|  |
| --- |
| **KERALA TECHNOLOGICAL UNIVERSITY**  http://ktu.edu.in/images/logo_final.png  **SCHEME AND SYLLABUS**  **FOR**  **M. Tech. DEGREE PROGRAMME**  **IN**  **MECHANICAL ENGINEERING**  **WITH SPECIALIZATION**  **THERMAL POWER ENGINEERING**  **CLUSTER 05 (ERNAKULAM II)**  **KERALA TECHNOLOGICAL UNIVERSITY CET Campus, Thiruvananthapuram Kerala, India -695016**  **(2015 ADMISSION ONWARDS)** |

**KERALA TECHNOLOGICAL UNIVERSITY**

**SCHEME AND SYLLABUS FOR M. Tech. DEGREE PROGRAMME**

**Branch: MECHANICAL ENGINEERING**

**Specialization: THERMAL POWER ENGINEERING**

**Semester 1** (Credits: 21)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Exam Slot | Course No: | Name | L- T - P | Internal  Marks | End Semester Exam | | Credits |
| Marks | Duration (hrs) |
| A | 05ME 6101 | Advanced Thermodynamics | 3-1-0 | 40 | 60 | 3 | 4 |
| B | 05ME 6103 | Compressible and Incompressible Flows | 3-1-0 | 40 | 60 | 3 | 4 |
| C | 05ME 6105 | Advanced Heat and Mass Transfer | 3-1-0 | 40 | 60 | 3 | 4 |
| D | 05ME 6107 | Numerical Methods in Engineering | 3-0-0 | 40 | 60 | 3 | 3 |
| E | 05ME 611x | Elective-I | 3-0-0 | 40 | 60 | 3 | 3 |
|  | 05ME 6177 | Research Methodology | 0-2-0 | 100 | 0 | 0 | 2 |
|  | 05ME 6191 | Thermal Power Lab | 0-0-2 | 100 | 0 | 0 | 1 |

21

**Elective I**

|  |  |
| --- | --- |
| 05ME 6111 | Solar Energy Technology |
| 05ME 6113 | Energy Conservation in Thermal Systems |
| 05ME 6115 | Air-Conditioning and Ventilation |

**Semester 2** (Credits: 21)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Exam Slot | Course No: | Name | L- T - P | Internal  Marks | End Semester Exam | | Credits |
| Marks | Duration (hrs) |
| A | 05ME 6102 | Measurement Systems in Thermal Engineering | 3-1-0 | 40 | 60 | 3 | 4 |
| B | 05ME 6104 | Computational Fluid Dynamics | 3-0-0 | 40 | 60 | 3 | 3 |
| C | 05ME 6106 | Design of Heat Transfer Equipments | 3-0-0 | 40 | 60 | 3 | 3 |
| D | 05ME 612x | Elective-II | 3-0-0 | 40 | 60 | 3 | 3 |
| E | 05ME 613x | Elective-III | 3-0-0 | 40 | 60 | 3 | 3 |
|  | 05ME 6166 | Seminar - I | 0-0-2 | 100 | 0 | 0 | 2 |
|  | 05ME 6188 | Mini Project | 0-0-4 | 100 | 0 | 0 | 2 |
|  | 05ME 6192 | CFD Lab | 0-0-2 | 100 | 0 | 0 | 1 |

21

**Elective II**

|  |  |
| --- | --- |
| 05ME 6122 | Alternative Fuels for IC Engines |
| 05ME 6124 | Principles of Turbo machinery |
| 05ME6126 | Thermal and Nuclear Power Plants |

**Elective III**

|  |  |
| --- | --- |
| 05ME 6132 | Advanced Refrigeration |
| 05ME 6134 | Gas Turbines |
| 05ME 6136 | Simulation of IC Engine |

**Semester 3** (Credits: 14)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Exam Slot | Course No: | Name | L- T - P | Internal  Marks | End Semester Exam | | Credits |
| Marks | Duration (hrs) |
| A | 05ME 714x | Elective-IV | 3-0-0 | 40 | 60 | 3 | 3 |
| B | 05ME 715x | Elective-V | 3-0-0 | 40 | 60 | 3 | 3 |
|  | 05ME 7167 | Seminar - II | 0-0-2 | 100 | 0 | 0 | 2 |
|  | 05ME 7187 | Project (Phase 1) | 0-0-12 | 50 | 0 | 0 | 6 |

14

**Elective IV**

|  |  |
| --- | --- |
| 05ME 7141 | Combustion and Emission in IC Engines |
| 05ME 7143 | Finite Element Methods in Thermal Engineering |
| 05ME 7145 | Direct Energy Conversion Systems |

**Elective V**

|  |  |
| --- | --- |
| 05ME 7151 | Propulsion Engineering |
| 05ME 7153 | Optimization Methods in Thermal Engineering |
| 05ME 7155 | Safety in Engineering Industry |

**Semester 4** (Credits: 12)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Exam Slot | Course No: | Name | L- T - P | Internal  Marks | End Semester Exam | | Credits |
| Marks | Duration (hrs) |
|  | 05ME 7188 | Project (Phase 2) | 0-0-21 | 70 | 30 | - | 12 |

