ACADEMIC REGULATIONS

PROGRAM STRUCTURE

and

DETAILED SYLLABUS

Master of Technology

(Thermal Engineering)

(Two Year Regular Programme)

(Applicable for Batches admitted from 2018)

Gokaraju Rangaraju Institute of Engineering and Technology

(Autonomous)

Bachupally, Kukatpally, Hyderabad- 500 090

Gokaraju Rangaraju Institute of Engineering and Technology
Department of Mechanical Engineering
Thermal Engineering

I YEAR - I SEMESTER

Sl. No	Course Code	Group	Subject	Credits			Total Hours	Total Credits	Int. Marks	Ext. Marks	Total Marks
				L	T	P					
1	GR18D5141	Core I	Thermodynamics and Combustion	3	0	0	3	3	30	70	100
2	GR18D5142	Core II	Advanced Fluid Dynamics	3	0	0	3	3	30	70	100
3	GR18D5143 GR18D5144 GR18D5145	**PE I**	1. Nuclear Engineering 2. Energy Conservation and Management. 3. Micro/Nano scale heat transfer	3	0	0	3	3	30	70	100
4	GR18D5146 GR18D5147 GR18D5148	**PE II**	1. Air Conditioning System Design 2. Gas Turbines 3. Theory of Heat pipes	3	0	0	3	3	30	70	100
5	GR18D5149	Core	Thermal Engineering Lab-I	0	0	4	4	2	30	70	100
6	GR18D5150	Core	Thermal Engineering Lab-II	0	0	4	4	2	30	70	100
7	GR18D5012	Core	Research Methodology and IPR	2	0	0	2	2	30	70	100
Total				**14**	**0**	**8**	**22**	**18**	**210**	**490**	**700**
8		Audit	Audit course -1	2	0	0		0	30	70	100

I YEAR - II SEMESTER

Sl. No	Course Code	Group	Subject	Credits			Total Hours	Total Credits	Int. Marks	Ext. Marks	Total Marks
				L	T	P					
1	GR18D5151	Core III	Advanced Heat Transfer	3	0	0	3	3	30	70	100
2	GR18D5152	Core IV	Steam Engineering	3	0	0	3	3	30	70	100
3	GR18D5153 GR18D5154 GR18D5155	**PE III**	1. Refrigeration and cryogenics 2. Design of Heat Exchangers 3. Convective Heat Transfer	3	0	0	3	3	30	70	100
4	GR18D5156 GR18D5157 GR18D5158	**PE IV**	1. Computational Fluid Dynamics 2. Modelling of IC Engines 3. Numerical Simulation and Modelling of Turbulent flows	3	0	0	3	3	30	70	100
5	GR18D5159	Core	Thermal Engineering Lab-III	0	0	4	4	2	30	70	100
6	GR18D5160	Core	Thermal Engineering Lab-IV	0	0	4	4	2	30	70	100
7	GR18D5190	Core	Mini-Projects	2	0	0	2	2	30	70	100
Total				**14**	**0**	**8**	**22**	**18**	**210**	**490**	**700**
8		Audit	Audit course – 2	2	0	0		0	30	70	100

II YEAR - I SEMESTER

Sl. No	Course Code	Group	Subject	Credits			Total hours	Total Credits	Int. Marks	Ext. Marks	Total Marks
				L	T	P					
1	GR18D5161 GR18D5162 GR18D5140	**PE V**	1. Design of Solar and Wind System 2. Advanced Mathematical Methods in Engineering 3. Optimization Techniques	3	0	0	3	3	30	70	100
2	GR18D5201 GR18D5202 GR18D5203 GR18D5204 GR18D5205 GR18D5206	**Open Elective**	1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy	3	0	0	3	3	30	70	100
3	GR18D5191	Dissertation	Dissertation (Phase – I)	0	0	20	20	10	30	70	100
			Total	**6**	**0**	**20**	**26**	**16**	**90**	**210**	**300**

II YEAR - II SEMESTER

Sl. No	Course code	Group	Subject	Credits			Total hours	Total Credits	Int. Marks	Ext. Marks	Total Marks
				L	T	P					
1	GR18D5192	Dissertation	Dissertation(Phase – II)	0	0	32	32	16	30	70	100
			Total			**32**	**32**	**16**	**30**	**70**	**100**

Audit course 1 & 2

1. English for Research Paper Writing (GR18D5207)
2. Disaster Management (GR18D5208)
3. Sanskrit for Technical Knowledge (GR18D5209)
4. Value Education (GR18D5210)
5. Indian Constitution (GR18D5211)
6. Pedagogy Studies (GR18D5212)
7. Stress Management by Yoga (GR18D5213)
8. Personality Development through Life Enlightenment Skills. (GR18D5214)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMODYNAMICS AND COMBUSTION

Course Code: GR18D5141 **L/T/P/C: 3/0/0/3**

Course objectives

- To present a comprehensive and rigorous treatment of classical thermodynamics.
- To lay the groundwork for subsequent studies in such fields as fluid mechanics, heat transfer and to prepare the students to effectively use thermodynamics in the practice of engineering.
- To present thermodynamic relations, equilibrium and stability of multiphase multi-component systems.
- To present a wealth of real world engineering examples to give students a feel for how thermodynamics is applied in engineering practice.
- To present second law analysis of reacting mixture, availability analysis of thermal systems.

Course outcomes

- Demonstrate the knowledge of exergy, basic laws governing energy conversion in multi-component systems and application of chemical thermodynamics.
- Demonstrate the knowledge of the molecular basis of thermodynamics.
- Apply theoretical, semi-theoretical and empirical models for the prediction of thermodynamic properties.
- Acquire the confidence in analyze the motion of combusting and non combusting fluids while accounting for variable specific heats, non-ideal gas properties, chemical non-equilibrium and compressibility.
- Apply the fundamental principles of thermodynamics to non-ideal models of numerous engineering devices.

Unit I

First law and State postulates, Second law and Entropy, Availability and Irreversibility Second-law efficiency.

Unit II

Nonreactive Ideal-Gas Mixture, PVT Behavior of Real gases and Real Gas mixtures, Generalized compressibility chart, General Thermodynamic Relationship: Maxwell relations, Specific heat relations(Mayer's relations), Clausius-Clapeyron equation, Throttling: Joule-Thomson coefficient, Evaluation of thermodynamic properties of working substances.

Unit III

Combustion and Thermo-chemistry, Second law analysis of reacting mixture, Availability analysis of reacting mixture, Chemical equilibrium.

Unit IV

Statistical thermodynamics, statistical interpretations of first and second law and Entropy,

Unit V

Third law of thermodynamics, Nernst-Simon theorem, Phenomenological Laws: Onsager Reciprocity relation, Applicability of the Phenomenological relations, Heat flux and entropy production.

Text Books

1. Y.A Cengel and M.A Boles “Thermodynamics an Engineering Approach”, McGraw Hill Co.
2. P.K Nag “Engineering Thermodynamics” McGraw Hill Co.,

Reference Books

1. Van Wylen & Sonntag, “Fundamentals of Classical Thermodynamics”, John Wiley and Sons Inc., U.S.A.
2. Holman, “Thermodynamics”, McGraw Hill Inc., New York, 2002. 3. Jones and Hawkings, “Engineering Thermodynamics”, John Wiley and Sons Inc., U.S.A, 2004.
3. Faires V.M. and Simmag, “Thermodynamics”, Macmillan Publishing Co. Inc., U.S.A.
4. Rao Y.V.C., “Postulational and Statistical Thermodynamics”, Allied Publishers Inc, 1994

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ADVANCED FLUID DYNAMICS

Course Code: GR18D5142 **L/T/ P/ C: 3/0/0/3**

Course objectives

- Learn to use control volume analysis to develop basic equations and to solve problems.
- Understand and use differential equations to determine pressure and velocity variations in internal and external flows.
- Understand the concept of viscosity and where viscosity is important in real flows.
- Learn to use equations in combination with experimental data to determine losses in flow systems. Learn to use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity.
- Derive the governing equations of fluid flow and applying them to simple flow problems.

Course outcomes

- The Students shall be able to understand and define the fluid flow problems along with range of governing parameters.
- The student shall be eligible to take up the fluid flow problems of industrial base and able to devise the experiments in the field of fluid mechanics.
- The Students shall be able understand the flow patterns and differentiate between the flow regimes and its effects.
- Apply the basic principles to derive the equation for viscous flow, including laminar flow & turbulent flow.
- Apply the boundary layer concept to the fluid flow problems.

