



MOHAMED SATHAK A J COLLEGE OF ENGINEERING

Sponsored by Mohamed Sathak Trust
(Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai)
Siruseri IT Park, Egattur, Chennai 603 103

B.E - MECHANICAL ENGINEERING

S.No	Name of the course that include experiential learning through Project work/ Internship (2020 - 2021)
1	PH8251 - Materials Science
2	GE8291 - Environmental Science and Engineering
3	GE8292 - Engineering Mechanics
4	ME8391 - Engineering Thermodynamics
5	CE8394 - Fluid Mechanics and Machinery
6	ME8351 - Manufacturing Technology - I
7	EE8353 - Electrical Drives and Controls
8	ME8492 - Kinematics of Machinery
9	ME8451 - Manufacturing Technology – II
10	ME8491 - Engineering Metallurgy
11	CE8395 - Strength of Materials for Mechanical Engineers
12	ME8493 - Thermal Engineering- I
13	ME8595 - Thermal Engineering- II
14	ME8593 - Design of Machine Elements
15	ME8501 - Metrology and Measurements
16	ME8594 - Dynamics of Machines
17	ME8651 - Design of Transmission Systems
18	ME8691 - Computer Aided Design and Manufacturing
19	ME8693 - Heat and Mass Transfer
20	ME8692 - Finite Element Analysis
21	ME8694 - Hydraulics and Pneumatics
22	ME8792 - Power Plant Engineering
23	ME8791 - Mechatronics
24	ME8072 - Renewable Sources of Energy
25	ME8073 - Unconventional Machining Processes

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26	ME8099 - Robotics
27	ME8097 - Non Destructive Testing and Evaluation
28	ME8091 - Automobile Enginneering

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	PH8251	Material Science	Composites, Classification, metallic glasses, types, glass forming ability of alloys.

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PH8251

MATERIALS SCIENCE
(Common to courses offered in Faculty of Mechanical
Engineering
Except B.E. Materials Science and Engineering)

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OBJECTIVES:

To introduce the essential principles of materials science for mechanical and related engineering applications.

UNIT I PHASE DIAGRAMS 9

Solid solutions - Hume Rothery's rules - the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions - free energy composition curves for binary systems - microstructural change during cooling.

UNIT II FERROUS ALLOYS 9

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws - phase transformations - T-T-T-diagram for eutectoid steel - pearlitic, bainitic and martensitic transformations - tempering of martensite - steels - stainless steels - cast irons.

UNIT III MECHANICAL PROPERTIES 9

Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination - fatigue failure - fatigue tests - methods of increasing fatigue life - hardness - Rockwell and Brinell hardness - Knoop and Vickers microhardness.

UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS 9

Ferromagnetism - domain theory - types of energy - hysteresis - hard and soft magnetic materials - ferrites - dielectric materials - types of polarization - Langevin-Debye equation - frequency effects on polarization - dielectric breakdown - insulating materials - Ferroelectric materials - superconducting materials and their properties.

UNIT V NEW MATERIALS 9

Ceramics - types and applications - composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics - metallic glasses: types, glass forming ability of alloys, melt spinning process, applications - shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications - nanomaterials: preparation (bottom up and top down approaches), properties and applications - carbon nanotubes: types.

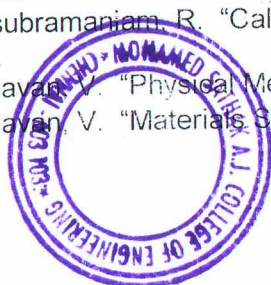
OUTCOMES:

Upon completion of this course,

- the students will have knowledge on the various phase diagrams and their applications
- the students will acquire knowledge on Fe-Fe₃C phase diagram, various microstructures and alloys
- the students will get knowledge on mechanical properties of materials and their measurement
- the students will gain knowledge on magnetic, dielectric and superconducting properties of materials
- the students will understand the basics of ceramics, composites and nanomaterials.

TEXT BOOKS:

1. Balasubramaniam, R. "Callister's Materials Science and Engineering". Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. "Physical Metallurgy: Principles and Practice". PHI Learning, 2015.
3. Raghavan, V. "Materials Science and Engineering : A First course". PHI Learning, 2015.





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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	GE8291	Environmental Science and Engineering	Air pollution, Thermal pollution, use of alternate energy sources, prevention and control of pollution.

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OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**14**

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION**8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES**10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.




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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	GE8292	Engineering Mechanics	Units and Dimensions, Equilibrium of particle, Types of supports, Action and reaction forces, stable equilibrium, Centroids and centre of mass, Displacements, Velocity and acceleration, Friction force, Plane motion of simple rigid bodies, disc / wheels

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OBJECTIVES:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I STATICS OF PARTICLES**9+6**

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES**9+6**

Free body diagram – Types of supports – Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS**9+6**

Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES**9+6**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND RIGID BODY DYNAMICS**9+6**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

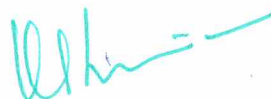
TOTAL : 45+30=75 PERIODS**OUTCOMES:**

On successful completion of this course, the student will be able to

- illustrate the vectorial and scalar representation of forces and moments
- analyse the rigid body in equilibrium
- evaluate the properties of surfaces and solids
- calculate dynamic forces exerted in rigid body
- determine the friction and the effects by the laws of friction

TEXT BOOKS:

- Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
- Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

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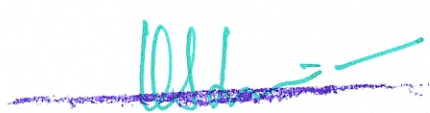


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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8391	Engineering Thermodynamics	Basic concepts Path and point functions, Heat and work transfer, definition and comparison, concept of temperature and thermal equilibrium, sink


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OBJECTIVE:

To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted)

UNIT I BASIC CONCEPTS AND FIRST LAW**9+6**

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work. P-V diagram. Zeroth law of thermodynamics - concept of temperature and thermal equilibrium - relationship between temperature scales - new temperature scales. First law of thermodynamics - application to closed and open systems - steady and unsteady flow processes.

UNIT II SECOND LAW AND AVAILABILITY ANALYSIS**9+6**

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for - pure substance, ideal gases - different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Available and non-available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law Efficiency.

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE**9+6**

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles.

UNIT IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS**9+6**

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties. Compressibility factor- Principle of Corresponding states. -Generalised Compressibility Chart and its use-. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations.

UNIT V GAS MIXTURES AND PSYCHROMETRY**9+6**

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture - Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

TOTAL : 75 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.
- CO2 Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.
- CO3 Apply Rankine cycle to steam power plant and compare few cycle improvement methods
- CO4 Derive simple thermodynamic relations of ideal and real gases

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	CE8394	Fluid Mechanics and Machinery	Flow through pipes in series and parallel, commercial pipes.

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OBJECTIVES

- The properties of fluids and concept of control volume are studied
- The applications of the conservation laws to flow through pipes are studied.
- To understand the importance of dimensional analysis
- To understand the importance of various types of flow in pumps.
- To understand the importance of various types of flow in turbines.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS**12**

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS**12**

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

UNIT III DIMENSIONAL ANALYSIS**12**

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

UNIT IV PUMPS**12**

Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle - work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps –classification.

UNIT V TURBINES**12**

Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.

TOTAL: 60 PERIODS**OUTCOMES:**

Upon completion of this course, the students will be able to

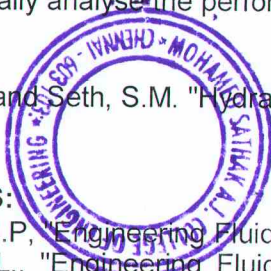
- Apply mathematical knowledge to predict the properties and characteristics of a fluid.
- Can analyse and calculate major and minor losses associated with pipe flow in piping networks.
- Can mathematically predict the nature of physical quantities
- Can critically analyse the performance of pumps
- Can critically analyse the performance of turbines.

TEXT BOOK:

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2013.

REFERENCES:

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
3. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	EE8353	Electrical Drives and Control	Mechanical characteristics, Speed-torque characteristics of various types of load and drive.

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OBJECTIVES:

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives

UNIT I INTRODUCTION

8

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

UNIT II DRIVE MOTOR CHARACTERISTICS

9

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

UNIT III STARTING METHODS

8

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES

10

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES

10

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

TOTAL: 45 PERIODS**OUTCOME:**

Upon Completion of this subject, the students can able to explain different types of electrical machines and their performance

TEXT BOOKS:

1. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 2006
2. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2010

REFERENCES:

1. Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2017
2. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 2012
3. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2006.




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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8451	Manufacturing Technology – II	Specification, operations, Milling operations, types of milling cutter.

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OBJECTIVES:

To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.

To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming

UNIT I THEORY OF METAL CUTTING

9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools– nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT II TURNING MACHINES

9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi automatic – single spindle : Swiss type, automatic screw type – multi spindle:

UNIT III SHAPER, MILLING AND GEAR CUTTING MACHINES

9

Shaper - Types of operations. Drilling, reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes –finishing of gears.

UNIT IV ABRASIVE PROCESS AND BROACHING

9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centreless grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines

UNIT V CNC MACHINING

9

Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre, part programming fundamentals CNC – manual part programming – micromachining – wafer machining.