12

Total: 68

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05ME 6101** | | **ADVANCED THERMODYNAMICS** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:  To impart knowledge on various thermodynamic systems, fuels, combustion systems and estimation of pollutant emission.  **COURSE OUTCOMES:**  (1)The student gets a thorough knowledge on the design of various thermodynamic systems.  (2)The student will be able to conduct a feasible combustion analysis  (3) Ability to find the available and unavailable energy in any thermal system.  (4) Able to suggest remedial measures for emission control. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Introduction to thermodynamics – Equation of states – Properties of gases & gas mixtures – First law of TD – Enthalpy of formation – Heat of reaction– First law for reaction systems – Second law analysis for reaction systems– Chemical Energy– Stoichiometric & Equivalence ratio – Adiabatic flame temperature | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | Second law of TD – Concept of chemical equilibrium – Gibbs free energy and equilibrium constant of a chemical reaction – Vant Hoff’s equation - Calculation of equilibrium composition of a chemical reaction Thermodynamic efficiencies-Available energy. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | Fuels and combustion – Classification of fuels (Detailed) – Basic chemistry- Combustion equations- theoretical & Excess air – Stoichiometric Air – fuel – ratio (A/F) – Air fuel ratio from analysis of products Calorific value of fuels– Determination of calorific values of solids liquid & gaseous fuels – Actual combustion analysis. | | | | 10 |
| **IV** | Combustion systems – Modelling – Well stirred & plug flow model – Laminar- turbulent premixed flows – Determination of flow velocity & length– correlations- Flammability limits – uses in gas burner design – Burning of fuel jets – Liquid droplets and sprays– Combustion in fluidized beds – Estimation of pollutant Emission (CO, NOx, unburned HC) – Emission indices and control measures. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Engineering Thermodynamics, P K Nag. 2. Engineering Thermodynamics, Dr. M. Achuthan 3. Fuels and Combustion, Sharma &Chandramohan. 4. Thermodynamics & Heat transfer, YunusCengel. | | | | | |
|  | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME 6103 | | **COMPRESSIBLE AND INCOMPRESSIBLE FLOWS** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:  To impart knowledge of various basic principles and equations of fluid flow, exact and approximate solutions of Navier-Stokes equations under various flow conditions and introducing concepts in compressible flow normal shock, oblique shock and Fanno flow and Reyleigh flow.  **COURSE OUTCOMES:**  The students will be able to analyse both incompressible and compressible flow situation and capable of using the theories in a real life situation and take appropriate decisions with regard to design of various fluid handling devices. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Concept of a fluid, Fluid as a Continuum, Variation of viscosity with temperature, Stream function, Vorticity and Circulation, Eulerian and Lagrangian formulations, Reynolds transport theorem, Continuity equation, Momentum equation, Energy equation, Newtonian and Non-Newtonian fluids, Integral relations for a control volume, Differential relations for fluid flow, Navier Stokes equation, Einstein summation, Boundary layer equations. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Turbulence models and flow equations, Steady and Unsteady Turbulent boundary layers, Reynolds averaging, RANS equation, Favre averaging, Continuity and Momentum equation for fluctuating quantities, Universal structure of mean velocity profile in turbulent boundary layer, Effect of roughness, Moody’s chart, Eddy viscosity concept, Mixing length models.  Isentropic flow with variable area: Stagnation and Critical conditions, Mass flow rate, Geometric chocking, Isentropic flow through Convergent nozzle and Convergent Divergent nozzle. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Fanno flow : Adiabatic flow in constant area duct with friction, Fanno line, Friction chocking and its consequences, Variation of Mach number with duct length (L=L\*, L<L\*, L> L\*).  Rayleigh flow : Frictionless flow in constant area duct with heat transfer, Raleigh line, Thermal chocking and its consequences, Maximum heat transfer, Variation of Mach number with heat transfer (Q=Q\*, Q<Q\*, Q>Q\*) | | | | 10 |
| **IV** | Normal Shocks : Fundamental relations, Prandtl Meyer relation for normal shock, Impossibility of shock in subsonic flow.  Oblique Shocks and Expansion waves : Fundamental relations, Prandtl’s relation, θ-β-M diagram, Shock Reflections and Interactions, Detached shocks, Shock diamond, Mach disk, Expansion of supersonic flow, Supersonic flow around a convex corner, Prandtl Meyer angle, Shock expansion theory, Method of characteristics. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Som and Biswas “Advanced Fluid Mechanics” , Tata McGraw Hill 2. MuralidharK.&Biswas “Advanced Engineering Fluid Mechanics”,.G, Narosa Publishing House. 3. Frank M White, “Fluid Mechanics”, Tata Mc Graw Hill Publishing Company Ltd., 2008. 4. Schlichting H,"Boundary Layer Theory", McGraw Hill Book Company, NewYork, 1979. 5. Shapiro A. H. , "The Dynamics and Thermodynamics of Compressible Flow", Ronald Press Company, New York, 1953. 6. John D Anderson, “Modern Compressible flow”, Mc Graw Hill, 2003. 7. Biswas & Eswaran, “Turbulent Flows”, Narosa Publishers. 2002. 8. James John & Theo Keith, Gas Dynamics, Pearson Education, 2006. | | | | | |
|  | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME 6105 | | **ADVANCED HEAT AND MASS TRANSFER** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:  To impart knowledge of various basic principles and equations of heat and mass transfer, exact and approximate solutions under various conditions.  To teach the application of dimensional analysis to heat transfer problems.  **COURSE OUTCOMES:**  (1)The student gets a thorough knowledge to model conduction heat transfer problems, to apply conservation principles, to find exact and approximate solutions.  (2) The student gets a thorough knowledge to model convection heat transfer problems, to find the pertinent non-dimensional parameters, to non-dimensionalise equations, to find solutions using empirical relations and analogy.  (3) The student gets a thorough knowledge of basic principles of radiation heat transfer problems and to calculate radiation heat exchange in simple geometries.  (4) The student gets a thorough knowledge of basic principles in boiling &condensation and to mass transfer. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | General heat conduction equation in Cartesian, cylindrical and spherical co-ordinates –Composite geometries – Variable thermal conductivity – Uniform heat generation- Extended surfaces - Two dimensional heat conduction –Separation of variable. Flux plot-Numerical methods-finite difference - energy balance methods  Unsteady heat conduction – Lumped heat systems – -General lumped capacitance analysis-Infinite and semi- infinite bodies | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Convective heat transfer – Boundary layers – Continuity, momentum and energy equations - Boundary layers equations – Normalised boundary layer equations-Dimensional analysis - Exact and approximate solutions to forced convection in laminar and turbulent, internal and external flow – Flow across sphere, banks of tubes-Reynolds and Colburn analogies – forced convection correlations –Free convection-Governing equations-similarity parameters-Laminar and turbulent free convection from vertical, horizontal and inclined surfaces-vertical channels. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Radiation heat transfer – Basic laws of radiations – Emissive power – Stefan – Boltzmann, Lambert’s, Wien’s and Kirchhoff’s laws – Emissivity – Radiation intensity -  Radiation heat exchange between black isothermal surfaces-diffuse grey surfaces-Reflecting surfaces-Radiation shape factor-Shape factor algebra-Radiation shields–Combined convection and radiation- Radiation from gases and vapours. | | | | 10 |
| **IV** | Heat transfer with phase change – Boiling and Condensation –pool boiling and Flow boiling –modes of boiling-drop wise and film condensation- Problems using Correlations.  Convective mass transfer – Concentration boundary layer – Momentum, mass and heat transfer analogy – Convective mass transfer numbers – Flow over flat plates, flow through tubes– Evaporation of water into air – Problems using Correlations | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Bird R.B and J.R. Howell, “Transport Phenomena” Wiley International, 1960. 2. E.R.G. Eckert and R.M. Drake, “Analysis of Heat Transfer”, McGraw Hill, 1972. 3. Frank P Incropera and David P Dewitt, “ Fundamentals of HMT ” 6th Edition 4. Holman. J.P, “Heat Transfer”, McGraw Hill. 5. P. K. Nag. Heat and Mass Transfer,Tata McGraw-Hill 6. R.C.Sachdeva, “Fundamental of Engineering. Heat and Mass Transfer”, New age International, 2003. 7. E.M. Sparrow, R.D. Cess, “Radiative Heat Transfer”, McGraw Hill, 1972. | | | | | |
|  | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME 6107 | | **NUMERICAL METHODS IN ENGINEERING** | 3-0-0-3 | 2015 | |
| COURSE OBJECTIVES:  To impart a basic knowledge about approximations and iterative techniques to solve complex algebraic equations.  2 To impart the knowledge about various interpolation methods.  3 To impart the knowledge about various transformation techniques.  4 To impart the knowledge about regression methods.  **COURSE OUTCOMES:**  1. An ability to apply approximation techniques as well as to carry out iterative techniques to solve complex algebraic equations.  2 An ability to apply various interpolation methods to solve Engineering problems.  3 An ability to apply various transformation techniques to solve Engineering problems.  4 An ability to apply regression methods. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Approximations: Accuracy and precision, definitions of round off and truncation errors, error propagation, Algebraic equations: Formulation and solution of linear algebraic equations, Gauss elimination, LU decomposition, iteration methods (Gauss – Siedel), convergence criteria, Eigen values and Eigen vectors. | | | | 9 |
| **II** | Interpolation methods: Newton’s divided difference, interpolation polynomials, Lagrange interpolation polynomials, Differentiation and Integration: High accuracy differentiation formulae, extrapolation, derivatives of unequally spaced data, Gauss quadrature and integration. | | | | 9 |
| **III** | Transform techniques: Continuous Fourier series, frequency and time domains, Laplace transform, Fourier integral and transform, Discrete Fourier Transform(DFT), Fast Fourier Transform(FFT), Differential equations: Initial and boundary value problems, Eigen value problems, solutions to elliptical and parabolic equations, partial differential equations. | | | | 10 |
| **IV** | Regression methods: Linear and non-linear regression, multiple linear regression, general linear least squares, Statistical methods: Statistical representation of data, modelling and analysis of data, tests of hypotheses, Introduction to optimization methods; Local and global minima, Line searches, Steepest descent method, Conjugate gradient method, Quasi Newton method, Penalty function, Solution to practical engineering problems using software tools. | | | | 8 |