Unit I

Governing equations in Fluid Dynamics: Derivation of Continuity and Momentum equations using integral and differential approach, dimensionless form of governing equations, special forms of governing equations, integral quantities

Unit II

Exact Solutions of Navier-Stokes Equations: Fully developed flows, parallel flow in straight channel, Couette flow, Creeping flows

Potential Flow: Kelvin's theorem, Irrotational flow, Stream function-vorticity approach

Unit III

Laminar Boundary layers: Boundary layer equations, flow over flat plate, Momentum integral equation for boundary layer, approximate solution methodology for boundary layer equations.

Unit IV

Turbulent Flow: Characteristics of turbulent flow, laminar turbulent transition, time mean motion and fluctuations, derivation of governing equations for turbulent flow, shear stress models, universal velocity distribution

Unit V

Experimental Techniques: Role of experiments in fluid, layout of fluid flow experiments, sources of error in experiments, data analysis, design of experiments, review of probes and transducers, Introduction to Hot wire Anemometry, Laser Doppler Velocimetry and Particle Image Velocimetry.

Text Books

1. Muralidhar and Biswas, Advanced Engineering Fluid Mechanics, , Alpha Science International, 2005.

Reference Books

1. Irwin Shames, Mechanics of Fluids, , McGraw Hill, 2003.
2. Fox R.W., McDonald A.T , Introduction to Fluid Mechanics, John Wiley and Sons Inc, 1985.
3. Pijush K. Kundu, Ira M Kohen and David R. Dawaling, Fluid Mechanics, Fifth Edition, 2005

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

NUCLEAR ENGINEERING

Course Code: GR18D5143 **L/T/ P/ C: 3/0/0/3**

Course objectives

- To teach students fundamental physics that applies to a broad range of nuclear technologies.
- To teach students analytical and computational methods for the solution of neutron transport and diffusion problems.
- To teach students the essential elements of reactor kinetics behavior.
- To have students approach in radiation shielding.
- To introduce students to environmental impacts of nuclear technology, and the physical and biological effects of ionizing radiation.

Course outcomes

- Student will understand the basic concepts and processes taking place inside a nuclear reactor, such as nuclear fission, neutron production, scattering, diffusion, slowing down and absorption.
- The student will be familiar with concepts of reactor criticality, the relationship between the dimension and fissile material concentration in a critical geometry.
- The student will also be familiar with Time dependent (transient) behaviour of power reactor in non-steady state operation and the means to control the reactor.
- The student will also be familiar with concepts of heat removal from reactor core, reactor safety and radiation protection
- The student will analyze economics of power plants and list power factors affecting the power plants.

Unit I

Basics of nuclear fission and power from fission: Radioactivity, nuclear reactions, cross sections, nuclear fission, power from fission, conversion and breeding.

Unit II

Neutron transport and diffusion: Neutron transport equation, diffusion theory approximation, Fick's law, solutions to diffusion equation for point source, planar source, etc., energy loss in elastic collisions, neutron slowing down.

Unit III

Multi group, multi region diffusion equation, concept of criticality: Solution of multi group diffusion equations in one region and multi region reactors, concept of criticality of thermal reactors

Unit IV

Reactor kinetics and control: Derivation of point kinetics equations, in hour equation, solutions for simple cases of reactivity additions, fission product poison, reactivity coefficients

Unit V

Heat removal from reactor core: Solution of heat transfer equation in reactor core, temperature distribution, critical heat flux

Reactor safety, radiation protection: Reactor safety philosophy, defence in depth, units of radioactivity exposure, radiation protection standards

Text Books

1. Introduction to Nuclear Engineering (3rd Edition) by John R. Lamarsh, Anthony J.Barrata, Prentice Hall, (2001)

Reference Books

1. Introduction to Nuclear Reactor Theory, by John R. Lamarsh, Addison-Wesley, 1966)
2. Nuclear Reactor Analysis, by James J. Duderstadt and Lewis J. Hamilton, John Wiley (1976).

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENERGY CONSERVATION AND MANAGEMENT

Course Code: GR18D5144 **L/T/ P/ C: 3/0/0/3**

Course objectives

- To understand and analyze the energy data for present and future.
- To conduct energy audit and suggest methodologies for energy savings.
- To carryout energy accounting and balancing.
- To identify and manage the various sources of power.
- To understand the standards and laws.

Course outcomes

- The student should acquire insight about the importance of energy and capable to analyze all scenarios from energy consumption.
- The student should generate scenarios of energy consumption and predict the future trend.
- The student should Suggest and plan energy conservation solutions.
- The student will analyze the simple techno economical assessments of renewable energy systems.
- The student will also enumerate the efficiencies of various renewable energy technologies and compare with Non renewable techniques.

Unit I

The energy market, energy scenario, planning, utilization pattern and future strategy, Importance of energy management.

Unit II

Energy auditing- methodology and analysis.

Unit III

Energy economics.

Unit IV

Energy conservation in industries, Cogeneration, Combined heating and power systems.

Unit V

Relevant international standards and laws.

Text Books

1. L.C. Witte, P.S. Schmidt, D.R.Brown, “Industrial Energy Management and Utilization”, Hemispherical Publication, 1988.
2. Callaghan “Energy Conservation”

Reference Books

1. D.A. Reeg, “Industrial Energy Conservation”, Pergamon Press, 1980.
2. T.L. Boyen, “Thermal Energy Recovery” Wiley, 1980.
3. L.J. Nagrath, “Systems Modeling and Analysis”, Tata McGraw Hill, 1982.
4. W.C. Turner, “Energy Management Handbook “, Wiley, New York, 1982.
5. I.G.C. Dryden, “The Efficient Use of Energy “, Butterworth, London, 1982.
6. R. Loftnen, Van Nostrarid Reinhold C. “Energy Handbook”, 1978.
   TERI Publications.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MICRO / NANO SCALE HEAT TRANSFER

Course Code: GR18D5145 **L/T/ P/ C: 3/0/0/3**

Course objectives

- Summarize the Micro scale and Nano scale heat transfer phenomenon.
- Determine the energy transfer by waves.
- Interpret the radiation phenomenon in spatial and temporal micro scales.
- Analyze carrier scattering and its constitutive laws and equations.
- Evaluate the thermal phenomenon in Nano fluids.

Course outcomes

- Appraise the micro scale and Nano scale phenomenon using quantum mechanics.
- Explore the size effects on specific heats of solids.
- Recommend the Boltzmann transport equation to Nano and micro energy transport.
- Examine the phonon and electron conduction and adapt the ballistic diffusive theory.
- Compile the thermal transport phenomenon in Nano suspensions and Probe the applications to cooling of electronics.

Unit I

Introduction to micro/nanoscale transport phenomena and applications, Quantum mechanics, Schroniger equation and solutions, statistical thermodynamics and quantum theory, ensembles,

Unit II

Probability statics, energy states in solids, size effects on specific heats of solids, thermal energy storage, energy transfer by waves,

Unit III

Radiation phenomenon in spatial and temporal micro scales, wave propagation in thin films, energy waves in nanostructures, kinetic theory of gases, Boltzmann transport equation,

Unit IV

Carrier scattering, constitutive laws and equations, classical size effects, size effects, size effects on phonon and electron conduction, ballistic-diffusive theory, rarefied flows, slip theory, effect of roughness.

Unit V

Thermal transport in nanofluids, transport phenomena in nano-suspensions, applications to microelectronic and thermoelectric devices, coupled energy transport and conversion, electronic cooling by micro channels and nanofluids.

Text Books

1. Nano scale Energy Transfer and Conversion: A Parallel Treatment of Electrons, Molecules, Phonons, and Photons, by G Chen, Oxford Press, 2005
2. Nano/Micro scale Heat Transfer, 1st Edition, by Z Zhang, Mcgraw Hill, 2007

Reference Books

1. Micro scale and Nano scale Heat Transfer: Fundamentals and Applications, 1st Edition, by C B Sobhan and G P Peterson, CRC Press Taylor and Francis Group, 2008
2. Micro scale energy Transport, C-L, Tien, A. Majumdar, and F.M. Gerner, Taylor & Francis, 1998
3. Heat and Fluid Flow in Micro scale and Nano scale Structures, M. Faghri and B. Sunden (Eds.) WIT Press, Southampton, 2004

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

AIR CONDITIONING SYSTEM DESIGN

Course Code: GR18D5146 **L/T/ P/ C: 3/0/0/3**

Course objectives

- Familiarize students with the terminologies associated with air conditioning.
- Cover the basic principles of psychometric and applied psychometrics.
- Familiarize students with system analysis.
- Familiarize students with load calculations and elementary duct design.
- Apply basic principles of noise control and performance.

Course outcomes

- Student should understand construction and design features of Air-conditioning system.
- Student should understand various types and its adoptability in the various environment and application areas.
- Student should design seasonal energy efficient system.
- Examine the principles and practice of thermal comfort conditions.
- Analyze the principles of ventilation and practice the requirements of ventilation.

