems approach-performance indices-planning and control-Strategy.

UNIT-II:

Maintenance management and control-functions and organization-critical maintenance-effective elements-project control methods-control indices - Maintainability-Concepts-tasks-modeling and allocation-prediction-FMECA-reliability and maintainability trade off-Design for maintainability-design methods. .

UNIT-III:

Preventive maintenance-elements and principle-measures-mathematical models-Advantages and disadvantages - Corrective maintenance-types-measures-mathematical models-effective failure rate equations - Reliability Centered Maintenance-goals and principles-components-predictive testing and Inspection techniques-effective measurement indicators-Advantages.

UNIT-IV:

Quality in Maintenance-Processes-Control Charts-Post maintenance testing-Maintenance Safety-maintenance tasks-improving safety-personnel safety.

UNIT-V:

Maintenance costing-factors-budget type and approaches-labor cost estimation-material cost estimation-cost estimation model-cost related indices-economic analysis-Convex and Concave costs-profit and life cycle cost tradeoffs.

REFERENCS BOOKS:

1. A. K. Gupta, Reliability, Maintenance and Safety Engineering,
2. B. S. Dhillon, Engineering Maintenance A Modern Approach, CRC Press.
3. Charles E. Ebeling, Reliability and Maintainability Engineering, Tata McGraw Hill, 2000.

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M.Tech : ENERGY SYSTEMS

II- SEMESTER

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ENERGY OPERATIONS LAB
(15D32213)

List of Experiments

S.No.	Experiment Name
1	Estimation of Load & Solar Panel Requirement for an house hold
2	Study of plant location of wind mills
3	Calculation of payback period for domestic solar water heater – A case study
4	Industrial visit of mind mills
5	Study on captive power generation of an industry
6	Study of Energy efficient building
7	Estimation of drag force by using wind tunnel
8	Estimation of lift force by using wind tunnel