TOTAL : 45 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 Explain the mechanism of material removal processes.
- CO2 Describe the constructional and operational features of centre lathe and other special purpose lathes.
- CO3 Describe the constructional and operational features of shaper, planner, milling, drilling, sawing and broaching machines.
- CO4 Explain the types of grinding and other super finishing processes apart from gear manufacturing processes.
- CO5 Summarize numerical control of machine tools and write a part program.

TEXT BOOKS:

- Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters 2014
- Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", 3rd Edition, Tata McGraw-Hill, New Delhi, 2013

REFERENCES:

- Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J. White "Machine Tool Practices", Prentice Hall of India, 1998
- Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Graw Hill, 1984
- HMT, "Production Technology", Tata McGraw Hill, 1998.
- Roy. A.Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education 2006.



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1	ME8493	Thermal Engineering - I	Air Standard Cycles, Concepts of Supercharging and Turbo charging, Emission Norms.

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OBJECTIVES:

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam.
- Turbines, Compressors and Refrigeration and Air conditioning systems
(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

UNIT I GAS AND STEAM POWER CYCLES

9

Air Standard Cycles - Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison – Rankine, reheat and regenerative cycle.

UNIT II RECIPROCATING AIR COMPRESSOR

9

Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

UNIT III INTERNAL COMBUSTION ENGINES AND COMBUSTION

9

IC engine – Classification, working, components and their functions. Ideal and actual : Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control.

UNIT IV INTERNAL COMBUSTION ENGINE PERFORMANCE AND SYSTEMS

9

Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common Rail Direct Injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms.

UNIT V GAS TURBINES

9

Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combinations. Materials for Turbines.

TOTAL:45 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 Apply thermodynamic concepts to different air standard cycles and solve problems.
- CO2 Solve problems in single stage and multistage air compressors
- CO3 Explain the functioning and features of IC engines, components and auxiliaries.
- CO4 Calculate performance parameters of IC Engines.
- CO5 Explain the flow in Gas turbines and solve problems.

TEXT BOOKS:

1. Kothandaraman.C.P., Domkundwar. S. Domkundwar. A.V., "A course in thermal Engineering" Fifth Edition, "Dhanpat Rai & sons", 2016
 2. Rajput, R. K., "Thermal Engineering" S.Chand Publishers, 2017
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REFERENCES:

1. Arora.C.P., "Refrigeration and Air Conditioning," Tata McGraw-Hill Publishers 2008
2. Ganesan V., "Internal Combustion Engines", Third Edition, Tata McGraw-Hill 2012
3. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
4. Rudramoorthy, R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003
5. Sarkar. B.K. "Thermal Engineering" Tata McGraw-Hill Publishers. 2007



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8595	Thermal Engineering - II	Source and utilization of residual heat, Heat pipes, Heat pumps.

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ME8595

THERMAL ENGINEERING – II

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OBJECTIVES:

- To apply the thermodynamic concepts for Nozzles, Boilers, Turbines, and Refrigeration & Air Conditioning Systems.
- To understand the concept of utilising residual heat in thermal systems.

UNIT I STEAM NOZZLE

9

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.

UNIT II BOILERS

9

Types and comparison. Mountings and Accessories. Fuels - Solid, Liquid and Gas. Performance calculations, Boiler trial.

UNIT III STEAM TURBINES

9

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing.

UNIT IV COGENERATION AND RESIDUAL HEAT RECOVERY

9

Cogeneration Principles, Cycle Analysis, Applications, Source and utilisation of residual heat. Heat pipes, Heat pumps, Recuperative and Regenerative heat exchangers. Economic Aspects.

UNIT V REFRIGERATION AND AIR – CONDITIONING

9

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration. Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.

TOTAL:45 PERIODS

OUTCOMES:

Upon the completion of this course the students will be able to

- CO1 Solve problems in Steam Nozzle
- CO2 Explain the functioning and features of different types of Boilers and auxiliaries and calculate performance parameters.
- CO3 Explain the flow in steam turbines, draw velocity diagrams for steam turbines and solve problems.
- CO4 Summarize the concept of Cogeneration, Working features of Heat pumps and Heat exchangers
- CO5 Solve problems using refrigerant table / charts and psychrometric charts

TEXT BOOKS:

1. Kothandaraman, C.P., Domkundwar S and Domkundwar A.V., "A course in Thermal Engineering", Dhanpat Rai & Sons, 2016.
2. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata Mc Graw Hill Publications, 2010.

REFERENCES:

1. Arora .C.P., "Refrigeration and Air Conditioning", Tata Mc Graw Hill, 2008
2. Ballaney. P.L. " Thermal Engineering", Khanna publishers, 24th Edition, 2012
3. Charles H Butler : Cogeneration" McGraw Hill, 1984.
4. Donald Q. Kern, " Process Heat Transfer", Tata Mc Graw Hill, 2001.
5. Sydney Reiter "Industrial and Commercial Heat Recovery Systems" Van Nostrand Reinholds, 1985.



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8593	Design of Machine Elements	Factors influencing machine design, selection of materials based on mechanical properties, Design of solid and hollow shafts, Welded joints, types of springs, Flywheels.

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OBJECTIVES

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components
- (Use of P S G Design Data Book is permitted)

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and 'C' frame- Factor of safety - theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

UNIT II SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys, keyways and splines - Rigid and flexible couplings.

UNIT III TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, riveted joints for structures - theory of bonded joints.

UNIT IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

UNIT V BEARINGS 9

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs, -- Selection of Rolling Contact bearings.

TOTAL: 45 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 Explain the influence of steady and variable stresses in machine component design. CO2 Apply the concepts of design to shafts, keys and couplings.
- CO3 Apply the concepts of design to temporary and permanent joints.
- CO4 Apply the concepts of design to energy absorbing members, connecting rod and crank shaft.
- CO5 Apply the concepts of design to bearings.

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co. 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 9th Edition, Tata McGraw-Hill, 2011.

REFERENCES:

1. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010
2. Ansel Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2003.
3. P.C. Gope, "Machine Design – Fundamental and Application", PHI learning private ltd, New Delhi, 2012.
4. R.B. Patel, "Design of Machine Elements", MacMillan Publishers India P Ltd., Tech-Max Educational resources, 2011.
5. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005
6. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications,



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8594	Dynamics of Machines	Field balancing of discs and rotors, Degrees of freedom, single degree of freedom, Free vibration, Equations of motion, Natural frequency, One degree freedom systems to periodic forcing, Harmonic disturbances, Disturbance caused by unbalance, Centrifugal governors, gravity controlled and spring controlled centrifugal, Effect of friction, Gyroscopic forces and torques, Gyroscope stabilization, Gyroscopic effects.

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OBJECTIVES:

To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.

To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.

To understand the effect of Dynamics of undesirable vibrations.

To understand the principles in mechanisms used for speed control and stability control.

UNIT I FORCE ANALYSIS

12

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses- Dynamics of Cam- follower mechanism.

UNIT II BALANCING

12

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.

UNIT III FREE VIBRATION

12

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

UNIT IV FORCED VIBRATION

12

Response of one degree freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

UNIT V MECHANISM FOR CONTROL

12

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

TOTAL : 60 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 Calculate static and dynamic forces of mechanisms.
- CO2 Calculate the balancing masses and their locations of reciprocating and rotating masses.
- CO3 Compute the frequency of free vibration.
- CO4 Compute the frequency of forced vibration and damping coefficient.
- CO5 Calculate the speed and lift of the governor and estimate the gyroscopic effect on automobiles, ships and airplanes.

TEXT BOOKS:

1. F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2011.
2. Rattan, S.S., "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
3. Uicker, J.J., Pennock, G.R. and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

REFERENCES:

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014.
2. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition, Affiliated East-West Pvt. Ltd., New Delhi, 2009.
3. Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005.
4. Rao.J.S. and Dukkupati.R.V., "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
6. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8693	Heat and Mass Transfer	One Dimensional Steady state heat conduction, Internal Heat Generation Extended Surfaces, Unsteady Heat conduction Lumped analysis, Semi infinite and infinite solids, Free and Forced convection during external flow over plates, Internal flow through tubes, Overall Heat Transfer coefficient.

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OBJECTIVES:

- To understand the mechanisms of heat transfer under steady and transient conditions.
 - To understand the concepts of heat transfer through extended surfaces.
 - To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer.
- (Use of standard HMT data book permitted)

UNIT I CONDUCTION**9+6**

General Differential equation of Heat Conduction— Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT II CONVECTION**9+6**

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes .

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**9+6**

Nusselt's theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method.

UNIT IV RADIATION**9+6**

Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.

UNIT V MASS TRANSFER**9+6**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL : 75 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems
- CO2 Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems
- CO3 Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems
- CO4 Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems
- CO5 Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications

TEXT BOOKS:

- Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2000.
- Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition, 2015.

REFERENCES:

- Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998.
- Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 1998.
- Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002
- Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
- R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2000.



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8692	Finite Elements Analysis	Mathematical Modeling of field problems in Engineering, Element types, Derivation of Shape functions and stiffness matrices and force vectors, Thermal problems, Body forces and temperature effects, stress calculations.