Unit I

Various air-conditioning processes, psychrometric properties and processes – Construction of Psychrometric chart. Requirements of Comfort Air –conditioning – Thermodynamics of human body – Effective temperature and Comfort chart – Parameters influencing the Effective Temperature.

Unit II

Air conditioning systems. Summer, winter and year round air – conditioning systems.

Unit III

Enthalpy deviation curve, psychrometry, SHF, dehumidified air quantity, human comfort, indoor air quality

Unit IV

Design conditions and load calculations, air distribution, pressure drop, duct design, fans &, blowers

Unit V

Performance & selection, noise control.

Text Books

1. Manohar Prasad, “Refrigeration & Air Conditioning”, New Age Publishers.
2. Stoecker, “Refrigeration & Air Conditioning”, Mc Graw Hill, 1992.

Reference Books

1. “Handbook of air-conditioning system design”, Carrier Incorporation, McGraw Hill Book Co.,U.S.A, 1965.
2. “Refrigeration and air-conditioning”, ARI, Prentice Hall, New Delhi, 1993.
3. Norman C. Harris, “Modern Air Conditioning”, New York, McGraw-Hill,1974.
4. Jones W.P., “Air Conditioning Engineering”, Edward Arnold Publishers Ltd., London, 1984.
5. Hainer R.W., “Control Systems for Heating, Ventilation and Air-Conditioning”, Van Nostrand
6. Reinhold Co., New York, 1984. 7. Arora C.P., “Refrigeration & Air Conditioning”, Tata Mc Graw Hill, 1985.
7. Stoecker, “Design of Thermal Systems”, Mc Graw Hill, 1992.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

GAS TURBINES

Course Code: GR18D5147 **L/T/ P/ C: 3/0/0/3**

Course objective

- To present a detailed understanding of the components of a typical turbojet engine.
- To demonstrate the physical processes involved in the operation of turbojets.
- To teach students methods to size and design components as well as perform integration of an engine system.
- To establish understanding of propulsion systems in aircraft that are essential to graduate engineers who are intended to work in aircraft system/component manufacturing/maintenance environments.
- To describe the key aeronautical engineering features of the context in which the relevant industry operates.

Course outcomes

- Understand construction and design features of gas turbines as used for power generation.
- Understand thermodynamics and fluid mechanics component for enhancing the efficiency and effectively of gas turbines
- Skills in problem solving for aircraft propulsion systems, in particular gas turbine engines.
- Ability to carry out a cyclic analysis of a gas turbine engine, including turbofan.
- Determine the applicability of a given propeller system for a given aircraft.

Unit I

Introduction, Cycles, Performance characteristics and improvement.

Unit II

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

Unit III

Turbine construction, Blade materials, manufacturing techniques, blade fixing ,

Unit IV

Problems of high temperature operation, blade cooling, practical air cooled blades Combustion Systems, various fuels and fuel systems,

Unit V

Jet propulsion cycles and their analysis, parameters affecting performance, thrust augmentation, environmental considerations and applications.

Text Books

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

Reference Books

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THEORY OF HEAT PIPES

Course Code: GR18D5148 **L/T/ P/ C: 3/0/0/3**

Course objectives

- To understand the heat pipes principles, working fluids and wick structures.
- To know about the heat pipe limitations like capillary, sonic entrainment and boiling limitations.
- To understand the principles of design and manufacture of heat pipes.
- To understand the thermal characteristics if heat pipes.
- To understand the geometrical considerations of the heat pipe.

Course outcomes

- Select a suitable heat pipe for a particular heating and cooling applications.
- Calculate the maximum and minimum heat capacities of a particular heat pipe.
- Heat pipe behaviour prediction under stat up and running conditions.
- Distinguish between different limitation of heat pipe.
- Compare theoretical, numerical and analytical models of heat pipe.

Unit I

Operating principle, Working fluids and its temperature ranges, heat transfer limits and heat pipe characteristics, various applications Interfacial heat transfer, physical surface phenomena, capillary and disjoining forces – Interfacial resistance in vaporization and condensation process, Interfacial mass, momentum energy, pressure balance – interfacial phenomena in grooved structures

Unit II

Steady Hydrodynamics – thermal characteristics and heat transfer limitation, thermal fluid phenomena in capillary media, vapor flow analysis, thermal characteristics including the wall effects and effect of vapor flow – capillary boiling – sonic, entrainment, viscous, condenser, continuum and frozen startup limitations.

Unit III

Area temperature relations, Pipe dimensions and structural considerations. Heat pipe heat exchanger, transient model calculations and procedures.

Unit IV

Heat Pipe Behavior- Transient response to sudden change in temperature heat input, frozen startup and shut down of heat pipe – numerical and analytical model for frozen startup.

Unit V

Two phase closed thermo siphon reflux-condensation heat transfer in analysis, evaporation heat transfer analysis, transient and oscillatory behavior of thermo siphon, Minimum liquid fill requirement, Thermo syphon with capillary wicks .

Text Books

1. S.W.Chi,1976 , Heat pipe theory and practice, Hemisphere publishing corporation , Washington

Reference Books

1. Dunn, P.D.and Reay D.A. 1982 , “Heat Pipes” , Third Edition , Pregamon Press
2. Amir Faghri , 1995 Heat Pipe science and Technology , publisher , Taylor and Francis
3. V.P. Carey , 1992 , Liquid – Vapor phase – Change phenomena. An Introduction to the Thermo physics of vaporization and condensation processes in heat transfer equipment, Hemisphere Publishers , New York
4. J.N.Israelachvili , 1985 , Inrter molecular and surface forces – Academic press, London
5. I.B.Ivanov , 1988, Thin liquid films :Fundamentals and application – Marcel Dekkar, New York M.N.Ivanovskii ,V.P.Sorokin and I.V. Yagodkin , 1982 , The physical principles of heat pipes Clarendon press , Oxford

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL ENGINEERING LAB PRACTICE – I

Course Code: GR18D5149 **L/T/ P/ C: 0/0/4/2**

Course objectives

- Analyze the performance parameters and exhaust emissions of an IC engine by conducting test on IC Engines.
- Understand the function of each component of thermal systems such as refrigeration, Air conditioning and Air compressor units and approaches to enhance the performance.
- Analyze the parameters such as proportion of fuel air mixture, different zones of flame to assess velocity of flame propagation gaseous fuels.
- Evaluate the performance of the Solar flat plate collector at different positions.
- Understand the properties of steam in assessing its quality.

Course outcomes

- Analyze the performance and exhaust emission of an IC engine by conducting the performance test on CI/SI engines.
- Evaluate the performance of the vapor compression, air conditioning and multi stage reciprocating compressor units.
- Examine the flame propagation velocity of the gaseous fuels.
- Analyze the performance of solar flat plate collector.
- Estimate the dryness fraction of steam.

Task1

Dryness fraction estimation of steam.

Task2

Flame propagation analysis of gaseous fuel.

Task3

Performance test on multi-cylinder petrol engine.

Task4

Performance test and exhaust gas analysis of CI Engine.

Task5

Performance test on variable compression ratio SI engine with electrical loading.

Task6

COP estimation of vapour compression refrigeration test rig

Task7

Performance analysis of Air conditioning unit.

Task8

Performance test and Exhaust gas analysis of SI Engine.

Task9

Performance analysis of Solar Flat Plate Collector.

Task10

Determination of volumetric efficiency of two stage reciprocating air compressor.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL ENGINEERING LAB PRACTICE – II

Course Code: GR18D5150 **L/T/ P/ C: 0/0/4/2**

Course objectives

- Demonstrate how a software package can reduce time to solve a fluid flow problem.
- Present to the students modeling concepts related to the slabs, cylinders and spherical type of thermal systems.
- Analyze the thermal systems by varying the fluid flow properties of the system.
- Identify the critical situations of the thermal system.
- Demonstrate the projects related to fluid flow.

Course outcomes

- Simulate and analyze the flow patterns and combustion in IC engines
- Simulate and analyze fuel injection in advanced engines.
- Model the thermal stresses in structures.
- Evaluate transient heat transfer in an infinite slab.
- Analyze the thermal systems under different flow conditions in laminar and turbulent flows.

Task1

Solving a cold flow simulation in IC engine

Task2

Solving a port flow simulation in IC engine

Task3

Solving a combustion simulation in IC engine

Task4

Solving a Gasoline Direct Injection Engine Simulation in IC Engine

Task5

To determine the thermal stresses in a thermally Loaded Support Structure

Task6

Thermal-Structural Contact of Two Bodies when subjected to prescribed temperature boundary conditions

Task7

To determine the Transient heat transfer in an infinite slab.