| **REFERENCES:**   1. Schilling R.J and Harris S.L , ‘Applied Numerical Methods for Engineering using MatLab and C’ , Brooks/Cole Publishing Co., 2000 2. Chapra S.C and Canale R.P , ‘Numerical Methods for Engineers’. McGraw Hill, 1989 3. Hines, W.W. and Montrogmery, “ Probability and Statistics in Engineering and Management Studies, “ John Wiley, 1990. 4. Gerald and Wheatley, Applied Numerical Analysis, Pearson Education, 1998. | | | | | |
|  | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME 6111 | | **SOLAR ENERGY TECHNOLOGY** | 3-0-0-3 | 2015 | |
| COURSE OBJECTIVES:   1. Understand solar energy systems . 2. To understand varies developments in solar energy collecting devices .   **COURSE OUTCOMES:**  The students will be aware different solar energy collecting technique and able to implement solar energy utilization by different methods. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Current alternate energy sources-thermodynamic view point and conversion methods. Components of solar energy systems, collector performance. Radiation and meteorological data processing, long term conversion factors. | | | | 9 |
| **II** | Solar thermal – Flat plate and concentrating collectors – Simulations, design methods. System design and optimizations. System configurations and system performance prediction. | | | | 9 |
| **III** | Solar passive devices solar stills, ponds, greenhouse, dryers. Trombe wall, overhangs and winged walls. Wind energy conversion systems. Economics of solar and wind energy systems. | | | | 10 |
| **IV** | Solar desalination –Solar cooker – Solar thermal systems applications to power generation, heating and cooling. Solar photo voltaic conversion – Solar cells – PV applications. | | | | 8 |
| **REFERENCES:**   1. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hill, New Delhi, 1996 2. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, second edition, John Wiley, New York, 1991 3. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000 4. D. D. Hall and R. P. Grover, Biomass Regenerable Energy, John Wiley, New York, 1987. 5. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986. | | | | | |
|  | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME 6113 | | **ENERGY CONSERVATION IN THERMAL SYSTEMS** | 3-0-0-3 | 2015 | |
| COURSE OBJECTIVES:   1. To understand the importance of energy conservation techniques   2 To study the thermodynamics of energy conservation.  3 To study about various waste heat recovery methods.  4 To understand about conservation methods in electricity utilization.  **COURSE OUTCOMES:**   1. Ability to suggest energy conservation methods for various industries 2. Ability to understanding of the thermodynamics of energy conservation. 3. Ability to suggest various waste heat recovery methods for industries. 4. Ability to suggest conservation methods in electricity utilization | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | General energy problem: Energy uses patterns and scope of conservation - Energy conservation scheme - Energy Management Principle: Need, Organizing and managing an energy management program - Energy auditing: types, methodologies, barriers. Role of energy manager. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Thermodynamics of energy conservation: Energy conservation in space conditioning - Energy conservation in Boilers and furnace - Steam pricing - Pricing other utilities - Energy conservation in stream and condensate system - Cogeneration: Concepts, Type of cogeneration system - performance evaluation of a cogeneration system. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Waste Heat Recovery: Waste heat recovery equipments -Types, Potential and benefit, - Heat pumps - Waste heat boilers - use of fluidized beds - Insulation - Cooling load - Industrial Insulation: Insulation materials, insulation selection - Economical thickness of insulation - Optimum selection of pipe size - Industrial Heating: Heating by indirect resistance, direct resistance heating (salt bath furnace), Heat treatment by induction heating in the electric furnace industry | | | | 10 |
| **IV** | Energy conservation in Electric Utility and Industry: Electric energy conversation methods - Energy cost and two -part tariff, Energy conservation in utility by improving load factor, Load curve analysis, Energy efficient motors, Energy conservation in illuminating system, Importance of power factor in energy conservation - Power factor improvement methods, Energy conservation in industries | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Electrical Energy Utilization and Conservation - S.C. Tripathy, Tata McGraw-Hill, 1991. 2. Energy management handbook - Wayne C. Turner, CRC Press Publications, 2004. 3. Industrial Energy Conversation - D.A. Reay, Pergamon Press 4. Industrial energy conservation Manuals: MIT Press. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME 6115 | | **AIRCONDITIONING AND VENTILATION** | 3-0-0-3 | 2015 | |
| COURSE OBJECTIVES:  To impart knowledge on Load estimation, Design of Air conditioning systems, Introduction to waste heat recovery and cogeneration.  **COURSE OUTCOMES:**  The student will be able to design an Air Conditioning system for the required comfort condition and also they will be in a position to minimize the total energy. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
|  | Thermal comfort - Effective temperature - Comfort chart - Inside design condition - Ventilation standards - Applied psychometry - Summer air conditioning processes, winter air conditioning processes. | | | | 9 |
| **II** | Load estimating - Comfort conditions - Weather data - Solar heat gain - Cooling and heating loads: heat gain/loss through glass - Heat gain/loss through structures – Internal load – Ventilation load - Infiltration load. | | | | 9 |
| **III** | Air distribution: room air distribution - Air diffusion equipments - Friction losses and dynamic losses in ducts- Air duct design.  Air handling equipments: Fans-types, Performance and selection - Air conditioning apparatus -Humidification and dehumidification equipments - Automatic controls - Noise reduction. | | | | 10 |
| **IV** | Air conditioning systems - DX systems-all water systems - All air systems - Air water systems -Central and unitary systems - Fan coil systems  Automatic controls of air conditioning systems - Thermostats dampers and damper motors -automatic valves piping design - Water piping - Refrigerant piping - Steam piping | | | | 8 |
| **REFERENCES:**   1. Arora and Domkundwar, Refrigeration and Air Conditioning - 1993 2. Wilbert F. Stoecker, Refrigeration and Air conditioning, Mc Graw Hill, Inc 1982. 3. ASHRAE HAND BOOK-HVAC systems & equipments, 1992 4. Kell J.R, Martin P.L, Heating and air-conditioning of buildings, Butterworth 5. Levenhagen, J.L.,Stethmann, D., heating ventilation and air conditioning controls and systems, Mc-Graw Hill | | | | | |
|  | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 05ME 6177 | | **RESEARCH METHODOLOGY** | 1-1-0-2 | 2015 | |
| COURSE OBJECTIVES:   1. To generate awareness about the importance, types and stages of research. 2. To introduce the methods for data collection, analysis, interpretation and presentation of the results.   **COURSE OUTCOMES:**  The students will be able to understand   1. The significance of different types of research and its various stages 2. The different methods of data collection 3. Different methods for analyzing data and interpreting the results. 4. The proper way of reporting and presenting the outcome. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| I | Research: Meaning & objectives – types of research - identification, selection and formulation of research problem - research design - review of literature. Data collection & presentation: Primary & secondary data - collection methods. Basic statistical measures: Measures of central tendency, variation and skewness. | | | | 9 |
| **II** | Probability:Definition – discrete and continuous probability distributions: binomial, poison, uniform, exponential and normal distributions. Sampling technique: Sampling methods, sampling distribution of mean, variance and proportion, confidence interval estimation, determination of sample size. | | | | 9 |
| **III** | Testing of hypothesis: Fundamentals of hypothesis testing – procedure of hypothesis testing - testing of mean, proportion and variance: one-tailed and two-tailed tests – chi-square test for checking independence of categorized data - goodness of fit test. Test for correlation and regression. | | | | 10 |
| **IV** | Non - parametric tests: One sample tests - sign test, chi-square test, Kolmogorov-Smirnov test, run test for randomness – two sample tests: sign test, median test, Mann-Whitney U test – K-samples tests: median tests, Kruskal-Wallis test. Interpretation and report writing: Meaning of interpretation, techniques of interpretations - types of report, layout of research report. | | | | 8 |
| **REFERENCES:**   1. Panneerselvam, R., “Research methodology”, Prentice Hall of India, New Delhi, 2011 2. Kothary, C. R., “Research methodology: methods and techniques”, New Age International, New Delhi, 2008 3. Goddard, W. and Melville, S., “Research methodology – an introduction”, Juta & Co. Ltd., Lansdowne, 2007 4. Miller and Freund, “Probability and statistics for engineers”, Prentice Hall of India Private Limited, New Delhi | | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| 05ME6191 | **Thermal POWER Laboratory** | 0-0-2-1 | 2015 |
| COURSE OBJECTIVES:  To impart knowledge about the performance of I C engines, to gain experience in the analysis of exhaust gas emissions. Familiarized with the thermal power plants.  **LIST OF EXPERIMENTS**   1. Performance, Combustion and Emission Studies on S.I. Engine fueled with alternative fuels 2. Performance, combustion and Emission Studies on C.I. Engines fueled with alternative fuels. 3. Performance test on variable compression ratio petrol and diesel engines. 4. Test on Thermal power plant (Steam Power Plant) 5. Test on Refrigeration plant. 6. Study of construction and principle of operation of Emission/Smoke analysers 7. Test on Air Conditioning plant 8. Test on Heat Exchangers to find the effectiveness/efficiency 9. Test on Heat Transfer Equipments to find thermal conductivity/heat transfer coefficient/emissivity etc   **REFERENCES:**   1. Wilbert F. Stoecker, Refrigeration and Air conditioning, Mc Graw Hill, Inc 1982. 2. Frank P Incropera and David P Dewitt, “ Fundamentals of HMT ” 6th Edition 3. Automotive Lubricants Reference Book, Second Edition, Roger F. Haycock and  John E. Hillier, SAE International Publications, 2004. 4. Engine Emissions: Pollutant Formation and Advances in Control Technology, B.P Pundir. Narosa Publishing House Pvt. Ltd., Delhi, 2007. 5. Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications,1990. | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME 6102 | | **MEASUREMENT SYSTEMS IN THERMAL ENGINEERING** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:  To provide knowledge on various measuring instruments.   1. To provide knowledge on advance measurement techniques. 2. To understand the various steps involved in error analysis and uncertainty analysis.   **COURSE OUTCOMES:**  1. The student gets an idea of the advanced measuring instruments and develops a skill to design measuring instruments according to the need.  2. Able to make a suitable selection of the appropriate instrument for a purpose  3. Able to select the sensors according to the need.  4. Able to do the analysis of the measurements. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Measurement characteristics, 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. | | | | 9 |