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OBJECTIVES:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

UNIT I INTRODUCTION

9

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II ONE-DIMENSIONAL PROBLEMS

9

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS

9

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS

9

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION

9

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

TOTAL : 45 PERIODS**OUTCOMES**

- CO1 Summarize the basics of finite element formulation.
- CO2 Apply finite element formulations to solve one dimensional Problems.
- CO3 Apply finite element formulations to solve two dimensional scalar Problems.
- CO4 Apply finite element method to solve two dimensional Vector problems.
- CO5 Apply finite element method to solve problems on iso parametric element and dynamic Problems.

TEXT BOOKS:

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw Hill, 2005
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd, New Delhi, 2007.



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8694	Hydraulics and Pneumatics	Properties of air, Compressor, Pneumatic actuators, Design of Pneumatic circuit, Electro Pneumatic System, Pneumatic logic circuits.

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OBJECTIVE:

- To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL:45 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 Explain the Fluid power and operation of different types of pumps.
- CO2 Summarize the features and functions of Hydraulic motors, actuators and Flow control valves
- CO3 Explain the different types of Hydraulic circuits and systems
- CO4 Explain the working of different pneumatic circuits and systems
- CO5 Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems – Principles and Maintenance", Tata McGraw-Hill, 2001.

REFERENCES:

1. Anthony Lal, "Oil hydraulics in the service industry", Allied publishers, 1982.
2. Dudleyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
3. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
4. Michael J, Princes and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8792	Power Plant Engineering	Otto, Diesel, Dual and Brayton Cycle, Pollution control technologies.

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OBJECTIVE:

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

UNIT I COAL BASED THERMAL POWER PLANTS

9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS

9

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS

9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY

9

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS

9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : 45 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 Explain the layout, construction and working of the components inside a thermal power plant.
- CO2 Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
- CO3 Explain the layout, construction and working of the components inside nuclear power plants.
- CO4 Explain the layout, construction and working of the components inside Renewable energy power plants.
- CO5 Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

TEXT BOOK:

1. Nag, P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd. 2008.

REFERENCES:

1. El Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	OIE751	Robotics	Requirements of a sensor, Principles and applications of the following types of sensors, Position sensors, Piezo Electric Sensor, LVDT.

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OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I FUNDAMENTALS OF ROBOT

6

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load-Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS

9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION

12

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors, binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Servoing and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING

13

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS

5

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

OUTCOME:**TOTAL: 45 PERIODS**

Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics

TEXT BOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall 2003.
2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001.

REFERENCES:

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation", Tata McGraw Hill Book Co., 1994.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. Fu.K.S., Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.



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Siruseri IT Park, Egattur, Chennai - 603 103

S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8073	Unconventional Machining Process	Wire cut EDM, parameters surface finish and MRR, Recent developments in non-traditional machining processes.

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Chennai-603 103.

OBJECTIVE:

To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT II THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing — Applications. Laser Beam machining and drilling, (LBM), plasma, Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

UNIT III CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro-Chemical machining (CHM and ECM)- Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters-ECG and ECH - Applications.

UNIT IV ADVANCED NANO FINISHING PROCESSES 9

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing their working principles, equipments, effect of process parameters, applications, advantages and limitations.

UNIT V RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES 9

Recent developments in non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Comparison of non-traditional machining processes.

TOTAL: 45 PERIODS

OUTCOMES:

Upon the completion of this course the students will be able to

- CO1 Explain the need for unconventional machining processes and its classification
- CO2 Compare various thermal energy and electrical energy based unconventional machining processes.
- CO3 Summarize various chemical and electro-chemical energy based unconventional machining processes.
- CO4 Explain various nano abrasives based unconventional machining processes.
- CO5 Distinguish various recent trends based unconventional machining processes.

TEXT BOOKS:

- Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007
- Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2007.

REFERENCES:

- Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.
- Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
- Paul De Garmo, J.T.Black, and Ronald. A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 8th Edition, New Delhi , 2001.



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8097	Non Destructive Testing and Evaluation	Various physical characteristics of materials and their applications, visual inspection unaided and aided.

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ME8097

NON DESTRUCTIVE TESTING AND EVALUATION

L	T	P	C
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OBJECTIVE:

- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

UNIT I OVERVIEW OF NDT

9

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided.

UNIT II SURFACE NDE METHODS

9

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET)

9

Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation -. infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)

9

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique – Principle, AE parameters, Applications

UNIT V RADIOGRAPHY (RT)

9

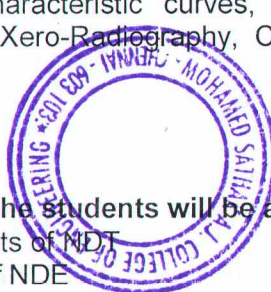
Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

TOTAL : 45 PERIODS

OUTCOMES:

Upon the completion of this course the students will be able to

- CO1 Explain the fundamental concepts of NDT
- CO2 Discuss the different methods of NDE
- CO3 Explain the concept of Thermography and Eddy current testing
- CO4 Explain the concept of Ultrasonic Testing and Acoustic Emission
- CO5 Explain the concept of Radiography



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME 8351	Manufacturing Technology – I	Operating principle, basic equipment, Manual arc welding, Gas Tungsten arc welding.

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OBJECTIVE:

To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

UNIT I METAL CASTING PROCESSES

9

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes : Shell - investment – Ceramic mould – Pressure die casting - Centrifugal Casting - CO₂ process – Stir casting; Defects in Sand casting

UNIT II JOINING PROCESSES

9

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of: Resistance welding - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure.

UNIT III METAL FORMING PROCESSES

9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – forging operations. Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion.

UNIT IV SHEET METAL PROCESSES

9

Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes-Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning– Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming

UNIT V MANUFACTURE OF PLASTIC COMPONENTS

9

Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – Typical industrial applications – introduction to blow moulding –Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

TOTAL: 45 PERIODS**OUTCOMES:**

- CO1 Explain different metal casting processes, associated defects, merits and demerits
- CO2 Compare different metal joining processes.
- CO3 Summarize various hot working and cold working methods of metals.
- CO4 Explain various sheet metal making processes.
- CO5 Distinguish various methods of manufacturing plastic components.

TEXT BOOKS:

1. Hajra Choudhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008
2. Kalpakjian, S., "Manufacturing Engineering and Technology", Pearson Education India Edition, 2013

REFERENCES:

1. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008
2. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice – Hall of India, 1997.
3. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition, TMH-2013
4. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
5. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2014.



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Siruseri IT Park, Egattur, Chennai - 603 103

S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8492	Kinematics of Machinery	Classification of mechanisms, Basic kinematic concepts and definitions, Degree of freedom, Displacement, velocity and acceleration analysis of simple mechanisms, kinematic analysis of simple mechanisms.

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OBJECTIVES:

- To understand the basic components and layout of linkages in the assembly of a system machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

UNIT I BASICS OF MECHANISMS

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Universal Joint – rocker mechanisms.

UNIT II KINEMATICS OF LINKAGE MECHANISMS

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method – Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration – Introduction to linkage synthesis problem.

UNIT III KINEMATICS OF CAM MECHANISMS

Classification of cams and followers – Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

UNIT IV GEARS AND GEAR TRAINS

Law of toothed gearing – Involute and cycloidal tooth profiles – Spur Gear terminology and definitions – Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains.

UNIT V FRICTION IN MACHINE ELEMENTS

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction in brakes- Band and Block brakes.

OUTCOMES:

Upon the completion of this course the students will be able to

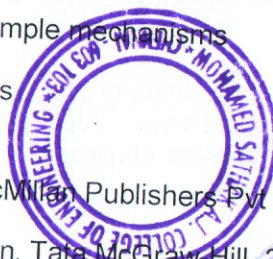
- CO1 Discuss the basics of mechanism
- CO2 Calculate velocity and acceleration in simple mechanisms
- CO3 Develop CAM profiles
- CO4 Solve problems on gears and gear trains
- CO5 Examine friction in machine elements

TEXT BOOKS:

1. F.B. Sayyad, "Kinematics of Machinery", MacMillan Publishers Pvt Ltd, 34 Bally Gandhi Salai (OMR), SIPCOT - IT Park, Siruseri, Educational 603 103.
2. Rattan, S.S., "Theory of Machines", 4th Edition, Tata McGraw Hill, 2014.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

REFERENCES:

1. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014
3. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006.
4. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
5. Thomas Beyer, "Theory of Machines" 2nd Edition, CBS Publishers and Distributors, 2005



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8491	Engineering Metallurgy	Stainless and tool steels, Copper and copper alloys, Aluminium, precipitation strengthening treatment, properties and applications of SiC composites, Classifications, Metal Matrix composites.

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ME8491

ENGINEERING METALLURGY

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OBJECTIVE:

To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

UNIT I ALLOYS AND PHASE DIAGRAMS

9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – carbon equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

UNIT II HEAT TREATMENT

9

Definition – Full annealing, stress relief, recrystallisation and spheroidising – normalising, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR – Hardenability, Jominy end quench test - Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening.

UNIT III FERROUS AND NON-FERROUS METALS

9

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels – Cast Iron - Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

UNIT IV NON-METALLIC MATERIALS

9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al_2O_3 , SiC, Si_3N_4 , PSZ and SIALON –Composites- Classifications- Metal Matrix and FRP - Applications of Composites.