Task8

To determine the thermal stresses in a long cylinder.

Task9

To determine the Transient thermal stresses in a long cylinder.

Task10

To determine the rate of heat transfer through a wall of temperature dependent thermal conductivity.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

RESEARCH METHODOLOGY AND IPR

Course Code: **L/T/ P/ C: 0/0/4/2**

Course objectives

- To provide knowledge on research problems and approaches of investigation of solutions for research problem.
- To analyze on literature surveys and to have idea about research ethics.
- To create a research document with effective technical writing.
- To impart knowledge on Intellectual Property Rights, Procedure for grants of patents and Patenting.
- To apply for Patent Rights, Licensing and transfer of technology.

Course outcomes

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

Unit I

Meaning of research problem, Sources of research problem criteria, Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit II

Effective literature studies approaches, analysis, Plagiarism, Research ethics,

Unit III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of

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

Unit V

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books

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

Reference Books

1. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
2. Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"
3. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. Mayall , "Industrial Design", McGraw Hill, 1992.
5. Niebel , "Product Design", McGraw Hill, 1974.
6. Asimov, "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ADVANCED HEAT TRANSFER

Course Code: GR18D5151 **L/T/ P/ C: 3/0/0/3**

Course objectives

- To present fundamentals of momentum, heat and mass transfer and to introduce general conservation equation for transport phenomena
- To introduce analogy between momentum, heat and mass transfer.
- To understand the subject of Heat Transfer in detail with capability to solve Industrial Problems.
- To explore the knowledge of heat transfer with phase change through boiling and condensation with relevant theories and correlations for analysis.
- To understand the physics of thermal radiation and thermal surface properties, and define surface-grayness and view-factor resistance.

Course outcomes:

- Recollect and analyze the basic concepts about conduction through fins with and without heat resources.
- Develop the mathematical models and use analytical methods for solving applications of transport phenomena in convective heat transfer.
- Examine the different phases of Boiling and condensation mechanisms to enhance the heat transfer rate.
- Elaborate the applications of classical heat transfer to practical problems includes the applications of heat pipes and radiation shields.
- Apply the concepts on different approaches in Radiative heat transfer for gases and vapours.

Unit I

Conduction- one and two dimensional, Fins, conduction with heat source, unsteady state heat transfer.

Unit II

Natural and forced convection, integral equation, analysis and analogies.

Unit III

Transpiration cooling, ablation heat transfer, boiling, condensation and two phase flow mass transfer, cooling, fluidized bed combustion,

Unit IV

Heat pipes, Radiation, shape factor, analogy, shields,

Unit V

Radiation of gases & vapours.

Text Books

1. J.P. Holman, “Heat Transfer”, McGraw Hill Book Company, New York, 1990.
2. Incropera and Dewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, NewYork, 2000.

Reference Books

1. Donald Q. Kern “Process Heat Transfer”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1975.
2. Gupta and Prakash, “Engineering Heat Transfer”, New Chand and Bros, Roorkee (U.P.) India, 1996
3. R.C. Sachdeva “Fundamentals of Engineering Heat and Mass Transfer”, Wiley Eastern Ltd., India,

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

STEAM ENGINEERING

Course Code: GR18D5152 **L/T/ P/ C: 3/0/0/3**

Course objectives

- Gain the knowledge on steam power plants, steam generators and their analyses on fuel and fluidized bed combustion, ash handling systems.
- Examine the design of Piping & Insulation, concepts of economic thickness and selection of materials.
- Explain the performance enhancement techniques including superheating, regeneration etc.
- Explore to the assessment of steam distribution losses, Steam leakages, Steam trapping and its significance.
- Discuss the steam energy sources and conservation methods available for power generation.

Course outcomes

- Demonstrate the working of different boilers and significance of mountings and accessories.
- Examine the theoretical and practical background in thermal systems, and will have a good understanding of energy conservation fundamentals.
- Design a steam piping system, its components for a process and also design economical and effective insulation.
- Analyze a thermal system for sources of waste heat design a systems for waste heat recovery.
- Assess and develop the controls and instrumentation for effective monitoring of the process.

Unit I

Introduction: Fundamentals of steam generation, Quality of steam, Use of steam table, Mollier Chart Boilers, Types, Mountings and Accessories, Combustion in boilers, Determination of adiabatic flame temperature, quantity of flue gases, Feed Water and its quality, Blow down; IBR, Boiler standards

Unit II

Piping & Insulation: Water Line, Steam line design and insulation; Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria, Refractory-types, selection and application of refractory, Heat loss.

Unit III

Steam Systems: Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Steam Engineering Practices; Steam Based Equipments / Systems.

Unit IV

Boiler Performance Assessment: Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boiler performance.

Unit V

Energy Conservation and Waste Minimization: Energy conservation options in Boiler; waste minimization, methodology; economical viability of waste minimization
Instrumentation & Control: Process instrumentation control and monitoring. Flow, pressure and temperature measuring and controlling instruments, its selection

Text Books

1. Domkundwar; A Course in Power Plant Engineering; Dhanapat Rai and Sons
2. T. D. Estop, A. McConkey, Applied Thermodynamics, Parson Publication

Reference Books

1. Yunus A. Cengel and Boles, “Engineering Thermodynamics “,Tata McGraw-Hill Publishing Co. Ltd
2. Book II - Energy Efficiency in Thermal Utilities; Bureau of Energy Efficiency
3. Book IV - Energy Performance Assessment for Equipment & Utility Systems; Bureau of Energy Efficiency
4. Edited by J. B. Kitto& S C Stultz; Steam: Its Generation and Use; The Babcock and Wilcox Company
5. P. Chatopadhyay; Boiler Operation Engineering: Questions and Answes; Tata Mc Graw Hill Education Pvt Ltd, N Delhi

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

REFRIGERATION AND CRYOGENICS

Course Code: GR18D5153 **L/T/ P/ C: 3/0/0/3**

Course objectives

- To learn the basics of refrigeration and cryogenics and its application area.
- Analyze the refrigeration cycles and methods for performance improvement.
- Know the components of refrigeration systems.
- Explain the operation of vapor compression, vapor absorption and air refrigeration systems.
- Student should examine various types and its adoptability in the various environment and application areas.

Course outcomes

- Apply the theoretical and mathematical principles to Multi vapour compression and Cascade refrigeration system.
- To design the refrigeration systems for domestic and industrial applications like cold storages.
- To learn about ODP, GWP and related environment issues and also examine the centrifugal and reciprocating compressors.
- Explain the conventional and alternate refrigerants.
- Ability to analyze various refrigerants and compare their relative performance.

Unit I

Vapour compression refrigeration, actual cycle, second law efficiency, multistage compression with inter-cooling, Multi-evaporator systems, Cascade systems.

Unit II

Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor,

Unit III

Design, selection of evaporators, condensers, control systems, motor selection, Refrigerants, alternative refrigerants, CFC/HCFC phase-out regulations,

Unit IV

Refrigeration applications, food preservation, transport,

Unit V

Introduction to Vapor absorption refrigeration, single effect and double effect systems, Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claude cycle.

Text Books

1. R.J.Dossat, “Principles of Refrigeration”, Pearson Education Asia, 2001.
2. C.P.Arora, “Refrigeration and Air-conditioning”, Tata McGraw-Hill, 2000.

Reference Books

1. Stoecker& Jones, “Refrigeration and Air-conditioning”, McGraw Hill Book Company, New York, 1982.
2. Jordan & Priester, “Refrigeration and Air-conditioning”.
3. A.R.Trott, “Refrigeration and Air-conditioning”, Butter worths, 2000.
4. J.L.Threlkeld, “Thermal Environmental Engineering”, Prentice Hall, 1970.
5. R.Barron, “Cryogenic systems”, McGraw–Hill Company, New Yourk, 1985.
6. G.G.Hasseldon. “Cryogenic Fundamentals”, Academic Press.
7. Bailey, “Advanced Cryogenics”, Plenum Press, London, 1971.
8. W.F.Stoecker, “Industrial Refrigeration Handbook”, McGraw-Hill, 1998.
9. John A.Corinchock, “Technician’s Guide to Refrigeration systems”, Mc Graw Hill.
10. P.C.Koelet, “Industrial Refrigeration: Principles, Design and Applications”, Macmillan, 1992.
11. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration.
12. Graham Walker, “Miniature Refrigerators for Cryogenic Sensors and Cold Electronics”, Clarendon Press, 1989

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DESIGN OF HEAT EXCHANGERS

Course Code: GR18D5154 **L/T/ P/ C: 3/0/0/3**

Course objectives

- Explain the classification of Heat Exchangers.
- Analyze the LMTD for parallel flow, counter flow, multi pass and, cross flow heat Exchanger.
- Ability to understand the NTU Method and solve the mathematical models.
- Explain the design methods of shell and tube heat exchanger.
- Examine the pressure drop calculations of double pipe and shell &Tube heat exchangers.