|  |  |  |
| --- | --- | --- |
| **INTERNAL TEST 1 (Module 1)** | | |
| **II** | Microprocessors and computers in measurement , Data logging and acquisition –analog to digital and digital to analog conversion- Use of sensors for error reduction, elements of micro computer interfacing, intelligent instruments in use. | 9 |
| **INTERNAL TEST 2 (Module 2)** | | |
| **III** | Measurement of physical quantities , Measurement of thermo-physical properties, instruments for measuring temperature, pressure and flow, use of sensors for physical variables. | 10 |
| **IV** | Advance measurement techniques , Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, heat flux sensors, Telemetry in measurement. Orsat apparatus, Gas Analysers, Smoke meters, gas chromatography, spectrometry. | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | |
| **REFERENCES:**   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.   1. Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, 2. Tata McGraw-Hill, New Delhi, 1983. 3. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 1958. 4. Barney, Intelligent Instrumentation, Prentice Hall of India, 1988 5. Prebrashensky. V., Measurement and Instrumentation in Heat Engineering, Vol.1   and MIR Publishers, 1980.   1. Raman, C.S. Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems,   Tata McGraw-Hill, New Delhi, 1983.   1. Doeblin, Measurement System Application and Design, McGraw-Hill, 1978. 2. Morris. A.S, Principles of Measurements and Instrumentation Prentice Hall of india | | |
|  | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME6104 | | **COMPUTATIONAL FLUID DYNAMICS** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:  1 To impart basic knowledge of governing equations and mathematical behavior of partial differential equations.  2 To impart the knowledge in finite difference method.  3 To impart the knowledge in finite volume method for steady and unsteady flow.  **COURSE OUTCOMES:**  1 Ability to understand and apply the governing equation to various engineering problems.  2 Ability to solve engineering problems using finite difference method.  3 Ability to solve steady and unsteady flow problems using finite volume method. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Philosophy of Computational Fluid Dynamics, Forms of Governing equations particularly suitable for CFD , Mathematical behavior of Partial Differential Equations – Hyperbolic equations – Parabolic equations – Elliptical equations. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Discretization – Introduction to finite differences- Difference equations – Explicit and Implicit approaches- stability – Simple CFD Techniques- Lax-Wendroff – Mac Cormack’s – Viscous flow-Conservation form – Space marching- The Relaxation Technique – Pressure correction – Stream function, Vorticity method of solution. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Finite Volume Method – One Dimensional steady state diffusion – Two and Three Dimensional diffusion problems – One Dimensional steady convection & diffusion – Central differencing scheme – Upwind differencing scheme – QUICK scheme – SIMPLE, SIMPLER, SIMPLEC, PISO | | | | 10 |
| **IV** | Finite Volume Method for Unsteady flow – One Dimensional Steady heat conduction – Explicit scheme – Crank-Nicholson scheme – Fully implicit scheme – Turbulence models- K- εmodel –Reynolds stress equation model. | | | | 8 |