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS

9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test Izod and Charpy, fatigue and creep failure mechanisms.

TOTAL: 45 PERIODS

OUTCOMES

Upon the completion of this course the students will be able to

- CO1 Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
- CO2 Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
- CO3 Clarify the effect of alloying elements on ferrous and non-ferrous metals
- CO4 Summarize the properties and applications of non metallic materials.
- CO5 Explain the testing of mechanical properties.

TEXT BOOKS:

1. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1997.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2014.



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	CE8395	Strength of Materials for Mechanical Engineers	Tension, Compression and Shear stresses, deformation, principal stresses.

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CE8395 STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS

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OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending – bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT III TORSION 9

Torsion formulation stresses and deformation in circular and hollow shafts – Stepped shafts – Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS 9

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams – Conjugate beam and strain energy – Maxwell's reciprocal theorems.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lamé's theorem.

TOTAL: 45 PERIODS**OUTCOMES**

Students will be able to

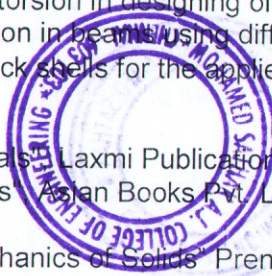
- Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
- Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Apply basic equation of simple torsion in designing of shafts and helical spring
- Calculate the slope and deflection in beams using different methods.
- Analyze and design thin and thick shells for the applied internal and external pressures.

TEXT BOOKS:

- Bansal, R.K., "Strength of Materials" Laxmi Publications (P) Ltd., 2016
- Jindal U.C., "Strength of Materials" Asian Books Pvt. Ltd., New Delhi, 2009

REFERENCES:

- Egor. P. Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2002
- Ferdinand P. Beer, Russell Johnson, J.R. and John J. Dewole "Mechanics of Materials" Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
- Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
- Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.



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CE8395 STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS
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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8501	Metrology and Measurements	Force, torque, power, mechanical, pneumatic

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OBJECTIVES:

To provide knowledge on various Metrological equipments available to measure the dimension of the components.

To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

UNIT I BASICS OF METROLOGY

9

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.

UNIT II LINEAR AND ANGULAR MEASUREMENTS

9

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT III ADVANCES IN METROLOGY

9

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

UNIT IV FORM MEASUREMENT

9

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE

9

Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration – Readability and Reliability.

TOTAL: 45 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 Describe the concepts of measurements to apply in various metrological instruments
- CO2 Outline the principles of linear and angular measurement tools used for industrial applications
- CO3 Explain the procedure for conducting computer aided inspection
- CO4 Demonstrate the techniques of form measurement used for industrial components
- CO5 Discuss various measuring techniques of mechanical properties in industrial applications

TEXT BOOKS:

1. Gupta. I.C., "Engineering Metrology", Dharmatrai Publications, 2005.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.

REFERENCES:

1. Alan S. Morris, "The essence of Measurement", Prentice Hall of India 1993.
2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education 2001.
3. Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA, 1990.
4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.
5. Raghavendra, Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.



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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8651	Design of Transmission System	Design of Flat belts and pulleys, Selection of V belts and pulleys.

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OBJECTIVES:

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements
- To learn to use standard data and catalogues
(Use of P S G Design Data Book permitted)

UNIT I DESIGN OF FLEXIBLE ELEMENTS

Design of Flat belts and pulleys - Selection of V belts and pulleys - Selection of hoisting wire ropes and pulleys - Design of Transmission chains and Sprockets. 9

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS9

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials - Design of straight tooth spur & helical gears based on strength and wear considerations - Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces for helical gears.

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT IV GEAR BOXES9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. - Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

UNIT V CAMS, CLUTCHES AND BRAKES9

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches -axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes - Internal expanding shoe brake.

OUTCOMES:**TOTAL : 45 PERIODS**

Upon the completion of this course the students will be able to

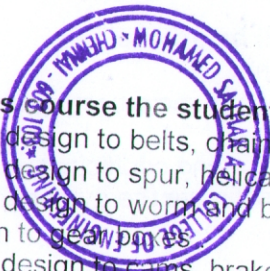
- CO1 apply the concepts of design to belts, chains and rope drives.
- CO2 apply the concepts of design to spur, helical gears.
- CO3 apply the concepts of design to worm and bevel gears. apply
- CO4 the concepts of design to gear boxes.
- CO5 apply the concepts of design to cams, brakes and clutches

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett, "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

REFERENCES:

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2003.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Prabhu. T. J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005
5. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003



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PRINCIPAL
MOHAMED SAEED
SIRUPUR, CHENNAI - 603 101



MOHAMED SATHAK A J COLLEGE OF ENGINEERING

(Approved by AICTE, New Delhi and affiliated to Anna University, Chennai)
Siruseri IT Park, Egattur, Chennai - 603 103

S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8691	Computer Aided Design and Manufacturing	Computer aided design, Line drawing, clipping, viewing transformation, Brief introduction to CAD, Manufacturing Planning.

PRINCIPAL
MOHAMED SATHAK A.J.COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Siruseri, IT Park
Chennai-603 103.

OBJECTIVES:

To provide an overview of how computers are being used in mechanical component design

To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT I INTRODUCTION

9

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM –CAD/CAM concepts –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance

UNIT II GEOMETRIC MODELING

9

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep

UNIT III CAD STANDARDS

9

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. – communication standards.

UNIT IV FUNDAMENTAL OF CNC AND PART PROGRAMING

9

Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

UNIT V CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS)

9

Group Technology(GT),Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS.

TOTAL : 45 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

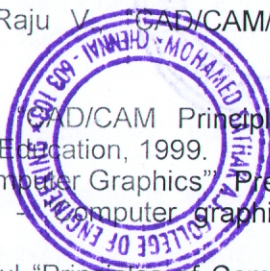
- CO1 Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics
- CO2 Explain the fundamentals of parametric curves, surfaces and Solids
- CO3 Summarize the different types of Standard systems used in CAD
- CO4 Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines
- CO5 Summarize the different types of techniques used in Cellular Manufacturing and FMS

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co. 2007
2. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
3. Radhakrishnan P, Subramanyan S. and Raju V. "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCES:

1. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management" Second Edition, Pearson Education, 1999.
2. Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc. 1992.
3. Foley, Van Dam, Feiner and Hughes - "Computer graphics principles & practice", Pearson Education - 2003
4. William M Neumann and Robert F. Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.



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Chennai-600 152



MOHAMED SATHAK A J COLLEGE OF ENGINEERING

(Approved by AICTE, New Delhi and affiliated to Anna University, Chennai)

Siruseri IT Park, Egattur, Chennai - 603 103

S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8791	Mechatronics	Sensors and Transducers, Static and dynamic Characteristics of Sensor, Mechatronics design concepts, Engine Management system.

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MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Siruseri
Chennai-603 103.

OBJECTIVE:

To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

UNIT I INTRODUCTION

9

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors

UNIT II MICROPROCESSOR AND MICROCONTROLLER

9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes – Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE

9

Introduction – Architecture of 8255, Keyboard interfacing, LED display – interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER

9

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN

9

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

TOTAL : 45 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.
- CO2 Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller.
- CO3 Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing
- CO4 Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronic engineering.
- CO5 Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies

TEXT BOOKS:

1. Bolton, "Mechatronics", Prentice Hall, 2008
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 5th Edition, Prentice Hall, 2008

REFERENCES:

1. Bradley D.A, Dawson D, Buru N.C and Loader A.J. "Mechatronics", Chapman and Hall, 1993.
2. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013
3. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", PWS publishing company, 2007.
4. Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India, 2007.
5. Michael B.Histand and Davis G.Alciatore, "Introduction to Mechatronics and Measurement systems", McGraw Hill International edition, 2007.



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Shriren, Chennai-600 095



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(Approved by AICTE, New Delhi and affiliated to Anna University, Chennai)

Siruseri IT Park, Egattur, Chennai - 603 103

S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ORO551	Renewable energy sources	Combustion characteristics of bio-gas

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MOHAMED SATHAK A.J.COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Siruseri, IT Park
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OBJECTIVE:

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT I PRINCIPLES OF SOLAR RADIATION

10

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II SOLAR ENERGY COLLECTION

8

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III SOLAR ENERGY STORAGE AND APPLICATIONS

7

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT IV WIND ENERGY

10

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT V GEOTHERMAL ENERGY:

9

Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC.

OUTCOMES:**TOTAL : 45 PERIODS**

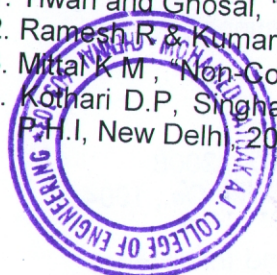
- Understanding the physics of solar radiation.
- Ability to classify the solar energy collectors and methodologies of storing solar energy.
- Knowledge in applying solar energy in a useful way.
- Knowledge in wind energy and biomass with its economic aspects.
- Knowledge in capturing and applying other forms of energy sources like wind, biogas and geothermal energies.