Course outcomes

- Students will demonstrate a basic understanding of several types of heat exchangers that will include shell-and-tube, double pipe, plate-and-frame, finned tube, and plate-fin heat exchangers, Heat pipes.
- Students will demonstrate the performance degradation of heat exchangers subject to fouling.
- Student will identify and understand the design of a heat exchanger is valid or not.
- Analyze the problems on LMTD Method and NTU Method.
- Examine the Tinker's, kern's, and Bell Delaware's methods of shell and tube heat exchangers.

Unit I

Heat Exchangers – Classification according to transfer process, number of fluids, surface compactness, and construction features. Tubular heat exchanger, plate type heat exchangers, extended surface heat exchangers, heat pipe, Regenerators. Classification according to flow arrangement: counter flow, parallel flow, cross flow exchanger.

Unit II

Heat exchanger design methodology, assumption for heat transfer analysis, problem formulation, e-NTU method, *P*-NTU method, Mean temperature difference method, fouling of heat exchanger, effects of fouling, categories of fouling, fundamental processes of fouling.

Unit III

Double Pipe Heat Exchangers: Thermal and Hydraulic design of inner tube, Thermal and hydraulic analysis of Annulus, Total pressure drop Compact
Heat Exchangers: Thermal and Hydraulic design of compact heat exchanger

Unit IV

Shell and Tube heat exchangers – Tinker's, kern's, and Bell Delaware's methods, for thermal and hydraulic design of Shell and Tube heat exchangers

Unit V

Mechanical Design of Heat Exchangers – design standards and codes, key terms in heat exchanger design, material selection, and thickness calculation for major components such as tube sheet, shell, tubes, flanges and nozzles. Introduction to simulation and optimization of heat exchangers, flow induced vibrations.

Text Books

1. D.C. Kern, "Process Heat Transfer", McGraw Hill, 1950.

Reference Books

1. Ramesh K. Shah and Dusan P. Sekulic, "Fundamentals of Heat Exchanger Design" John Wiley & sons Inc., 2003.
2. SadikKakac and Hongton Liu, "Heat Exchangers: Selection, Rating and Thermal Design" CRC Press, 1998.
3. A .P. Frass and M.N. Ozisik, "Heat Exchanger Design", McGraw Hill, 1984 4. Afgan N. and Schlinder E.V. "Heat Exchanger Design and Theory Source Book".
4. T. Kuppan, "Hand Book of Heat Exchanger Design".
4. "T.E.M.A. Standard", New York, 1999.
5. G. Walkers, "Industrial Heat Exchangers-A Basic Guide", McGraw Hill, 1982.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

CONVECTIVE HEAT TRANSFER

Course Code: GR18D5155 **L/T/ P/ C: 3/0/0/3**

Course objectives

- Provide a fundamental treatment of fluid flows controlled by viscous or turbulent stress gradients and the subsequent heat transfer between fluids and solid surfaces.
- Explain analytical solutions to the momentum and energy conservation equations for both laminar and turbulent flows will be considered.
- Develop solid foundation for the engineering practitioner engaged in single phase convective thermal transport.
- Provide solid foundation for further studies in multiphase convective transport.
- Identifying solution methodologies to solve for external and internal forced convective heat transfer.

Course outcomes

- Apply transport equations to convective transport problems and evaluate appropriate transport properties such as friction factors, Nusselt numbers, Sherwood numbers and Stanton numbers.
- Evaluate the heat transfer coefficient for the engineering systems with natural convection, forced convection.
- To formulate the fundamental governing equations of mass, momentum and energy and describe their approximations leading to analytical solutions.
- To analyze the solution methodologies (similarity and integral methods) to solve for external and internal forced convective heat transfer.
- To solve related convective heat transfer problems using different methods, correlations and available charts.

Unit I

Introduction to Forced, free & combined convection: convective heat transfer coefficient – Application of dimensional analysis to convection – Physical interpretation of dimensionless numbers.

Equations of Convective Heat Transfer: Continuity, Navier-Strokes equation & energy equation for steady state flows – similarity – Equations for turbulent convective heat transfer – Boundary layer equations for laminar, turbulent flows – Boundary layer integral equations.

Unit II

External laminar forced convection: Similarity solution for flow over an isothermal plate– integral equation solutions – Numerical solutions – Viscous dissipation effects on flow over a flat plate.

External Turbulent Flows: Analogy solutions for boundary layer flows – Integral equation solutions –Effects of dissipation on flow over a flat plate.

Internal Laminar Flows: Fully developed laminar flow in pipe, plane duct & ducts with other cross sectional shapes – Pipe flow & plane duct flow with developing temperature field – Pipe flows & plane duct flow with developing velocity & temperature fields.
Internal Turbulent Flows: Analogy solutions for fully developed pipe flow –Thermally developing pipe& plane duct flow.

Unit III

Natural convection: Boussineq approximation – Governing equations – Similarity – Boundary layer equations for free convective laminar flows – Numerical solution of boundary layer equations. Free Convective flows through a vertical channel across a rectangular enclosure – Horizontal enclosure – Turbulent natural convection.

Unit IV

Combined convection: Governing parameters & equations – laminar boundary layer flow over an isothermal vertical plate – combined convection over a horizontal plate – correlations for mixed convection – effect of boundary forces on turbulent flows – internal flows - internal mixed convective flows – Fully developed mixed convective flow in a vertical plane channel & in a horizontal duct.

Unit V

Convective heat transfer through porous media: Area weighted velocity – Darcy flow model – energy equation – boundary layer solutions for 2-D forced convection – Fully developed duct flow –Natural convection in porous media – filled enclosures – stability of horizontal porous layers.

Text Books

1. Introduction to Convective Heat Transfer Analysis/ Patrick H. O osthuigen & David Naylor /McGraw Hill
2. Convective Heat & Mass Transfer /Kays & Crawford/TMH

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

COMPUTATIONAL FLUID DYNAMICS

Course Code: GR18D5156 **L/T/ P/ C: 3/0/0/3**

Course objectives

- Describe the physical significance of each term in the governing equation for CFD.
- Identify the use of a commercial CFD package to solve practical CFD problems.
- Quantify and analyze the numerical error in CFD discretization schemes.
- Develop finite difference and finite volume forms of the CFD equation for heat transfer and fluid flow.
- Formulate explicit and implicit algorithms for solving the Navier-stokes equations.

Course outcomes

- Classify the partial differential equations to understand the behavior of the equations.
- Probe various numerical techniques (FEM, FVM, and FDM) available for solving CFD problems.
- Assess the pressure velocity coupling and checker board pressure field.
- Probe the various grid generation techniques.
- Compare the various discretization schemes for convection diffusion equation.

Note: The students are expected to understand the subject of Computational Fluid Dynamics and know how to use it as tool to solve the Heat Transfer and Fluid Mechanics related Industrial Problems. This will also create the base and interest among the students to carry out the Future Research.

Unit I

Introduction to CFD: with experimental and Hyperbolic Equations.
Computational approach to Fluid Dynamics and its comparison analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations.
Governing Equations: Review of Navier-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.

Unit II

Finite Volume Method: Domain discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach

Unit III

Geometry Modeling and Grid Generation: Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance

Unit IV

Methodology of CFDHT: Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation

Unit V

Solution of N-S Equations for Incompressible Flows: Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non Staggered Grid System of N-S Equations for Incompressible Flows

Text Books

1. Computational Fluid Dynamics, The Basic with applications by John A. Anderson, Jr., McGraw Hill International editions, Mechanical Engineering series.
2. Numerical Methods in Fluid Flow & Heat Transfer by Dr.Suhas Patankar.
3. An Introduction to Computational Fluid Flow (Finite Volume Method), by H.K. Versteeg, W.Malalasekera, Printice Hall

Reference Books

1. Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer Publication.
2. An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.
3. Computational Fluid Flow & Heat Transfer by Murlidhar and Sundarrajan, Narosa Publication.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MODELLING OF IC ENGINE

Course Code: GR18D5157 **L/T/ P/ C: 3/0/0/3**

Course objectives

- To introduce to the students the processes and performance by application of first principles in thermodynamics, chemistry, heat transfer, fluid flow, and mechanical dynamics.
- To provide a basis for analyzing and understanding the complex interactions between subsystems and processes inside the engine system.
- To demonstrate the gas exchange process and power boosting by means of turbo charging.
- To make students familiar with the design and modelling of internal combustion engines.
- To apply analytical techniques to the engineering problems and performance analysis of internal combustion engines.