|  |
| --- |
| **END SEMESTER EXAM (ALL Modules)** |
| **REFERENCES:**   1. 1. John D Anderson Jr - “Computational Fluid Dynamics”– McGraw Hill 2. H.K Versteeg& W Malalasekera - “An Introduction to Computational Fluid Dynamics”– 3. S.V. Patankar Hemisphere - “Numerical Fluid Flow & Heat transfer” 4. HoftmanKlaw Vol-1 & 2 “ Computational Fluid Dynamics” 5. T. Sundernajan- Narosa “Computational Fluid Flow and Heat Transfer” 6. Anderson, Tunne Hill and Pletcher “Computational Fluid Flow and Heat Transfer” 7. F.B.Dubin: Energy conservation Standards. McGraw Hill,1978. |
|  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME6106 | | **DESIGN OF HEAT TRANSFER EQUIPMENTS** | 3-0-0-3 | 2015 | |
| COURSE OBJECTIVES:  (I) To impart knowledge of various heat transfer equipments.  (II) To provide knowledge for the basic design of heat transfer equipments.  (III) To conduct the performance analysis heat transfer equipments.  **COURSE OUTCOMES:**  (1)The student gets a thorough knowledge of flow arrangements, for the design and performance analysis of double pipe heat exchanger.  (2) The student gets a thorough knowledge to design, to compare, to calculate pressure drop and the effect fouling and flow arrangements on performance of shell-and-tube heat exchangers.  (3) The student gets a thorough knowledge of working, flow arrangements, design and performance analysis of cooling towers.  (4) The student gets a thorough knowledge of basic principles of plate heat exchangers, heat pipe and their applications. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Different classification of heat exchangers-overview of heat exchanger design methodology-optimum design-Double pipe heat exchangers- Film coefficients of fluids in tubes- equivalent diameter for fluids flowing in annuli- Film coefficients for fluids flowing in annuli- Fouling factor- Average/Mean fluid temperature- Heat load-LMTD- LMTD correction factor-ε- NTU methods of evaluation of heat exchangers- P-NTU method-Double pipe heat exchangers in counter flow and parallel flow arrangements-Multi pass exchangers-series and parallel arrangements-selection of heat exchangers. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Shell and tube heat exchangers- Different types of shell and tube heat exchangers- Tube layout, baffles spacing- Calculation of shell and tube exchangers- Shell side equivalent diameter, shell side film coefficients- additional considerations for P-NTU &ε- NTU method –fluid by passing and leakage-flow patterns-flow fractions for each shell side stream-The Bell-Delaware method-stream analysis method-unequal heat transfer area in individual passes-shell side heat transfer coefficient-shell side pressure drop-rating procedure-approximate design method- tube side pressure drop- Flow arrangements for increased heat recovery- Influence of approach temperature on correction factor- TEMA standards. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Direct contact heat exchangers- Classification and types of cooling towers-Cooling tower requirements-Basic relations: Relation between wet bulb and dew point temperatures- Effective temperature- Diffusion theory-Heat Balance-Tower characteristics-The Lewis number-Water consumption-Fill characteristics-Pressure drop-Limitation on air and water flow rates- Overall coefficient of mass transfer-Size of cooling tower-Cooling tower performance-Design of cooling tower. | | | | 10 |
| **IV** | Types and characteristics-Plate heat exchanger-Flow pattern and pass arrangement-Application-limitation-heat transfer and pressure drop-Plate fin heat exchanger-rating- limitations-application-Tube fin heat exchanger-Spiral plate heat exchanger-Flow arrangement and applications- advantages and limitations- Methods of heat transfer augmentation-Description only  Heat pipes-working-Effect of gravity and heat pipe tilt-operating characteristics- application | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Donald Q. Kern. Process heat transfer, McGraw-Hill,1997. 2. Ozisik M.N., Heat transfer, McGraw-Hill,1988. 3. P K Nag. Heat and Mass Transfer,Tata McGraw-Hill 4. Nicholas Cheremisioff, Cooling tower, Ann Arbor Science pub.1981. 5. Ramesh K. Shah and D. P. Sekulic. Fundamentals of Heat Exchanger Design,Wiley 6. TEMA Hand book, Tubular Exchanger Manufacturer Association, New York,1981. 7. T Kuppan, Heat exchanger design hand book, Taylor & Francis, 2009 | | | | | |
|  | | | | | |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME 6122 | | **ALTERNATIVE FUELS FOR I C ENGINES** | 3-0-0-3 | 2015 | |
| COURSE OBJECTIVES:   1. Gain a working understanding of the engineering issues and perspectives affecting fuel and engine development. 2. Examine future trends and development, including hydrogen as an internal combustion engine fuel. 3. Explore further fuel specification and performance requirements for advanced combustion systems.   **COURSE OUTCOMES:**   1. The students will be aware different types alternative fuels and there usage in IC engine. 2. Students will be aware the production storage and handling of different alternative   fuels and the major modification required to the engine for operating by fuel mode. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Availability and Suitability and properties of Potential Alternative Fuels – Ethanol, Methanol, DEE, DME, Hydrogen, LPG, Natural Gas, Producer Gas, Bio gas and Bio-diesel, Properties, Merits and Demerits. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Requirements of fuels for SI engines-Different Techniques of utilizing alternative liquid fuels– Blends, Neat form, Reformed Fuels - Manufacturing, Storage and Safety-Performance and Emission Characteristics of alternative liquid fuels. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Requirements of fuels for CI engines- Different Techniques for their utilization- Blends, Fuel modifications to suit CI engines, Neat fuels, Reformed fuels, Emulsions, Dual fuelling, Ignition accelerators and other additives– Performance and emission characteristics. | | | | 10 |
| **IV** | Use of Hydrogen, CNG, LPG, Natural Gas, Producer gas and Bio gas in SI engines– Safety Precautions – Engine performance and emissions. Use of Hydrogen, Producer Gas, Biogas, LPG, Natural gas, CNG in CI engines. Dual fuelling, Performance and emission characteristics. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Automotive Lubricants Reference Book, Second Edition, Roger F. Haycock and  John E. Hillier, SAE International Publications, 2004. 2. Engine Emissions: Pollutant Formation and Advances in Control Technology, B.P Pundir. Narosa Publishing House Pvt. Ltd., Delhi, 2007. 3. Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications,1990. 4. Osamu Hirao and Richard K.Pefley, Present and Future Automotive Fuels, John Wiley and Sons, 1988. 5. Richard L.Bechtold, Automotive Fuels Guide Book, SAE Publications, 1997. | | | | | |
|  | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME 6124 | | **PRINCIPLES OF TURBO MACHINERY** | 3-0-0-3 | 2015 | |
| COURSE OBJECTIVES:  To impart knowledge on various types of turbo machines and their operation, flow mechanism through the impeller, methods of their performance evaluation under various operating conditions.  **COURSE OUTCOMES:**  By undergoing the course, one will be able to understand the working of various turbomachines under different operating conditions and will be able to design a system for the required output at the given conditions. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Definition and Classification of Turbomachines, Principles of operation, Specific work- representations on enthalpy entropy diagram. Fundamental equation of energy transfer, flow mechanism through the impeller, vane congruent flow, velocity triangles, ideal and actual flows, slip and its estimation, losses and efficiencies, degree of reaction, shape number and specific speed. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Two dimensional cascades: cascade nomenclature, lift and drag, circulation and lift, losses and efficiency, compressor and turbine cascade performance, cascade test results, cascade correlations, fluid deviation, off –design performance, optimum space-chord ratio of turbine blades. | | | | 9 |