TEXT BOOKS:

1. Rai G.D. , "Non-Conventional Energy Sources", Khanna Publishers, 2011
2. Twidell & Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011

REFERENCES:

1. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2007
2. Ramesh R & Kumar K.U , "Renewable Energy Technologies", Narosa Publishing House, 2004
3. Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2003
4. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010



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Siruseri IT Park, Egattur, Chennai - 603 103

S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME8091	Automobile Engineering	Bio-diesel, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels.

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MOHAMED SATHAK A.J.COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Siruseri IT Park
Chennai-603 103.

OBJECTIVES:

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

UNIT I VEHICLE STRUCTURE AND ENGINES

9

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components-functions and materials, variable valve timing (VVT).

UNIT II ENGINE AUXILIARY SYSTEMS

9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT III TRANSMISSION SYSTEMS

9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS

9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V ALTERNATIVE ENERGY SOURCES

9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

OUTCOMES:**TOTAL: 45 PERIODS**

Upon the completion of this course the students will be able to

- CO1 recognize the various parts of the automobile and their functions and materials.
- CO2 discuss the engine auxiliary systems and engine emission control.
- CO3 distinguish the working of different types of transmission systems.
- CO4 explain the Steering, Brakes and Suspension Systems.
- CO5 predict possible alternate sources of energy for IC Engines.

TEXT BOOKS:

- Jain K.K. and Asthana R.B. "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
- Kirpal Singh, "Automobile Engineering" Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014.

REFERENCES:

- Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
- Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
- Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
- Martin W, Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA, 1978.

PREPARATION AND EMISSION ANALYSIS OF NEEM OIL BIODIESEL

A PROJECT REPORT

Submitted by

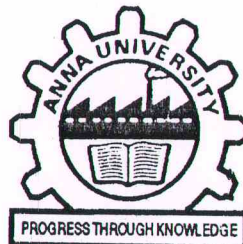
ABDUL BASIT	311817114002
GOKUL L	311817114301
MANOJ KUMAR	311817114028
KARTHICK KUMAR	311817114025

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

In

MECHANICAL ENGINEERING



[Signature]

PRINCIPAL

MOHAMED SATHAK A J COLLEGE OF ENGINEERING
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Siruseri, Chennai - 603 103.

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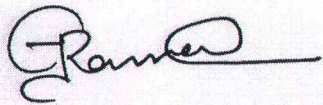


MARCH 2021

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report “**PREPARATION AND EMISSION ANALYSIS OF NEEM OIL BIODIESEL**” is the bonafide work of **GOKUL L (311817114301) ABDUL BASIT (311816114002) MANOJ KUMAR (311817114028) KARTHICK KUMAR (311817114025)** who carried out the project work under my supervision.



SIGNATURE

Mr.G RAMESH (ME, PhD)

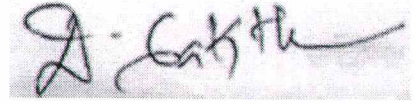
HEAD OF THE DEPARTMENT

Department of Mechanical Engineering

Mohamed Sathak A J College of Engineering

IT Sipcot, OMR, Siruseri,

Chennai – 603 103



SIGNATURE

Mr. SAKTHIVEL ME

SUPERVISOR

Assistant Professor

Department of Mechanical Engineering

Mohamed Sathak A J College of Engineering

IT Sipcot, OMR, Siruseri,

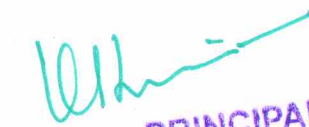
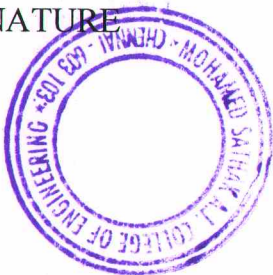
Chennai – 603 103

Project Viva-Voce held on 05/08/2021



INTERNAL EXAMINER

SIGNATURE



PRINCIPAL
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No.34.Rajiv Gandhi Salai (OMR), SIPCOT - IT Park
Siruseri, Chennai - 603 103.
AP - 311817114026

EXTERNAL EXAMINER

SIGNATURE

ABSTRACT

In the current energy scene of fossil fuel, renewable energy sources such as biodiesel, bioethanol, biomethane, and biomass from wastes or hydrogen have become the subjects of great interest. These fuels contribute to the reduction of dependence on fossil fuels. In addition, energy sources such as these could partially replace the use of those fuels which are responsible for environmental pollution and may be scarce in the future. For these reasons they are known as “alternative fuels”. Vegetable oil cannot be directly used in the diesel engine for its high viscosity, high density, high flash point and lower calorific value. So it needs to be converted into biodiesel to make it consistent with fuel properties of diesel. Biodiesel production is a valuable process which needs a continued study and optimization process. This present study will focus on the preparation of the biodiesel using Neem oil from its seed by two step method, analyzing the property of the prepared neem fatty acid and analyzing the combustion and emission properties like NOX, Hydrocarbon, carbon dioxide and Oxygen for different blend.




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Chapter 8

Conclusion

- The two-step transesterification process determines the maximum biodiesel yield. A maximum biodiesel yield of 90% was obtained by this method.
- The value of Density, Kinematic viscosity, Acid value and FFA of biodiesel properties are reduced by this double stage transesterification method and well within the requirement range.
- The Emission values of Hydrocarbon & Oxides of Nitrogen of B10 blend is lower than diesel.
- When compared with B20 blend the percentage of CO₂ is lower than other blends.
- B40 Oxygen emission values are lower than other blends.




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FABRICATION OF BOREWELL RESCUE SYSTEM

A PROJECT REPORT

Submitted by

JAMALUL ASHRAQ
AZBAQ MEERAN
ABDUL MUKSHITH

311817114023
311817114015
311817114003

*in partial fulfillment for the award of the degree
of*

BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING



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PRINCIPAL

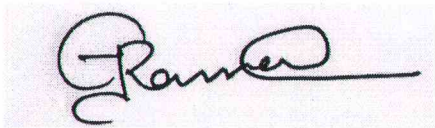
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SIRUSERI IT PARK, OMR, CHENNAI – 603 103**

**ANNA UNIVERSITY : CHENNAI 600 025
MARCH 2021**

BONAFIDE CERTIFICATE

Certified that this project report "FABRICATION OF BOREWELL RESCUE SYSTEM" is the bonafide work of **AZBAQ MEERAN.F (311817114015)** **ABDUL MUKSHITH.A (311817114003)** **JAMALUL ASHRAQ.I (311817114023)** who carried out the project work under my supervision.



SIGNATURE

Mr.G RAMESH

HEAD OF THE DEPARTMENT

Department of Mechanical Engineering
Mohamed Sathak A J College of Engineering
IT Sipcot, OMR, Siruseri,
Chennai – 603 103



SIGNATURE

Dr.R SENTHILKUMAR

SUPERVISOR

Professor
Department of Mechanical Engineering
Mohamed Sathak A J College of Engineering
IT Sipcot, OMR, Siruseri,
Chennai – 603 103

Project Viva-Voce held on 05/08/2024



INTERNAL EXAMINER



PRINCIPAL

MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
No. 47 Rajiv Gandhi Salai (OMR), SIPCOT - IV
Siruseri, Chennai - 603 103.

(K. CHANDRAN SUNDARAM
AP - 3105026)

EXTERNAL EXAMINER

ABSTRACT

Deep well accidents are common due to uncovered openings of Deep well. It is very difficult and risky to rescue the trapped children. A small delay in the rescue can cost the child his or her life. Lifting the child out of the narrow hole of the bore well is not easy. The child who has suffered the trauma of the fall is confined to a small area where with the passage of time, the supply of oxygen reduces. The main objective of this project is to design and construct a portable robot which is cost effective, quick in action and accurate. The Bore well Rescue Robot is capable of moving inside the well and performs operations according to the user commands. The proposed model is designed to provide the child with two level of safety achieved by using robotic arms at the top which operate by pneumatic power transmission. This arrangement ensures that the child does not slip further deep during the rescue operation. Deepwell rescue Robot is a human controlled computerized Robotic system embedded with additional safety devices.




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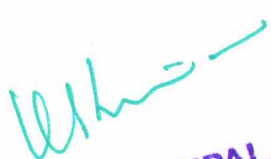
CHAPTER 5

CONCLUSION

The proposed prototype performs the rescuing actions more precisely in very limited time. Usage of robotic arms ensures the rescuing action in both conditions such as when the child has been struck in between or at the bottom of the well. The inclusion of metallic plates has been proposed to provide an additional support and ensure the complete safety of the child. The robot is also capable of performing lifesaving actions like supplying oxygen.

Human life is precious. Our bore well child rescue system is a significant attempt to save the life of the victim of bore well accidents. Besides this, the unique capability of climbing through vertical and inclined pipes makes wide scope of application for this machine in manufacturing industries and other relevant fields. In the current design of bore well child saver machine it has been made to suit every possible situation that may occur during a rescue operation. We would like to conclude that with our project, we were able to carry out a rescue operation successfully. With the utilization of advanced robot technology we can overcome the existing limitations to save many lives.