Course outcomes

- Demonstrate a basic understanding of several types of engine models that will include zero dimensional thermodynamic model, one dimensional and multi-dimensional, single zone, two zone etc., and simulate them for diesel engine petrol engine, gas engine.
- Demonstrate the performance evaluation and emission standards for such modelled engines.
- Analyze the subject of Computational Fluid Dynamics and know how to use it as tool to solve the Heat Transfer and Fluid Mechanics related Industrial Problems. This will also create the base and interest among the students to carry out the Future Research.
- Interpret different alternative emission control strategies to control the emissions.
- Analyze different electronic fuel injection system, supercharging and its effect on performance of SI and CI engine.

Unit I

Fundamentals: Governing equations, Equilibrium charts of combustion chemistry, chemical reaction rates, and approaches of modeling, model building and integration methods, gas exchange through valves, engine and porting geometry, exhaust gas recirculation, valve lift curves.

Unit II

Thermodynamic Combustion Models of CI Engines: Single zone models, premixed and diffusive combustion models, combustion heat release using wiebe function, wall heat transfer correlations, ignition delay, internal energy estimations, two zone model, application of heat release analysis.

Unit III

Fuel spray behavior: Fuel injection, spray structure, fuel atomization, droplet turbulence interactions, droplet impingement on walls.

Unit IV

Modeling of Induction system: Constant pressure and pulse turbo charging, compressor and turbine maps, charge air cooler.

Unit V

Mathematical models of SI Engines: Simulation of Otto cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Auto ignition modeling, single zone models, mass burning rate estimation, SI Engine with stratified charge. Friction in pumping, piston assembly, bearings and valve train etc. friction estimation for warm and warm up engines.

Text Books

1. J.B.Haywood, "Internal Combustion Engine fundamentals ", Mc Graw Hill.
2. Ramos J (1989) Internal Combustion Engine Modeling. Hemisphere Publishing Company

Reference Books

1. C. D. Rakopoulos and E. G. Giakoumis, "Diesel Engine Transient
2. Operation Principles of Operation and Simulation Analysis", Springer, 2009.
3. V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill, New Delhi, 1996.
4. P.A. Lakshmi narayanan and Y. V. Aghav, " Modelling Diesel Combustion" Springer, 2010
5. Bernard Challen and Rodica Baranescu, "Diesel Engine Reference Book" Butterworth Heinemann, 1999.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

NUMERICAL SIMULATION AND MODELLING OF TURBULENT FLOWS

Course Code: GR18D5158 **L/T/ P/ C: 3/0/0/3**

Course objectives

- Describe the significance of turbulent flows.
- Identify the DNS method for channel and free shear flows.
- Analyze the RANS models for turbulent flows.
- Compare various turbulent K.E. models for turbulent flows.
- Introduce various Reynold's stress models.

Course outcomes

- Analyze the significance for turbulent flows.
- Probe DNS for free shear and wall bounded flows.
- Evaluate LES and RANS models.
- Assess various turbulent viscosity models.
- Interpret various Reynold's stress models.

Unit I

Introduction: Physical description and significance of turbulent flows. Transition and onset of turbulence; Turbulent free shear and wall-bounded flows; Challenges and complexities.

Unit II

Direct Numerical Simulation (DNS): Introduction; Governing Equations; Computational cost; Examples of DNS of channel and free-shear flows.

Unit III

Large Eddy Simulation (LES): Introduction; Filtering; Filtered conservation equations; Smagorinsky's model; Appraisal and perspective. Reynolds Averaged Equations: Reynolds averaging, Closure problem.

Unit IV

Turbulent Viscosity Models: Turbulent viscosity hypothesis; Algebraic models; Turbulent kinetic-energy models; Exact and modelled equations for turbulent-kinetic-energy and its dissipation;

Unit V

Modifications for wall effects and buoyancy driven flows. Reynolds-Stress Models: Introduction; Closure relations; Examples; Limitations

Text Books

1. Tennekes, H., and Lumley, J.L., 1972, *A First Course in Turbulence*, MIT Press, Cambridge, Massachusetts, USA.
2. Pope, S.B., 2000, *Turbulent Flows*, Cambridge University Press.

Reference Books

1. Ferziger, J.H., and Peric, M., 2002, *Computational Methods for Fluid Dynamics*, Springer.
2. Schlichting, H., and Gersten, K., 2000, *Boundary Layer Theory*, Springer.
3. Garde, R.J., 2000, *Turbulent Flow*, New Age International.
4. Wilcox, D.C., 1993, *Turbulence Modelling for CFD, DCW Industries*, California, USA.
5. White, F.M., 1991, *Viscous Fluid Flow*, McGraw-Hill.
6. White, F.M., 1999, *Fluid Mechanics*, McGraw-Hill.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL ENGINEERING LABPRACTICE III

Course Code: GR18D5159 **L/T/ P/ C: 0/0/4/2**

Course objectives

- Examine the basic concepts of heat transfer models - thermal gradients, conduction, convection, and radiation.
- Relate the rate of heat transfer to the potential for heat flow (difference in temperature) and thermal resistances.
- Determine the resistances for conduction, radiation heat transfer, using the fundamental relationships and correlations.
- Discuss the physics of thermal radiation and define surface-grayness and view-factor resistance.
- Understand Application to fins, heat exchanges, condensation, boiling.

Course outcomes

- Calibrate the thermocouples with the resistance thermometers.
- Determine the heat transfer enhancement with fins.
- Calculate the heat transfer coefficients in free and forced convection heat transfer.
- Compute the rate of heat transfer in different heat pipes.
- Estimate heat transfer through various types of radiation emitting.

Task1

Determination of Critical Heat flux of a wire

Task2

Performance analysis of a Thermo-syphon Heat Pipe

Task3

Calibration of thermocouples

Task4

Determination of Emissivity of a Grey body

Task5

Performance analysis of a Sintered and helical groove wicked Heat Pipe

Task6

Determination of Heat transfer coefficient in forced convection

Task7

Evaluation of overall heat transfer coefficient in parallel and counter flow heat exchanger.

Task8

Heat transfer analysis in Film-wise and Drop-wise condensation.

Task9

Determination of Heat transfer coefficient in free convection.

Task10

Heat transfer through Pin-fin apparatus.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL ENGINEERING LABPRACTICE IV

Course Code: GR18D5160 **L/T/ P/ C: 0/0/4/2**

Course objectives

- Describe the usage of CFD software package, to reduce the time for solving different fluid flow problems.
- Model the heat transfer and fluid flow problems in CFD software package such as ANSYS CFX, ANSYS FLUENT.
- Analyze the different thermal systems for variable fluid flow properties such as mass flow rate, Reynolds number etc.
- Examine the various thermal systems under different flow conditions such as turbulent flow etc.
- Correlating the results obtained using different software with theoretical knowledge.

Course outcomes

- Evaluate how a software package can reduce time to solve a fluid flow problem and heat transfer problem.
- Analyze the thermal systems by varying the fluid flow properties of the system.
- Model the different thermal systems used in real world and handle projects related to fluid flow.
- Simulate the heat transfer equipment like heat exchanger.
- Analyze the temperature distribution in extended surfaces.

Task1

Simple thermal system modeling and analysis

Task2

Fluid Flow and Heat Transfer analysis in a Mixing Elbow

Task3

Simulation of 2-D heat exchanger.

Task4

Simulation of 3-D heat exchanger

Task5

Analysis of turbulent flow past a transonic airfoil

Task6

Analysis of Transient Temperature Distribution in a Slab.

Task7

Analysis of Temperature Distribution on an Insulated Wall.

Task8

Analysis of Temperature Distribution along a Straight Fin and tapered fin.

Task9

Analysis of cavitation in centrifugal pump.

Task10

Analysis of Flow through porous media

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DESIGN OF SOLAR AND WIND SYSTEMS

Course Code: GR18D5161 **L/T/ P/ C: 3/0/0/3**

Course objectives

- To introduce the need of alternative energy resources.
- To sanitize about solar energy radiation on the earth surface and outside earth atmosphere, solar radiation measurement and estimation etc.
- To recognize the source and potential of wind energy and understand the classifications of wind mills.
- To impart knowledge on different ways of energy generation.
- To summarize the principles of fuel cells, bio-conversion, geothermal energy and etc.

Course outcomes

- The student should aware of the energy scenario and the environmental aspects related to the utilization of energy sources.
- The student should capable to analyze various techno economical obstacles in the commercial development of NCES in India.
- The student should capable to conceptually model and design general NCES systems and predict the long term performance.
- The student should suggest and plan hybrid NCES solutions to conventional energy systems.
- The student should differentiate direct energy conversion over other energy generation.