|  |  |  |
| --- | --- | --- |
| **INTERNAL TEST 2 (Module 2)** | | |
| **III** | Axial flow turbines: Two dimensional theory Velocity diagram, Thermodynamics, stage losses and efficiency, Soderberg’s correlation, stage reaction, diffusion within blade rows, efficiencies and characteristics.  Three-dimensional flows in axial turbines: Theory of radial equilibrium, indirect and direct problems, compressible flow through a fixed blade row, constant specific mass flow rate, free vortex, off-design performance, blade row interaction effects.  Axial flow compressors: Two dimensional analysis Velocity diagram, Thermodynamics, Stage losses and efficiency, reaction ratio stage loading, stage pressure rise, stability of compressors. | 10 |
| **IV** | Centrifugal compressors: Theoretical analysis of centrifugal compressor, inlet casing, impeller, diffuser, inlet velocity limitations, optimum design of compressor inlet, prewhirl, slip factor, pressure ratio, choking in a compressor stage, Mach number at exit.  Radial Flow Turbines: Types of inlet flow radial turbines (IFR), thermodynamics of 90oIFR turbine. Efficiency, Mach number relations, loss coefficient, off-design operating conditions, losses, pressure ratio limits. | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | |
| **REFERENCES:**   1. S L Dixon: Fluid Mechanics and Thermodynamics of Turbo machinery, 1998 2. H I H Saravanamuttoo, G F C Rogers, H Cohen: Gas Turbine Theory,2001 3. P G Hill, C R Peterson: Mechanics and Thermodynamics of Propulsion 4. S M Yahya: Turbines, Compressors and Fans 5. V Kadambi and Manohar Prasad: An Introduction to Energy Conversion Vol III Turbo machinery 6. G F Wislicunes: Fluid Mechanics of Turbomachinery 7. G T Csandy: Theory of Turbo machines | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME6126 | | **THERMAL AND NUCLEAR POWER PLANTS** | 3-0-0-3 | 2015 | |
| COURSE OBJECTIVES:  To impart knowledge on various types of power plants and their operation.  To study different cycles and operating conditions.  To study different components and control devises.  To study different nuclear reactors and its operations.  **COURSE OUTCOMES:**  By undergoing the course, one will be able to understand the working of various types of power plants, its components and different cycle of operation. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Energy scenario. Overview of steam power plant. Analysis of steam cycles. Feedwater heaters. Decelerator and drain cooler. Analysis of multi-fluid coupled cycles. Combined cycle power generation. Draft systems. Combustion control. Furnaces for burning coal in fluidized beds and in pulverized form. Coal handling installation. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Different types of boilers and their specific uses. Boiler mountings and accessories. Feedwater treatment. Boiler maintenance. Circulation theory. Down-comers and risers. Drum and its internals. Economizer. Recuperative and regenerative air pre-heaters. Dust and ash removal systems. Environmental aspects of power generation | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Basic concepts of reactor, radioactivity. Neutron Scattering. Thermal and fast reactors. Nuclear cross-sections. Neutron flux and reaction rates. Moderator criteria. Reactor core design. Conversion and breeding. Types of reactors. Characteristics of boiling water, pressurized water, pressurized heavy water, gas cooled and liquid metal cooled reactors. | | | | 10 |
| **IV** | Thermal-hydraulics of reactors. Heavy water management. Containment system for nuclear reactor. Reactor safety radiation shields. Waste management. Indian nuclear power programme. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. 1. M.M.EI. Wakil., ‗Nuclear Power Engineering’, McGraw Hill Book Company, New York, 1987. 2. S. Glasstone and A. Setonske., ‗Nuclear Reactors, Engineering‘, 3rd Ed., CBS Publishers and Distributors, 1992. 3. Loftness, ‗Nuclear Power Plants’, D. Van Nostrand Company Inc, Princeton, 1964. 4. S. Sarg et al., ‗Physics of Nuclear Reactors’, Tata McGraw Hill Publishing Company Ltd., 1985. 5. T. J. Connoly., ‗Fundamentals of Nuclear Energy’, John Wiley, 1978. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME6132 | | **ADVANCED REFRIGERATION** | 3-0-0-3 | 2015 | |
| COURSE OBJECTIVES:  To impart knowledge on various types refrigeration systems, effect of operating conditions, refrigerants used and its designation.  **COURSE OUTCOMES:**  By undergoing the course, one will be able to understand the working and performance of various refrigeration systems and its components under different operating conditions, types of refrigerants used, their selection criteria and nomenclature.  Students | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Recapitulation of thermodynamics - Different methods of refrigeration - Multi pressure systems -Flash gas removal - Multi evaporator systems - Compound refrigeration systems - Multi evaporator and multi compressor systems - Low temperature refrigeration - Cascade systems. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Thermal compression against mechanical compression - Vapour absorption refrigeration systems - Maximum COP - Common refrigerant absorbent systems - Modification to simple vapour absorption systems - Using liquid-liquid heat exchanger - Using analyzer - Actual vapour absorption systems - and its representation on enthalpy composition diagram - Absorption system calculations - Lithium bromide water systems. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Vapour compression systems - Limitations of reversed Carnot cycle with vapour as refrigerant -Vapour compression cycle - Enthalpy pressure diagrams - Ewing’s construction - Suction cycle for maximum COP - Standard rating cycle and effect of operating conditions - Effect of evaporator pressure - Condenser pressure-suction vapour superheat - Liquid sub cooling -using liquid vapour regenerative heat exchanger - Actual vapour compression system - Complete vapour compression system. | | | | 10 |
| **IV** | Refrigerants - Classification-designation of refrigerants - selection criterion - Thermodynamic requirements - Chemical-physical requirements - Secondary refrigerants - Lubrication in refrigeration system - Non conventional refrigeration systems – Thermo electric - Pulse tube -Vortex tube refrigeration systems - Ejector compression systems - Air refrigeration systems. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. C.P. Arora, Refrigeration and Air conditioning, Tata Mc Graw Hill, 2000. 2. Wilbert F. Stoecker, Refrigeration and Air conditioning, Mc Graw Hill, Inc 1982. 3. Roy. J Dossat, Refrigeration and Air conditioning, Pearson 4. P.N Anantha Narayanan, Basic Refrigeration & Air-conditioning, T M H 1996. 5. Manohar Prasad, Refrigeration and Air conditioning, New Age 1999. 6. Carriers Handbook system Design of Air Conditioning. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME 6134 | | **GAS TURBINES** | 3-0-0-3 | 2015 | |
| COURSE OBJECTIVES:  To impart the concepts of various gas turbine arrangements and its cycle.  2 To impart the knowledge about centrifugal and axial flow compressors.  3 To describe about the gas turbine combustion and design factors of combustion chamber.  4 To impart the knowledge about centrifugal and axial flow turbines.  **COURSE OUTCOMES:**  To evaluate the performance of various types of gas turbine arrangements.  2 To evaluate the performance of centrifugal and axial flow compressors.  3 To understand the different types of combustion chamber and its design factors.  4 To evaluate the performance of centrifugal and axial flow turbines. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Ideal and actual gas turbine cycles: Re-heater, Intercooler, Heat Exchange and combined cycles-Factors affecting the performance of a practical gas temperature operation - Blade cooling.turbine. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Centrifugal compressors: Principle of operation- Blade shape and Velocity triangles - Analysis of flow - Performance parameters - Losses - surging and chocking.  Axial Flow Compressors: Working principle - stage velocity triangles - Stage efficiency - Factors affecting stage pressure ratio - performance coefficients - Degree of reaction - Flow through blade rows -Three-dimensional flow - Cascade testing – Losses - Compressor characteristic curves - Surging and stalling. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Combustion: Combustion process - Types of combustion systems – Design factors – Requirements of a combustion chamber - Combustion chamber performance – Combustion chamber geometry – Fuel injection - ignition – Inlets and nozzles - Gas turbine emission. | | | | 10 |
| **IV** | Axial and Radial Flow Turbines: Turbine: Stage velocity triangles – stage efficiencies –Maximum utilization factor – Compounding – Multistage Reaction Turbine – Degree of reaction - losses and co-efficient –Blade fixing – High | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. 1. Ganesan, V., Gas Turbines, Tata McGraw-Hill Pub.Co.Ltd., New Delhi, 1999. 2. Cohen, H., Rogers, G.E.C., and Saravanamuttoo, H.I.H., Gas Turbine Theory,b Longman Group Ltd, 1989. 3. Yahya, S.M., Turbines, Compressors and Fans, Tata McGraw-Hill, 1983. 4. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker, Inc., USA, 1992 5. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbomachinery, Pergamon Press, 1978. | | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| 05ME6136 | **SIMULATION OF I C ENGINE** | 3-0-0-3 | 2015 |
| COURSE OBJECTIVES:   * To make the students understand the basic concept of thermodynamics of combustion and estimation of gas properties. * To understand various chemical reactions of combustion and adiabatic flame temperature calculations. * To give awareness about basic concepts of combustion and its simulation in SI engines. * To give awareness about the combustion processes and its simulation in CI engines. * To understand various simulation processes in engines under different load conditions and to know about progressive combustion   **COURSE OUTCOMES:**  After completing the course students must be able to:   * Explain the basics of concept of thermodynamics of combustion and estimation of gas properties. * Explain various combustion and adiabatic flame temperature calculations. * Explain various concepts of combustion and its simulation in SI engines. * Communicate different concepts of the combustion processes and its simulation in CI engines. * Evaluate and explain various simulation processes in engines under different load conditions and to know about progressive combustion | | |
| **II** | Simulation principles-First and second laws of thermodynamics – Estimation of properties of gas mixtures - Structure of engine models – Open and closed cycle models - Cycle studies, Chemical Reactions, First law application to combustion, Heat of combustion – Adiabatic flame temperature. | 9 |
| **III** | Simulation in C I engine Combustion in CI engines Single zone models – Premixed-Diffusive models – Wiebe’s model. Combustion in diesel engines - Heat transfer in engines -Heat transfer correlations. | 10 |