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FABRICATION OF BRAKE FAILURE INDICATOR ALARM

A PROJECT REPORT

Submitted by

MOHAMED ALI HASAN.S.A (311817114009)

AHAMED MUKSHITH.M (311817114030)

ABDUL RAHIM.A.K (311817114004)

In partial fulfilment for the award of the

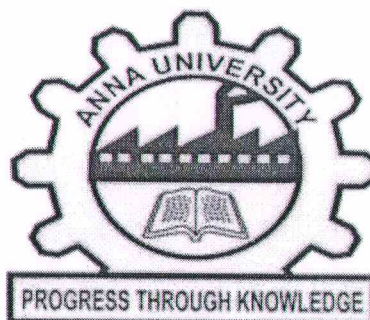
degree of

BACHELOR OF ENGINEERING

In

MECHANICAL ENGINEERING

MOHAMED SATHAK AJ COLLEGE OF ENGINEERING



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ANNA UNIVERSITY, CHENNAI 600025

APRIL 2021



MOHAMED SATHAK AJ COLLEGE OF ENGINEERING

ANNA UNIVERSITY, CHENNAI-603103

BONAFIDE CERTIFICATE

It is certified that this project report titled "**FABRICATION OF BRAKE FAILURE INDICATOR ALARM**" is bonafide work of **ABDUL RAHIM A.K (311817114004), AHAMED MUKSHITH.M (311817114009) MOHAMMAD ALI HASAN S.A (311817114030)**, who carried out the research under my supervision.

SIGNATURE

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ABSTRACT

The aim is to design and develop a control system based on an electronically controlled automatic brake failure indicator by using IR Sensor and engine over heating alarm by using heat sensor is called "AUTOMATIC BREAK FAILURE INDICATOR ALARM". Now a day, Machines are widely controlled by control system. To meet the need of exploding population economic and effective control of machines is necessary. The main theme of our project is to monitor the brake system at every moment.

Today accidents occur due to a lot of reasons, the one of the main reason is brake failure, it is caused due to poor maintenance as well as product defect, in order to safeguard the valuable human for accident the accident monitoring of brake is a very important thing in automobile.




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CHAPTER 6

CONCLUSION

The **Fabrication of Brake Failure Indicator Alarm** is working with satisfactory conditions and able to understand the difficulties in maintaining the tolerances and also quality. The indication of brake failure is sensed with the temperature sensor and the alarm is made to switched on to indicate the buzzer . Thus the life of the brake shoe is monitored and the failure system is activated which helps to know how to achieve low cost automation. The application produces smooth operation. By using more techniques, they can be modified and developed according to the applications.




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**STUDY OF MECHANICAL AND METALLURGICAL
PROPERTIES OF MAGNESIUM (AZ31D)/SIC COMPOSITE
FABRICATED THROUGH POWDER METALLURGY
TECHNIQUE**

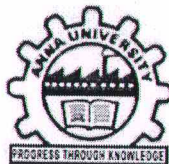
A PROJECT REPORT

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EXTERNAL EXAMINER

CHAPTER 6

CONCLUSION

In the present investigation, Mg and Mg-SiC composites are fabricated through powder metallurgy with different SiC Content, the characterization was executed with Optical microscope, density with Archimedes' principle, hardness on micro-Vickers hardness tester and compression behaviour on UTM. Based on conducted experiments, the following conclusions are drawn.,

1. The effect of tubular sintering displayed a better densification response due to volumetric uniform heating. Density increases with increases in addition of SiC as showed better densification than base matrix.
2. The optical microscope revealed the presence of SiC particles with uniform distribution on base matrix with defect free composites.
3. The hardness of 4 wt.% SiC composite shows higher hardness than another fabricated samples, the hard SiC resist the deformation during indentation.
4. The maximum compressive strength is 10.635 KN on AZ31D+4 wt.% SiC composite are responsible preventing plastic deformation and also higher strain hardening. In addition, the difference in density among Mg and SiC particles as results improves internal stress and higher density of dislocations.




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EXPERIMENTAL ANALYSIS OF MICROCHANNEL HEATSINKS FOR ELECTRONICS COOLING

A PROJECT REPORT

Submitted by

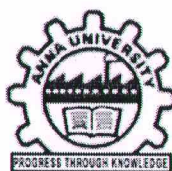
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ABSTRACT

In this modern world, it is a complicated task to eliminate the heat produced by IC in the computers; better heat transfer is required for the optimum operation of the device. Numerous problems arises due to this improper heat dissipation. Adequate damages also occur in the main system in computers, as well as in automotive electronics and causes unwanted crisis to the user, so here it is an important issue we have is the elimination of heat from the IC computers in an efficient way. Heat sink is one of the prominent devices used for better thermal transport and better operation. In this work the study of heat transfer characteristics in a micro channel heat sink (MCHS) is done, the heat is liberated by using fluid and temperature distribution in solid section (fin) designed in heat sink. By the help of MCHS we able to study the factors which affect the heat transfer in automotive electronics. By using MCHS temperature distribution, velocity and Nusselt number can be obtained and reliable solution for the thermal management problems associated with data centers could be resolved.




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CHAPTER 7

CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION:

It can be seen that there is up to 50% increase in the thermal conductivity of fluids as compared to those of base fluids. It has been observed with change in temperature the fluids show more enhancement of conductivity containing smaller CuO particles. It is also observed that over a temperature range of 21°C to 51°C, there is two to four times increase in thermal conductivity enhancement of fluids that takes place. This makes fluids even more attractive cooling fluids for devices that have high energy density where the cooling fluid can work at a temperature higher than the room temperature. The heat transfer coefficient of split channel has comparatively greater of the order of 7000 W/m²K in one side. Moreover, the high heat-transfer coefficient of the order of 14000 W/m²K can be achieved by heat transfer in two directions. Also the leakage and evaporation problems could be avoided much better by using liquid metal as the coolant of micro channel cooling devices.




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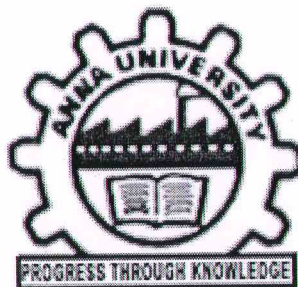
**EXPERIMENTAL INVESTIGATION ON AA5083
REINFORCED WITH Al_2O_3 & SiC
PARTICULATES COMPOSITES PRODUCED
BY POWDER METALLURGY ROUTE
A PROJECT REPORT**

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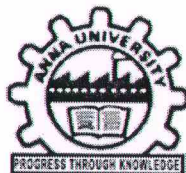
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EXTERNAL EXAMINER

ABSTRACT

The expectations over novel composite materials have been increased especially in automotive and aerospace applications due to its superior weight to strength ratio and tailored mechanical properties. In this frame work, aluminum alloy AA5083 alloy matrix reinforced with (8% wt –2% wt) of Al₂O₃ and Sic-particles.

The composite samples were fabricated through powder metallurgy route.

Optimum amount of reinforcement were determined by evaluating mechanical properties like micro-hardness and compressive strength of composites. The characterizations were probed by Microstructure.

The results reveal that the composites containing 6% wt of Al₂O₃ and 4% SiC reinforcement witnessed superior mechanical properties due to its combined effect of concentration and particulate scale and the great isotropic behavior was achieved by homogenous dispersion of reinforcement in the matrix phase.




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CHAPTER 5

CONCLUSION

- The present review has been undertaken with an objective to compare the composite materials with particulates Al_2O_3 & SiC as reinforcements and AA5083 as the matrix material.
- It shows different values of mechanical properties by varying the % of weight concentration.
- The combination of AA5083- Al_2O_3 (90-10%) shows best result in both the compression test and hardness.
- The microstructure images shows that the consolidation of SiC is poor with AA5083 in comparison of Al_2O_3 with AA5083. So the porosity is more in AA5083-SiC than the AA5083- Al_2O_3 and the porosity increases with increase of reinforcements.
- The hardness of the composites increases with increase of Al_2O_3 and decreases with the increase of SiC. The hardness of Al_2O_3 is more than the AA5083 when Al_2O_3 is added, so the hardness increases with increase of Al_2O_3 .
- The hardness of SiC is less than the AA5083, so the hardness decreases with increase of SiC. In the upcoming years the researchers may focus on hybrid composites and fully biodegradable composites.
- The future of the hybrid composites appears to be bright.




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INVESTIGATION OF MICROSTRUCTURAL AND MECHANICAL BEHAVIOR OF AA6351/B₄C COMPOSITES THROUGH POWDER METALLURGY

A PROJECT REPORT

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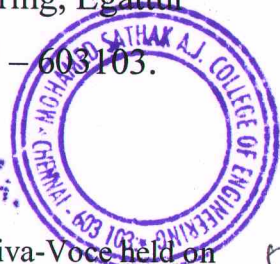
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EXTERNAL EXAMINER

ABSTRACT

The tribological behaviour of AA6351/ Boron Carbide (0-5.0 wt.%B₄C) composites were processed through Powder Metallurgy (PM) routine. The varying wt. % of Al/ B₄C composites were compacted with help of uniaxial press in a pressure range of 400 MPa and sintered in tubular furnace at 600 °C with argon gas environment. The investigation on theoretical density of alloy and composites of sintered composites increased up to 95%. The optical micrograph of composites reveals fine distribution of B₄C particles over the matrix material. The hardness of fabricated samples was characterized with micro-Vickers hardness tester its shows increase in hardness up to 62.5 % on (AA6351+5.0 wt.% B₄C) as compare to base matrix (AA6351+0wt.% B₄C). The improvement in compression properties as effect of decreased grain size of α -Al with fine distribution of reinforcement particles with effect heat transfer during sintering process.