Unit I

Conventional sources of energy, Nuclear, Alternative energy sources.

Unit II

Solar Radiation-estimation, prediction & measurement, Solar energy utilization.

Unit III

Performance of Solar flat plate collectors, concentrating collectors, thermal storage.

Unit IV

Wind energy, Direct Energy conversion- PV, MHD

Unit V

Fuel cells, thermionic, thermoelectric, Biomass, biogas, hydrogen, Geothermal.

Text Books

1. Sukhatme S.P., “Solar Energy”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
2. Bansal and othes, “Non-Conventional Energy Sources”.

Reference Books

1. D.Y. Goswami, F. Kreith and J.F. Kreider, “Principle of Solar Engineering”, Taylor and Francis, 2000.
2. J.F. Kreider, F. Kreith, “Solar Energy Handbook”, McGraw Hill, 1981
3. J.A. Duffie and W.A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley, 1991.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ADVANCED MATHEMATICAL METHODS IN ENGINEERING

Course Code: GR18D5162 **L/T/ P/ C: 3/0/0/3**

Course objectives

- Describe the ODE (Ordinary Differential Equation).
- Examine partial differential equations.
- Justify maximum principle of elliptic equations.
- Discuss the standard discrete and continuous distributions..
- Explain the principles of design of experiments.

Course outcomes

- Students will be able to analyze and develop the mathematical model of thermal system.
- Student should able analyze the reliability and maintainability of the series and parallel thermal system.
- Students will be able to solve differential equations using numerical techniques.
- To know the maximum principles of elliptic equations.
- Design of experiments, some standard designs such as CRD, RBD, LSD.

Unit I

Ordinary Differential Equations: First-order equations (Linear, Equi dimensional, Separable Exact, Homogeneous,); Second-order linear differential equations (homegeneous an nonhomogeneous); Solution methods such as un dertermined coefficients and variation o parameters.

Unit II

Partial Differential Equations: First order partial differential equations; Second order linear partial differential equations; Canonical forms; Fourier series, Second order equation (Parabolic, Elliptic and Hyperbolic) in rectangular, cylindrical polar and spherical coordinate systems; Solution techniques such as separation of variables, eigen function expansions, integral transforms (Fourier and Laplace transforms); D'Alembert's solution for the Wave equation;

Unit III

Maximum principle for Elliptic equations; Variational methods for approximate solutions of differential equations.

Unit IV

Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential etc. Central Limit Theorem and its significance. Some sampling distributions like c2, t, F.

Unit V

ANOVA: One – way, Two – way with/without interactions, Latin
Squares ANOVA technique, Principles of Design Of Experiments, some standard designs such as CRD, RBD, LSD.
Some of the relevant topics required for ANOVA (sample estimates and test hypothesis) may also be included.

Text Books

1. Kreyszig, Erwin, I.S., Advanced Engineering Mathematics, Wiley, 1999.
2. Peter O'Neil, "Advanced Engineering Mathematics", Seventh Edition, Cengage Learning, 2012 (Indian Edition).

Reference Books

1. J.B. Doshi, "Differential Equations for Scientists and Engineers", Narosa, 2010.
2. Michael Greenberg, "Advanced Engineering Mathematics", Second Edition, Pearson Education, 2002 (Indian Edition).
3. Jennings. A., Matrix Computation for Engineers and Scientists. John Wiley and Sons, 1992.
4. Prem.K.Kythe, Pratap Puri, Michael R.Schaferkotter, Introduction to Partial Differential Equations and Boundary Value problems with Mathematics, CRC Press, 2002.
5. Ramamurthy. V., Computer Aided Design in Mechanical Engineering., Tata McGraw Hill Publishing Co., 1987
6. Fundamental Concepts in the Design of Experiments, 5th Ed., by Hicks and Turner
7. Devore, Jay L., Probability and Statistics for Engineering and the Sciences, 5th edition, Brooks- Cole (1999)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

OPTIMIZATION TECHNIQUES

Course Code: GR18D5140 **L/T/ P/ C: 3/0/0/3**

Course objectives

- To have an understanding of research design and plot layout.
- To analyze the data and interpret the results.
- To create the factor and factorial design like single, multiple, full and fractional.
- To understand the statistical terms like ANOVA, regression expected R square, F-test etc.
- To optimize the data using the techniques of RSM and Taguchi method.

Course outcomes

- Understand the fundamentals of experiments and its uses.
- Analyze and apply the basic statistics including ANOVA and regression
- Design experiments such as Latin Square, factorial and fractional factorial designs
- Explain the application of statistical models in analyzing experimental data,
- Apply RSM and taguchi to optimize response of interest from an experiment

Unit I

Experimental Design Fundamental Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression model.

Unit II

Single Factor Experiments Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.

Unit III

Multi factor Experiments Two and three factor full factorial experiments, 2K factorial Experiments, Confounding and blocking designs.

Unit IV

Special Experimental Designs Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methodology, Experiments with random factors, rules for expected mean squares, approximate F- tests.

Unit V

Taguchi Methods Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, case studies.

Text Books

1. Montgomery, D.C., Design and Analysis of experiments, JohnWileyandSons, 2003.

Reference Books

1. Nicolo Belavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.
2. Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

BUSINESS ANALYTICS

Course Code: GR18D5201 **L/T/P/C: 3/0/0/3**

Course Objectives

- Understand the role of business analytics and statistical tools used within an organization.
- Discuss Trendiness and Regression Analysis and different visualization techniques to explore data.
- Describe the organization structures and different type of business analytics.
- Know Forecasting Techniques, Monte Carlo Simulation and Risk Analysis.
- Understand decision analysis and recent trends in business intelligence.

Course outcomes

- Demonstrate business analytics process and use statistical tools for implementation of business process.
- Design relationships and trends to explore and visualize the data.
- Examine the organization structures of business analytics and Categorize types of analytics.
- Apply Forecasting Techniques, Monte Carlo Simulation and Risk Analysis.
- Formulate decision analysis and summarize recent trends in business intelligence.

Unit I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.
Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit III

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes, Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining

Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.

Unit IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making, Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference Books

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INDUSTRIAL SAFETY

Course Code: GR18D5202 **L/T/P/C: 3/0/0/3**

Course Objectives

- To understand the importance of maintaining a safe workplace.
- To maintain safety standards in compliance with regulatory requirements and within engineering limits understand personal safety and industrial safety.
- To create a job safety analysis (JSA) for a given work project.
- To follow safety recordkeeping and management, and the role of the safety manager.
- To utilize personal proactive equipment.

Course Outcomes

- Understanding of Safety principles.
- Analyze different types of exposure and biological effects, exposure guidelines and basic workplace monitoring Ability to do Hazard analysis.
- Demonstrate an understanding of workplace injury prevention, risk management, and incident investigations.
- Understand the acute and chronic health effects of exposures to chemical, physical and biological agents in the workplace.
- Demonstrate knowledge of the types of hazards, planning, organization and training needed to work safely with hazardous materials.

Unit I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv.

Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Reference Books

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

OPERATIONS RESEARCH

Course Code: GR18D5203 **L/T/P/C: 3/0/0/3**

Course Objectives

- To define and formulate linear and Non-linear programming problems and appreciate their limitations arising from a wide range of applications.
- To perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- To distinguish various inventory models and develop proper inventory policies.
- To solve the scheduling and sequencing models.
- To understand how to model and solve problems using dynamic programming, Game Theory.

Course Outcomes

- The student will formulate and solve problems as networks and graphs for optimal allocation of limited resources such as machine, material and money.
- The student will able to carry out sensitivity analysis.
- The student will solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
- The student will able to distinguish various inventory models and develop proper inventory policies.
- The student will also propose the best strategy using decision making methods under uncertainty and game theory.

Unit I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex techniques, Sensitivity Analysis, Inventory Control Models

Unit II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Reference Books

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

COST MANAGEMENT OF ENGINEERING PROJECTS

Course Code: GR18D5204 **L/T/P/C: 3/0/0/3**

Course Objectives

- To provide the student with a clear understanding of strategic cost management process.
- To describe the various stages of project execution.
- To prepare the project schedule by bar charts and network diagrams.
- To conduct breakeven and cost-volume-profit analysis.
- To make students understand various budgets and quantitative techniques used for cost management.

Course Outcomes

- The student will be able to explain the various cost concepts used in decision making.
- To be able to identify and demonstrate various stages of project execution.
- The student will be able to prepare the project schedule by bar charts and network diagrams.
- The student will be to differentiate absorption costing and marginal costing, also conduct breakeven and cost-volume-profit analysis.
- The student will be able to prepare various budgets and quantitative techniques used for cost management.