| **IV** | Simulation of Otto cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Exhaust and intake process analysis.  Simulation of Diesel cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Exhaust and intake process analysis. | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | |
| **REFERENCES:**   1. 1 Ashley S. Campbell, Thermodynamic Analysis of Combustion Engines, John Wiley and Sons, 1980. 2. V.Ganesan, Computer Simulation of Spark Ignition Engine Processes, Universities Press, 1995. 3. V.Ganesan, Computer Simulation of Compression Ignition Engine Processes, Universities Press, 2002. 4. Horlock and Winterbone, The Thermodynamics and Gas Dynamics of Internal Combustion Engines, Vol. I & II, Clarendon Press, 1986. 5. J.I.Ramos, Internal Combustion Engine Modeling, Hemisphere Publishing Corporation, 1989. 6. J.N.Mattavi and C.A.Amann, Combustion Modeling in Reciprocating Engines, Plenum Press, 1980. | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| 05ME6166 | **seminar – I** | 0-0-2-2 | 2015 |
| COURSE OBJECTIVES:  To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his ideas and thus creating in him self esteem and courage that are essential for an engineer.  Individual students are required to choose a topic of their interest from IC Engines , Renewable energy, Solar energy and Turbo Machinery related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation. | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| 05ME6188 | **MINI PROJECT** | 0-0-2-2 | 2015 |
| **Course Objectives :**  To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his ideas and thus creating in him self esteem and courage that are essential for an engineer.  Individual students are required to choose a topic of their interest from IC Engines , Renewable energy, Solar energy and Turbo Machinery related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation. | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| 05ME 6192 | **CFD LAB** | 0-0-2-1 | 2015 |
| **Course Objectives:**  To gain awareness to CFD packages related to thermal engineering problems like:   * + 1. STAR CD     2. FLUENT     3. GAMBIT/ PRO E     4. LAB VIEW     5. ANSYS   **SIMULATION STUDIES**  CFD analysis for fluid flow problem with and without heat transfer in simple geometries like:  Flow over plates  Flow over pipes  Flow over aerofoil  Flow through pipes  Flow through vertical channels  Flow through horizontal channels  Refernces:  1. John D Anderson Jr - “Computational Fluid Dynamics”– McGraw Hill   1. H.K Versteeg& W Malalasekera - “An Introduction to Computational Fluid Dynamics”– 2. S.V. Patankar Hemisphere - “Numerical Fluid Flow & Heat transfer” 3. HoftmanKlaw Vol-1 & 2 “ Computational Fluid Dynamics” 4. T. Sundernajan- Narosa “Computational Fluid Flow and Heat Transfer” 5. Anderson, Tunne Hill and Pletcher “Computational Fluid Flow and Heat Transfer” 6. F.B.Dubin: Energy conservation Standards. McGraw Hill,1978. | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME7141 | | **COMBUSTION AND EMISSION IN I C ENGINES** | 3-0-0-3 | 2015 | |
| **COURSE OBJECTIVES:**   1. To make the students understand the basic concept, the principle, and theories of combustion of fuels 2. To understand combustion in Spark Ignition and Compression Ignitionl engines. 3. To identify the nature and extent of the problem of pollutant formation from Internal Combustion Engines 4. To understand the Pollutant Control methods and After Treatment Devices used in in Internal Combustion Engines   **COURSE OUTCOME:**  After completing the course students must be able to:   1. Explain the basics of combustion reactions of any type of fuels 2. Explain the combustion and emission formation in the spark ignited engine 3. Explain the combustion and emission formation in the diesel engine 4. Identify the most common exhaust emissions from internal combustion engines and their impact on health and environment 5. Communicate different methods to reduce exhaust emissions from engines during combustion and after treatment process. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Combustion principles **:** Combustion – Combustion equations of fuels, heat of combustion - Theoretical flame temperature - chemical equilibrium and dissociation and its harmful effects - Theories of Combustion - Pre-flame reactions - Laminar and Turbulent Flame Propagation in Engines. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Combustion in Spark Ignition (SI). engine:Initiation of combustion, stages of combustion, normal and abnormal combustion, knocking combustion, pre-ignition, knock and engine variables, features and various design consideration of combustion chambers. Flame structure and speed, Cycle by cycle variations, Lean burn combustion, stratified charge combustion systems. After treatment devices for SI engines. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Combustion in Compression Ignition (CI) engine :Stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl measurement, knock and engine variables, features and various design considerations of combustion chambers, Influence of the injection system on combustion. Direct and indirect injection systems. After treatment devices for diesel engines. | | | | 10 |
| **IV** | Emissions :Main pollutants in engines, Kinetics of NO formation, NOx formation in SI and CI engines. Unburned hydrocarbons, sources, formation in SI and CI engines, Soot formation and oxidation, Particulates in diesel engines, Emission control measures for SI and CI engines- Two-way and Three-way Catalytic convertors, EGR, urea SCR injection. Effect of pollutant emissions on environment and human beings. | | | | 8 |
| **END SEMESTER EXAM (All Modules)** | | | | | |
| **REFERENCES:**   1. John B.Heywood, Internal Combustion Engine Fundamentals,McGraw Hill Book, 1998 2. Bosch Automotive Handbook 3. Ganesan, V, Internal Combustion Engines, Tata McGraw Hill Book Co., 2003. 4. Obert,E.F., Internal Combustion Engine and Air Pollution, International Text Book Publishers, 1983. 5. Mathur,M.L., and Sharma,R.P., A Course in Internal Combustion Engines, DhanpatRai Publications Pvt. New Delhi-2, 1993. 6. Ramalingam, K.K., Internal Combustion Engines, Scitech Publications (India) Pvt. Ltd., 2004. 7. Cohen,H, Rogers,G,E.C, and Saravanamuttoo, H.I.H., Gas Turbine Theory, Longman Group Ltd., 1980. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME7143 | | **FINITE ELEMENT METHODS IN THERMAL ENGINEERING** | 3-0-0-3 | 2015 | |
| **COURSE OBJECTIVES:**  To impart basic knowledge of governing equations and mathematical behavior of partial differential equations.  To impart the knowledge in finite element method.  To impart the knowledge to apply various boundary conditions.  **COURSE OUTCOME:**  Students will be able to apply the governing equation to various heat transfer problems.  Students will be able to solve different modes of heat transfer problems using finite element method. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Overview of numerical methods - Discretised representation of physical systems - thermal resistance, flow resistance networks, thermal capacitance - Governing equations and Boundary conditions for thermal and flow systems. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | One dimensional Heat conduction - Principles of variations calculus - applications of various approach to one dimensional heat conduction -element matrix contribution and assembly. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Heat functions and analysis-Weighted residual methods - Galerkin's approach - Shape functions and interpolations - Application of Galerkin's weighted residual approach to one dimensional heat conduction - Three nodded triangular elements, 2 D steady state conduction using triangular elements. | | | | 10 |
| **IV** | Convective heat transfer- Higher order elements and numerical integration solution of heat conduction and creeping flow using higher orderelement - Solution of convective heat transfer. | | | | 8 |
| **END SEMESTER EXAM (All Modules)** | | | | | |
| **REFERENCES:**   * 1. The Finite Element Method in Engg., 2nd ed. S.S.Rao Pergamon Press, 1990.   2. Applied Finite Element Analysis, 2nd ed, Larry Segerlind John Wiley & Sons, 1988.   3. Finite Element Analysis Theory and Programming 2nd ed, C.S.Krishnamoorthy, Tata McGraw-Hill 1991.   4. Finite Elements Methods, J.N.Reddy, McGraw-Hill 1988.   5. Finite Element Methods O.C.Zienkiewiez, McGraw-Hill 1980.   6. Introduction to Finite Elements in Engg., T.R.Chandrapatla and Belegundu, Prentice Hall of India.   7. Finite Element Computational Fluid Mechanics - A.J.Baker, McGraw-Hill. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05ME 7145** | | **DIRECT ENERGY CONVERSION SYSTEMS** | 3-0-0-3 | 2015 | |
| **COURSE OBJECTIVES:**  To impart knowledge about various types of direct energy conservation systems and their principles of operation.  To attain knoledge of PV Cells, MHD Generators and fuel cells.  **COURSE OUTCOMES:**  The students will be aware different types various types of energy conservation systems and their principles of operation.  Students will be aware P V cells and MHD generators and fuel cells | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Basic science of energy conversion – Orderly and disorderly energy - Reversible and irreversible engines – Analysis of basically reversible engines – Duality of matter – Thermoelectric vs photoelectric phenomena – Basic thermoelectric engine – Thermoelectric materials – Applications. | | | | 9 |
| **INTERNAL TEST 1 (Module 1)** | | | | | |
| **II** | Physics of solar photovoltaic cells – Production of solar cells – Design concept of PV cell systems – Solar cells connected in series and parallel – Voltage regulation and energy storage – Centralized and decentralized PV systems – Maintenance of PV systems – Current developments. | | | | 9 |
| **INTERNAL TEST 2 (Module 2)** | | | | | |
| **III** | Thermionic emission – Richardson’s equation – Analysis of high vacuum thermionic converter – Gaseous converters – Introduction to MHD generators – Seeding and ionisation in MHD generators – Analysis of MHD engines and MHD equations – Conversion efficiency and electrical losses in MHD power generation systems. | | | | 10 |
| **IV** | Definition, general description, types, design and construction of fuel cells – Thermodynamics of ideal fuel cells – Practical considerations - Present status – Future energy technologies – Hydrogen energy - Nuclear fusion. | | | | 8 |
| **END SEMESTER EXAM (All Modules)** | | | | | |
| **REFERENCES:**   1. S.S.L Chang: Energy Conversion, Prentice Hall, 1963 2. G. W. Sutton: Direct Energy Conversion, McGraw Hill, 1966 3. S.L. Soo: Direct Energy Conversion, Prentice Hall ,1968 4. S.W.Angrist: Direct Energy Conversion,4e,Allwyn & Bycon,1982 5. D.Merick and R.Marshall: Energy,Present and future options,VolI&II,John Wiley,1981 6. B.Sorenson: Renewable Energy, Academic Press,1989 7. N.B.Breiter: Electro chemical Processes in fuel cells ,Spring-Verlag,1969. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME7151 | | **PROPULSION ENGINEERING** | 3-0-0-3 | 2015 | |