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CHAPTER 6

CONCLUSION

The AA6351/B4C composites have been successfully fabricated through powder metallurgy technique. The density, hardness, microstructure, and Compression behaviour of alloy and composites were assessed.

The experimental results as follows.

- The improved density in fabricated composites and its increases with increasing wt.% of B4C, it improves the strength of composites.
- The hardness of AA6351+5.0 wt.% B4C composite shows improved hardness as compared to base matrix, as effect of hard ceramic particles.
- The optical microstructures reveal the uniform distribution of reinforcement particles with a minimal amount of porosity.
- The incorporation of B4C particles to AA6351 alloy increases the compressive strength as due to reduction in grain size and precipitation hardening effect because the precipitated particles act as obstacles to dislocation movement.



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STUDY OF HEAT TRANSFER PERFORMANCE AND ORIENTATION ANALYSIS OF FLAT HEAT PIPE

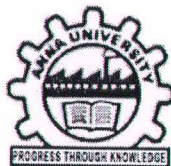
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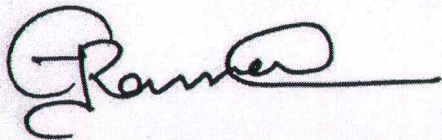
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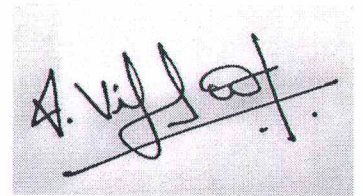
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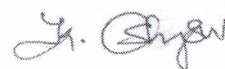


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EXTERNAL EXAMINER



ABSTRACT

In this 21st century, Humans are living in a era of miniaturization of electronic devices such as laptops, Smart phones etc., Every electronic devices emits heat energy at great rate. Miniaturization increases the damage for efficiency in cooling technology which is used to reduce the heat dissipation in those electronic devices. The cooling technology includes the heat pipe, heat sink, heat exchangers etc. Very few cooling methods finds efficient application in heat dissipation of miniaturized electronic devices. This is where Heat pipe plays a vital role in miniaturized device cooling technology. Heat pipes can be a viable and promising solution for this heat reduction issue. There are several types of heat pipes in cooling electronic devices, out of which flat heat pipe is most commonly used. A flat heat pipe has been developed to assist in meeting the high thermal design requirements in high power microelectronics, power converting systems, laptop computers and spacecraft thermal control system. Both experimental and analytical investigations were to be conducted to examine the maximum heat transport capacity and optimize the design parameters of this design. The performance analysis and fabrication of a flat heat pipe is done in this paper.




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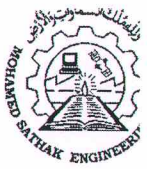
CHAPTER 7

CONCLUSION

The results from the experiment shows that the Water as Cooling liquid in Copper Flat heat pipe provides very effective heat reduction or dissipation than the acetone as cooling liquid. So this project provide the evidences that water is the best cooling liquid in flat heat pipe which is used to reduce the temperature generated in Electronic devices than any other cooling liquid.




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AUTOMATIC PNEUMATIC RAMMING MACHINE

A PROJECT REPORT

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EXTERNAL EXAMINER

ABSTRACT

Sand casting is relatively cheap and sufficiently refractory even for steel foundry use. In addition to the sand, a suitable bonding agent (usually clay) is mixed or occurs with the sand. The mixture is moistened, typically with water, but sometimes with other substances, to develop strength and plasticity of the clay and to make the aggregate suitable for molding. The sand is typically contained in a system of frames or mould known as a flask. The mould cavities and gate system are created by compacting the sand around models, or patterns, or carved directly into the sand.

We use rammer in sand moulding. Moulding is one of the important metals forming process in manufacturing components for various applications in industry. Casting of any size and shape can be made accurately. Automation in this field helps to improve the foundry environment and accuracy of the cast parts. Efficiency of moulding is affected by various parameters like permeability, collapsibility, adhesiveness etc. So it is a must to avoid defects in casting. The defects occur in sand castings post a great problem in foundry. On account of defects more than 10% castings are rejected. Even though skilled labor is employed for ramming operation, the packing of molding sand will not be even throughout the molding box. So we have selected the idea of fabricating "PNEUMATIC RAMMER". This rammer is operated pneumatically. By using this rammer moulding sand will be packed evenly throughout the box

Keywords: Moulding, Casting, permeability, collapsibility, adhesiveness, pneumatically




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CHAPTER 8

COCLUSION AND REFERENCE

8.1 CONCLUSION

This study proposes that Pneumatic ramming machine is very cheap as compared to hydraulic ramming machine. The range of the ramming sand can be increased by arranging a high pressure compressor and installing more hardened blades. This machine is advantageous to sand ramming process industries as they cannot afford the expensive hydraulic ramming machine, Electromagnetic ramming machine, rack and pinion, and spring ramming machine. Thus our concept complying with the demand of the customer whose use the product as well as those who our new. The latent needs of the customer which they were not able to reciprocate properly is the estimated successfully the individual functions were study and thoroughly and were evaluated further study will involve more analysis about the product and comparison of the similar product available in the market this process has cheaper than other ramming process.

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FABRICATION OF AUTOMATIC PNEUMATIC CONTROLLED THREE SIDE TILTING TRAILER.

A PROJECT REPORT

Submitted by

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*in partial fulfillment for the award of the degree
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ABSTRACT

To deliver the material from the storing point to the particular place. To develop the automation in material handling system. To promote the convenient method of discharging the materials on three directional side in for sand, stone, wood etc .

In the present situation , the transportation with discharging of materials like sand through the automotive system is on one side only i.e rear side of vehicle. In order to discharge the material on three sides for our convenient in order to store the materials to required side..


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CHAPTER 8

CONCLUSION

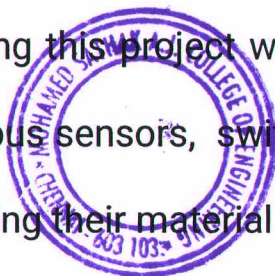
We make this project entirely different from other projects. Since concepts involved in our project is entirely different that a single unit is used to various purposes which is not developed by any of other team members.

By doing this project we gained the knowledge of controller programming ,pneumatic system and how automation can be effectively done with the help of pneumatic system.

It is concluded that any automated material handling system can be done with the help of controller & pneumatic system.

We have successfully completed the project work on using controller and pneumatic components at our Institute.

By doing this project work, we understood the working principle and uses of various sensors, switches, relays etc. as more and more industries are automating their material handling process.



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**FABRICATION OF QUADCOPTER WITH
AGRICULTURAL PESTICIDE SPRAYER**

Project Work

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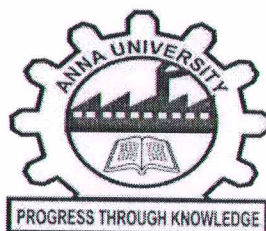
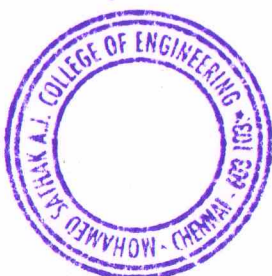
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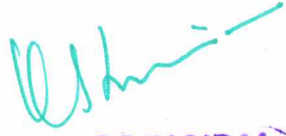
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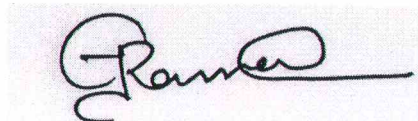
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ABSTRACT

One of the main sources of income in of India is agriculture. The production rate of crops in agriculture is based on various parameters like temperature, humidity, rain, soil, etc. Which are natural factors and not in farmers control. The field of Agriculture is also depends on some of factors like pests, disease, fertilizers, etc which can be control by giving proper treatment to crops. Pesticides may increase the productivity of crops but it also affects on human health. So the main aim of this work is to design agriculture drone for spraying pesticides. In this project, we are going to discuss different architecture based on unmanned aerial vehicles (UAVs). The use of pesticides in agriculture is very important to agriculture and it will be so easy if will use intelligent machines such as robots using new technologies. This project gives the idea about various technologies used to reduce human efforts in various operations of agriculture like detection of presence of pests, spraying of UREA, spraying of fertilizers, etc. and describes the development of quad copter UAV and the spraying mechanism further also discuss about the integration of sprayer module to quad copter system. The discussed system involves designing a prototype which uses simple cost effective equipment like BLDC motor, Arduino, ESC wires, etc

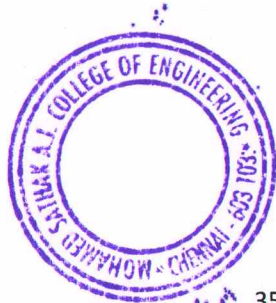
Keywords: Unmanned Arial vehicles, Brushless motors, remote sensing, ESC wires, Li Pro wireless charger




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9 CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. Regarding, planning, purchasing, assembling and add application while doing this project work . we feel that the project work is a good solution to bridge the gates between institution and industries . we are proud that we have completed the work with the limited time successfully. The **“FABRICATION OF QUADCOPTER WITH AGRICULTURAL PESICIDE SPRAYER”** is working with satisfactory condition . we are able to understand the difficulties in maintaining the tolerance and also quality. We have done to our ability and skill making maximum use of availability facilities.