Unit I

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit II

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance.

Unit III

Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit IV

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

Unit V

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Reference Books

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

COMPOSITE MATERIALS

Course Code: GR18D5205 **L/T/P/C: 3/0/0/3**

Course Objectives

- To understand the concepts of fundamental science and engineering principles relevant to materials engineering.
- To expose the various methods to test mechanical properties on materials.
- To categorize the various equilibrium diagrams and describe the changes which occurs on metals.
- To explain the concepts on various heat treatment operations.
- To categorize the various ferrous and non-ferrous metals with their properties and applications.

Course Outcomes

- Relate crystal structures and identify the relation between different materials.
- Test the various mechanical properties of metal by suitable method.
- Relate the equilibrium transformation diagrams for various ferrous and Non- ferrous metals.
- Utilize appropriate techniques in treating a metal with proper heat treatment operations.
- Evaluate the behaviour of material when it is subjected to heat treatment process.

UNIT I

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II

Reinforcement: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT III

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix, Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT V

Strength, Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Reference Books

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

WASTE TO ENERGY

Course Code: GR18D5206 **L/T/P/C: 3/0/0/3**

Course Objectives

- To find or recall the non-Hazardous secondary materials from waste.
- To compare precisely to overcome the cost and most economically attractive course of action for CH4 emission.
- To demonstrate the techno-economic feasibility of replacing.
- To extend the students for possible future activity in a biomass plant.
- To utilization in spark-ignited internal combustion engine.

Course outcomes

- Students are able to make use of energy installation and the small of household bio-waste incineration.
- To develop actual dimension must of course, fit requirement of the masonry block.
- To become capable of analyze and design of energy conversion system.
- Students are to estimate the possibility of invest in biomass generation.
- Students will be able to explain the biogas its uses and benefits.

Unit I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Unit II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - 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.

Reference Books

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGLISH FOR RESEARCH PAPER WRITING

Course Code: GR18D5207 **L/T/P/C: 2/0/0/2**

Course objectives

- To state how to put research on paper.
- To demonstrate how to write an abstract.
- To apply the process of research.
- To appraise the key skills involved in writing the title, abstract, introduction and review of literature.
- To compose a paper which is good and has the qualities of acceptance and publication.

Course Outcomes

- Will be able to understand how to write a research paper.
- Will outline the drafting of an abstract.
- Will acquire the skills of various elements of research.
- Will be in a position to write a good paper.
- Will result in increasing the chance of publication.

Unit I

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

Unit II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

Unit III

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

Unit IV

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

Unit V

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusion.

Unit VI

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Reference Books

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DISASTER MANAGEMENT

Course Code: GR18D5208 **L/T/P/C: 2/0/0/2**

Course objectives

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches.
- Planning and programming in different countries, particularly their home country or the countries they work in.

Course Outcomes

- Capacity to integrate knowledge and to analyze, evaluate and manage the different public health aspects of disaster events at a local and global levels, even when limited information is available.
- Capacity to describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.
- Capacity to work theoretically and practically in the processes of disaster management (disaster risk reduction, response, and recovery) and relate their interconnections, particularly in the field of the Public Health aspects of the disasters.
- Capacity to manage the Public Health aspects of the disasters.
- Capacity to obtain, analyze, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios with the ability to clearly present and discuss their conclusions and the knowledge and arguments behind them.

Unit I

Introduction: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit II

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

Unit III

Disaster Prone Areas in India: Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

Unit IV

Disaster Preparedness and Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit V

Risk Assessment: Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co- Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Unit VI

Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal bookCompany
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, NewDelhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., NewDelhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Code: GR18D5209 **L/T/P/C: 2/0/0/2**

Course objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects.
- Enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

Course Outcomes

- Understanding basic Sanskrit alphabets and Understand tenses in Sanskrit Language.
- Enable students to understand roots of Sanskrit language.
- Students learn engineering fundamentals in Sanskrit.
- Students can attempt writing sentences in Sanskrit.
- Ancient Sanskrit literature about science & technology can be under stood.

Unit I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Unit II

Order, Introduction of roots, Technical information about Sanskrit Literature

Unit III

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Reference Books

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, NewDelhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New DelhiPublication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., NewDelhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

VALUE EDUCATION

Course Code: GR18D5210 **L/T/P/C: 2/0/0/2**

Course objectives

- Understand value of education and self-development.
- Imbibe good values in students.
- Let the should know about the importance of character.
- To understand the significance of human conduct and self-development.
- To enable students to imbibe and internalize the value and Ethical behaviour in personal and professional lives.

Course outcomes

- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.
- Student will be able to realize the significance of ethical human conduct and self-development.
- Students will be able to inculcate positive thinking, dignity of labour and religious tolerance.

Unit I

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgement.

Unit II

Importance of cultivation of values, Sense ofduty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline.

Unit III

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

Unit IV

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INDIAN CONSTITUTION

Course Code: GR18D5211 **L/T/P/C: 2/0/0/2**

Course objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional.
- Role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.
- To understand the role and functioning of Election Commission of India.

Course outcomes

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of1956.
- Discuss the significance of Election Commission of India.

Unit I

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working).

Unit II

Philosophy of the Indian Constitution: Preamble Salient Features.

Unit III

Contours of Constitutional Rights &Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Unit IV

Organs of Governance: Parliament-Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary,

Appointment and Transfer of Judges, Qualifications, Powers and Functions.

Unit V

Local Administration: District's Administration head, Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: Zilla Panchayat. Elected officials and their roles, CEO Zilla Panchayat, Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.
Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Reference Books

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition,2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis,2015.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PEDAGOGY STUDIES

Course Code: GR18D5212 **L/T/P/C: 2/0/0/2**

Course objectives

- Review existing evidence on the review topic to inform programme design and policy making.
- Undertaken by the DFID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.
- Establishing coordination among people in order to execute pedagogy methods.
- To study pedagogy as a separate discipline.

Course Outcomes

- What pedagogical practices are being used by teachers in formal classrooms in developing countries?
- What pedagogical practices are being used by teachers in informal classrooms in developing countries?
- Synergy from the work force.
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Unit I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

Unit II

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

Unit III

Evidence on the effectiveness of pedagogical practices, Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit IV

Professional development: alignment with classroom practices and follow- up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Unit V

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Reference Books

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3):272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston:Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, ‘learning to read’campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

STRESS MANAGEMENT BY YOGA

Course Code: GR18D5213 **L/T/P/C: 2/0/0/2**

Course objectives

- To achieve overall Good Health of Body and Mind.
- To lower blood pressure and improve heart health.
- To become non-violent and truthfulness.
- To increase the levels of happiness.
- To eliminate all types of body pains.

Course outcomes

- Develop healthy mind in a healthy body thus improving social health also improve efficiently.
- Develop body awareness. Learn how to use their bodies in a healthy way. Perform well in sports and academics.
- Will balance, flexibility, and stamina, strengthen muscles and connective tissues enabling good posture.
- Manage stress through breathing, awareness, meditation and healthy movement.
- Build concentration, confidence and positive self-image.

Unit I

Definitions of Eight parts of yog. (Ashtanga)

Unit II

Yam and Niyam. Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya andaparigraha Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit III

Asan and Pranayam, Various yoga poses and their benefits for mind & body. Regularization of breathing techniques and its effects-Types of pranayam

Reference Books

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal,Nagpur
2. "Rajayoga or conquering the Internal Nature" by SwamiVivekananda, Advaita Ashrama (Publication Department),Kolkata

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Code: GR18D5214 **L/T/P/C: 2/0/0/2**

Course objectives

- To learn to achieve the highest goal happily.
- To become a person with stable mind, pleasing personality and determination.
- To awaken wisdom in students.
- To differentiate three types of happiness (Sukham).
- To describe the character traits of a spiritual devotee.

Course outcomes

- Study of Shrimad- Bhagwad-Gita wiil help the student in developing his personality and achieve the highest goal in life.
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity.
- To develop self-developing attitude towards work without self-aggrandizement.
- To develop tranquil attitude in all favorable and unfavorable situations.
- To develop high spiritual intelligence.

Unit I: Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride &heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Unit II: Approach to day to day work andduties.

- Shrimad Bhagwad Geeta : Chapter 2-Verses 41,47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23,35,
- Chapter 18-Verses 45, 46,48.

Unit III: Statements of basicknowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62,68
- Chapter 12 -Verses 13, 14, 15, 16,17,18
- Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses36,37,42,
- Chapter 4-Verses 18,38,39
- Chapter18 – Verses37,38,63

Reference Books

1. “Srimad Bhagavad Gita” by Swami Swarupananda Advaita Ashram (Publication Department),Kolkata
2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, NewDelhi.