| **COURSE OBJECTIVES:**  1 To impart the basic concepts of Jet propulsion and rocketry.  2 To impart the knowledge about solid propulsion and liquid propulsion system.  3 To impart a sound knowledge in ramjet propulsion system.  **COURSE OUTCOMES:**  1 An ability to carry out simple performance analysis of a propulsion system.  2 An understanding of the fundamentals of solid propulsion and liquid propulsion system.  3 An understanding about the ramjet propulsion system. | | | | | |
| MODULE |  | | | | HRS |
| **I** | Principles Of Jet Propulsion And Rocketry: Fundamentals of jet propulsion, Rockets and air breathing jet engines – Classification – turbo jet , turbo fan, turbo prop, rocket (Solid and Liquid propellant rockets) and Ramjet engines. Nozzle Theory and Characteristics Parameters: Theory of one dimensional convergent – divergent nozzles – aerodynamic choking of nozzles and mass flow through a nozzle – nozzle exhaust velocity – thrust, thrust coefficient, Ac / At of a nozzle, Supersonic nozzle shape, non-adapted nozzles, summer field criteria, departure from simple analysis – characteristic parameters – 1) characteristic velocity, 2) specific impulse 3) total impulse 4) relationship between the characteristic parameters 5) nozzle efficiency, combustion efficiency and overall efficiency. | | | | 9 |
| **II** | Solid Propulsion System: Solid propellants – classification, homogeneous and heterogeneous propellants - double base propellant compositions and manufacturing methods - Composite propellant oxidizers and binders. - Effect of binder on propellant properties. - Burning rate and burning rate laws - factors influencing the burning rate - methods of determining burning rates.  Solid propellant rocket engine – internal ballistics - equilibrium motor operation and equilibrium pressure to various parameters - Transient and pseudo equilibrium operation - end burning and burning grains - grain design. Rocket motor hard ware design - Heat transfer considerations in solid rocket motor design - Ignition system - simple pyro devices. | | | | 9 |
| **III** | Liquid Rocket Propulsion System: Liquid propellants – classification, Mono and Bi propellants - Cryogenic and storage propellants - ignition delay of hypergolic propellants - physical and chemical characteristics of liquid propellant.  Liquid propellant rocket engine – system layout, pump and pressure feed systems - feed system components - Design of combustion chamber, characteristic length, constructional features, and chamber wall stresses - Heat transfer and cooling aspects - Uncooled engines - injectors – various types, injection patterns, injector characteristics, and atomization and drop size distribution - propellant tank design. | | | | 10 |
| **IV** | Ramjet And Integral Rocket Ramjet Propulsion System: Fuel rich solid propellants - gross thrust - gross thrust coefficient - combustion efficiency of ramjet engine - air intakes and their classification – critical, super critical and sub-critical operation of air intakes - classification and comparison of IIRR propulsion systems. | | | | 8 |
| **END SEMESTER EXAM (All Modules)** | | | | | |
| **REFERENCES:**   * 1. Hill and Peterson,Mechanics and Dynamics of Propulsion, John Wiley & Sons .   2. Sutton,Rocket propulsion elements, John Wiley & Sons,8th Edition .   3. Ganesan , Gas Turbines, TMH   4. Khajuria & Dubey, Gas Turbines & Propulsive Systems, Dhanpat Rai & Sons   5. Nicholas Cumpsty, Jet propulsion, Cambbridge university press, 2003. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME7153 | | **OPTIMIZATION METHODS IN THERMAL ENGINEERING** | 3-1-0-3 | 2015 | |
| **COURSE OBJECTIVES:**  To understand and model different engineering problems. To identify different operating and design parameters relevant for optimizing an engineering system. To study different tools used for optimization.  **COURSE OUTCOMES:**  Students will be able to analyze and model a thermal engineering system, will be able to identify the pertinent parameters, to formulate the problem and to apply different techniques. Students will be able to get an optimized solution for thermal engineering problems. | | | | | |
| MODULE |  | | | | HRS |
| **I** | Introduction: workable and optimum system-evaluating potential investments-taxes-depreciation. Mathematical modeling: solution of simultaneous equations-polynomial representations-Langrange interpolation-exponential forms-equation fitting-best fit. Modeling thermal equipment(Heat exchanger):enthalpy-pressure drop and pumping power | | | | 9 |
| **II** | System simulation: Sequential and simultaneous calculations-Taylor series expansion-Newton-Raphson method-overview of system simulation. Optimization: Levels of optimization-mathematical presentation-optimization procedures-mathematical statement of optimization-Langrage multiplier equations-unconstrained and constrained optimization. | | | | 9 |
| **III** | Search methods: Single variable-Exhaustive, Dichotomous, Fibonacci search; Multivariable unconstrained-lattice, univariate, steepest ascent; Multivariable constrained-penalty functions, search along a constrained. Dynamic programming-symbolic description-characteristics-pattern of solution. Linear programming-mathematical statement and development-slack variables-simplex algorithem. | | | | 10 |
| **IV** | Modeling thermodynamic properties: Linear and nonlinear regression analysis-Clapeyron equation, relation at saturated condition, Maxwell relations, specific heat-v-t relations-set of data; steady state simulation of large systems-convergence and divergence-evaluation of Newton-Raphson method-accelerating solution-influence of coefficients. | | | | 8 |
| **END SEMESTER EXAM (All Modules)** | | | | | |
| **REFERENCES:**   1. W. F. Stoecker. Design of Thermal Systems, McGraw hill international. 2. Taha. H. A., Operations Research, An Introduction , Sixth edition PHI. 3. Simmons D. M, Nonlinear Programming for Operations Research, PHI 4. M. S. Bazaraa. H. D. Sherali, C. M. Shetty, Nonlinear programming theory and Algorithm, John Wiley, II edition, 1993. 5. Hadley G, Linear Programming, Addison Wesley. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| 05ME7155 | | **SAFETY IN ENGINEERING INDUSTRY** | 3-0-0-3 | 2015 | |
| **COURSE OBJECTIVES:**   1. To make the students understand the basic concept of safety management system. 2. To understand various safety aspects related to machine guarding. 3. To give awareness about basic concepts of risk and various risk assessment techniques. 4. To give awareness about the safety precautions and safe practices to be followed in Engineering Industries.   **COURSE OUTCOMES:**  After completing the course students must be able to:   1. Explain the basics of concept of safety management systems 2. Explain various safe working conditions and accident investigations 3. Explain various machine guarding methods,risk and various risk assessment techniques. 4. Communicate different safety precautions and safe practices followed in Engineering Industries. 5. Evaluate and explain various types of pollution control methods | | | | | |
| MODULE |  | | | | HRS |
| **I** | Safety management-introduction, safety management system. History of safety movement, Henrich theory, safety policy, budget, productivity and safety techniques. Actual investigation and report, methods – 4E s, types of accident investigation. Duties of investigator, types of evidence, supervisor’s role in safety. Accident potential, cost of an accident, .un-safe acts and un safe conditions. Accidents classification and analysis-fatal, serious, minor and reportable accidents –safety audits-recent development of safety engineering approaches | | | | 9 |
| **II** | Machine guarding- types of guards, guard design, lock out and tag out. Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. | | | | 9 |
| **III** | Basic concepts of risk-reliability and hazard potential-elements of risk assessment –statistical methods – control charts-appraisal of advanced techniques-fault tree analysis-failure mode and effect analysis – quantitative structure-activity relationship analysis-fuzzy model for risk assessment. | | | | 10 |
| **IV** | Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers. Health and welfare measures in engineering industry-pollution control in engineeringindustry-industrial waste disposal. | | | | 8 |
| **END SEMESTER EXAM (All Modules)** | | | | | |
| **REFERENCES:**   * + 1. Accident Prevention Manual, NSC, Chicago, 1982 Occupational safety Manual, BHEL, Trichy, 1988.     2. John V. Grimaldi and Rollin H. Simonds, Safety Management by, All India Travelers Book seller, New Delhi, 1989.     3. N.V. Krishnan, Safety in Industry, Jaico Publishery House, 1996.     4. Indian Boiler acts and Regulations, Government of India.     5. Safety in the use of wood working machines, HMSO, UK 1992.     6. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989. | | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| 05ME7167 | **seminar   II** | 0-0-2-2 | 2015 |
| **COURSE OBJECTIVES:**  To assess the debating capability of the student to present a technical topic.  Also to impart training to a student to face audience and present his ideas and thus creating in him self esteem and courage that are essential for an engineer.  Individual students are required to choose a topic of their interest from IC Engines , Renewable energy, Solar energy and Turbo Machinery related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation. | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| 05ME 7187 | **PROJECT PHASE-1** | 0-0-1-2 | 2015 |
| The thesis (Phase-I) shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation/numerical work, design and or development work that the candidate has executed. In Phase-I of the thesis it is expected that the student should decide a topic of thesis, which is useful in the field or practical life. It is expected that students should refer national and international journals, proceedings of national and international seminars. Emphasis should be given to the introduction to the topic, literature review, and scope of the proposed work along with some preliminary work / experimentation carried out on the thesis topic. Student should submit Phase-I thesis report in two copies covering the content discussed above and highlighting the features of work to be carried out in part-I of the thesis. Student should follow standard practice of thesis writing. The candidate will deliver a talk on the topic and the assessment will be made on the basis of the term work and talks there on by a panel of internal examiners one of which will be the internal guide. These examiners should give suggestions in writing to the student to be incorporated in thesis work Phase-II. | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| 05ME7188 | **PROJECT PHASE-2** | 0-0-2-1 | 2015 |
| **COURSE OBJECTIVES:**  To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.  Masters Research project phase-II is a continuation of project phase-I started in the third semester. Before the end of the fourth semester, there will be two reviews, one at middle of the fourth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre qualifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation. | | | |