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**EVALUTATION OF MECHANICAL BEHAVIOUR OF
ALUMINIUM E-GLASS COMPOSITE**

Project Work

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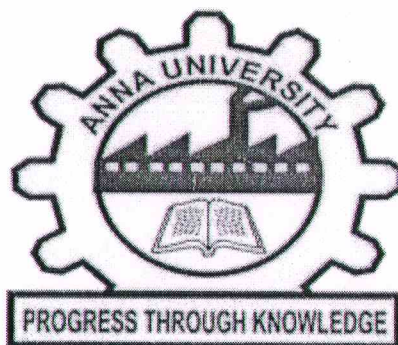
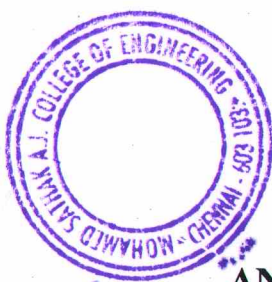
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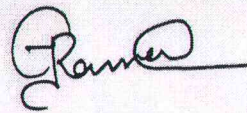
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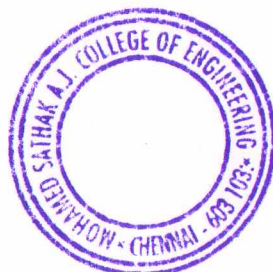
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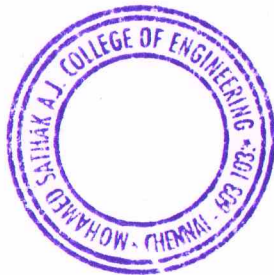
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ABSTRACT

The main problem in wood based products is mainly deforestation. Various steps and measures are in process for reducing global warming by saving trees. Very soon a demand for wood will arise in India. Hence to implement a better solution in advance we came up with Aluminium and steel based composite material by replacing existing E-glass. The core idea of our project is to reduce the risk of shortage of wood in future as well as to save more tress for our environment. There are many drawbacks in using wood as furniture for houses. The present Work concentrates on the properties and Aluminium composition of steel and E-glass. It is challenge to the creation of better materials for the improvement of quality of life with better mechanical properties. And also focuses on the physical properties, mechanical properties, and steel aluminium composition of E-glass. The objective of the present study is to utilize the advantages offered by renewable resources for the development of composite materials based on aluminium.




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CHAPTER 6

CONCLUSION

- Aluminum alloy (Al6061) with a specific composition along with the E-Glass fiber is selected as a matrix material and reinforcement material respectively in this project work
- The E-Glass fiber was effectively reinforced with Al6061 alloy matrix by the Sand casting method to prepare the composite specimens as per ASTM standards to carry out tensile test.
- The results of this test indicated that there is an increase in tensile strength of the composite specimens was better than the base metal (Al6061 alloy).
- When Al6061 is reinforced with 5% of E-Glass fiber, tensile strength of composite specimens was found to be increased
- Tensile Strength & compression survey of Al6061 significantly improved with the addition of E-Glass fiber, when it was compared with the results of unreinforced matrix material i.e. Al6061 alloy.
- From this analysis the fibre metal laminates are have high energy absorption properties by combining the properties of low strength materials like aluminium improved ductility. Here we attain the properties of FML is nearly equal to dual phase steel plate
- We can also use the FML for automobile body panels instead of steel plate which gives the better result at compared with monolithic aluminium plates.




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FABRICATION OF PNEUMATIC REVERSE LOCKING TESTING RIG

A PROJECT WORK

SUBMITTED BY

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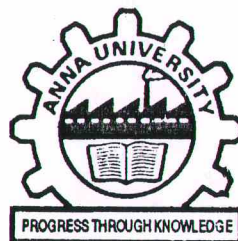
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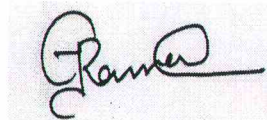
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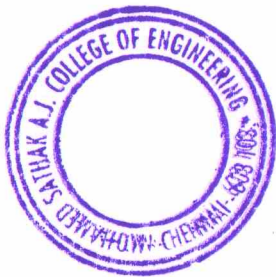
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DESIGN AND FABRICATION OF PNEUMATIC REVERSE LOCKING TESTING RIG

ABSTRACT

Road transport safety is an important issue in the land transport sector all over the world due to the increment in the usage of automobiles in few decades. In this project, we are designed to develop a locking system of reverse motion using Pneumatic system for light motor vehicles. Its outline system requirements to successfully develop and deploy a less complicated, safe and secure mechanism for the uncontrolled reverse motion of the vehicle on hilly terrains. The mechanism consists of a vehicle and ratchet & pawl connected to the rear drive shaft of the vehicle and an actuator along with the help of an inclination sensor which will control the movement of the pawl while engaging or disengaging the mechanism. The engaging mechanism will represent the reverse motion is undesirable or to be restricted and disengaging mechanism when the reverse motion is desirable.




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CHAPTER 7

7. CONCLUSION

Our project “Pneumatic Reverse Locking Testing Rig” would help in avoiding the rearward motion of the vehicle on the hilly terrains and Ghats. Since a less complex structure is been used in our design, it can be easily used by new drivers. Thus the mechanism can stop the vehicle from rolling back in hill roads. This would be more helpful for the drivers to drive their cars and park them comfortably in hilly road. Here we conclude that with the use of this system, the unwanted reverse motion of the vehicles can be prevented. It provides working vehicle with differential locking system to be capable of reliable straight running and excellent working performance.




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**INVESTIGATE THE EFFECT OF COPPER AND SiC ASSISTED
DISSIMILAR WELDMENT OF SS304 AND SS316L WITH 308L
ON TIG WELDING.**

Project Work

Submitted by

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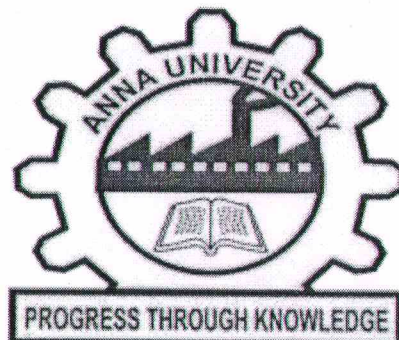
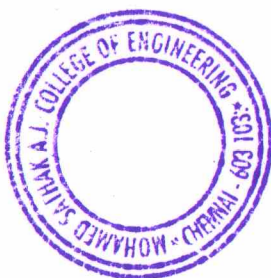
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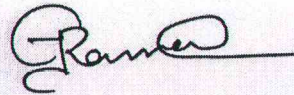
BONAFIDE CERTIFICATE

It is certified that this project report titled “Investigate The Effect Of Copper And Sic Assisted Dissimilar Weldment Of Stainless Steel Grade 304 And 316L With 308L On Tungsten Inert Gas(TIG) Welding” is bonafide work of **K. MOHAMED REEFDEEN (311817114041), J.MUHAMMED SUFYAN (311817114048), M.MOHAMMED FAYAAS (311817114045)**, who carried out the research under my supervision.



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SYNOPSIS

Tungsten Inert Gas welding is one of the widely used welding techniques mainly in stainless steel applications. The major objective of this project is to weld two dissimilar stainless steel plates SS304 and SS316L by activated TIG welding along with analyzing the mechanical property (Hardness) of the welded joints. Two dissimilar metals of 6mm thick AISI 304 and SS 316L stainless steel plate are welded by activated Tungsten Inert Gas welding. The activated flux used in this welding such as SiC, copper which increases the weld penetration of the joint and also to done the welding in two pass. The life span of many food processing machines has been reduced over the years due to low quality welded joints in the machine or has not fulfilled the estimated life span of the machine due to their poor quality of joints and the materials of the machine could not adopt the working condition of the machine.

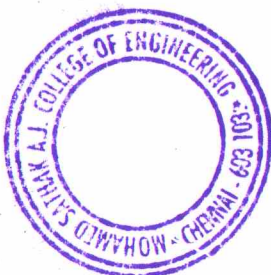
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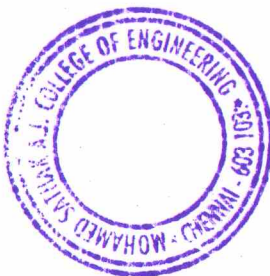

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CHAPTER 6

CONCLUSION

In this investigation, the copper powder and SiC powder fluxes were used to compare the effect of fluxes in the TIG welding of dissimilar metal and to evaluate the hardness (mechanical) of TIG welding with stainless steel 304 and stainless steel 316L. The following conclusions are observed from this investigation.

- Higher hardness were found at the sample 3 of 58 HRC found at the weld zone.
- Lower Hardness of 44.5 HRC found on the weld zone of Sample 1 which has a combination of copper powder coating on both weld passes.
- Combination of copper Powder and SiC powder fluxes which does not meet the hardness achieved by sample 3.
- Hence the recommendation for Hardness while using Dissimilar weld is SiC powder as a flux coated material on the specimen.




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