



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 (2017 - 2018)
1	GE6253 - Engineering Mechanics
2	CE6306 - Strength of Materials
3	ME6302 - Manufacturing Technology - I
4	ME6402 - Manufacturing Technology- II
5	GE6351 - Environmental Science and Engineering
6	ME6404 - Thermal Engineering
7	ME6502 - Heat and Mass Transfer
8	ME6503 - Design of Machine Elements
9	ME6504 - Metrology and Measurements
10	ME6505 - Dynamics of Machines
11	ME6601 - Design of Transmission Systems
12	ME6602 - Automobile Engineering
13	ME6702 - Mechatronics
14	ME6007 - Composite Materials and Mechanics
15	ME6008 - Welding Technology
16	ME6016 - Advanced I.C. Engines



PRINCIPAL

MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
No.34.Rajiv Gandhi Salai (OMR), SIPCOT - IT Park
Siruseri, Chennai - 603 103.

OBJECTIVES:

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:**

Upon completion of this course, the students can able to apply the different manufacturing process and use this in industry for component production

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, 1997
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2006

REFERENCES:

1. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008
2. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
3. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice – Hall of India, 1997.
4. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2004.
5. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 2nd Edition, TMH-2003;



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 34, Rajiv Gandhi Road (OMR), Siruseri, IT PARK
 Chennai-603 103.

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:**

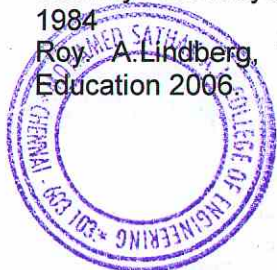
Upon completion of this course, the students can able to understand and compare the functions and applications of different metal cutting tools and also demonstrate the programming in CNC machining.

TEXT BOOKS:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters
2. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 2003.

REFERENCES:

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



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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 BASICS AND STATICS OF PARTICLES

12

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

12

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

12

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

12

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 ELEMENTS OF RIGID BODY DYNAMICS

12

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 : 60 PERIODS**OUTCOMES:**

ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.

ability to analyse the forces in any structures.

ability to solve rigid body subjected to dynamic forces.

TEXT BOOKS:

1. 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).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES:

1. Hibbeler, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
3. Meriam J.L. and Kraige L.G., "Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons, 1993.
4. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
5. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
6. Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi 2008.




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OBJECTIVES:

To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.

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.

OUTCOMES:**TOTAL (L:45+T:15): 60 PERIODS**

Upon completion of this course, the students can able to apply mathematical knowledge to calculate the deformation behavior of simple structures.

Critically analyse problem and solve the problems related to mechanical elements and analyse the deformation behavior for different types of loads.

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007

REFERENCES:

1. Egor. P. Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2007.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
4. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.



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OBJECTIVES:

To the study of nature and the 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

12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – 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

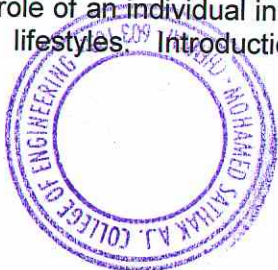
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Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO₂, NO_x, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards-role of an individual in prevention of pollution – pollution case studies – 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 overutilization of surface and ground 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. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; 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. Introduction to Environmental Biochemistry: Proteins –Biochemical



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degradation of pollutants, Bioconversion of pollutants. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

Public awareness of environmental is at infant stage.

Ignorance and incomplete knowledge has lead to misconceptions

Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS :

1. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.

REFERENCES :

1. Trivedi.R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 3rd edition, BPB publications, 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.



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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 POWER CYCLES

8

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency - Comparison of cycles.

UNIT II INTERNAL COMBUSTION ENGINES

10

Classification - Components and their function. Valve timing diagram and port timing diagram - actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburettor. MPFI, Diesel pump and injector system. Battery and Magneto Ignition System - Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculation.

UNIT III STEAM NOZZLES AND TURBINES

9

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations -Governors.

UNIT IV AIR COMPRESSOR

9

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling -work of multistage air compressor

UNIT V REFRIGERATION AND AIR CONDITIONING

9

Refrigerants - Vapour compression refrigeration cycle- super heat, sub cooling - Performance calculations - working principle of vapour absorption system, Ammonia -Water, Lithium bromide - water systems (Description only) . Air conditioning system - Processes, Types and Working Principles. - Concept of RSHP, GSHP, ESHP- Cooling Load calculations.

TOTAL: 45 PERIODS**OUTCOMES:**

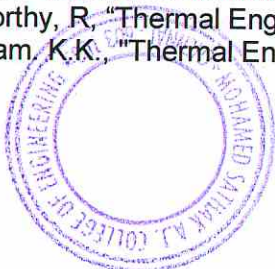
Upon completion of this course, the students can able to apply the different gas power cycles and use of them in IC and R&AC applications.

TEXT BOOKS:

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000
2. Kothandaraman.C.P., Domkundwar. S, Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition, "Dhanpat Rai & sons , 2002

REFERENCES:

1. Sarkar, B.K, "Thermal Engineering" Tata McGraw-Hill Publishers, 2007
2. Arora.C.P, "Refrigeration and Air Conditioning , " Tata McGraw-Hill Publishers 1994
3. Ganesan V.. " Internal Combustion Engines" , Third Edition, Tata McGraw-Hill 2007
4. Rudramoorthy, R, "Thermal Engineering ", Tata McGraw-Hill, New Delhi, 2003
5. Ramalingam, K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.

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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

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

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

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

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

UNIT V MASS TRANSFER

9

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 : 45 PERIODS**OUTCOMES:**

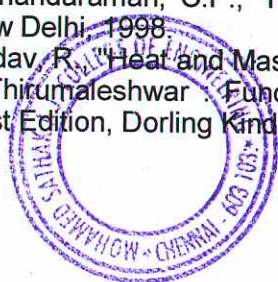
Upon completion of this course, the students can able to understand and apply different heat and mass transfer principles of different applications.

TEXT BOOK:

1. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 2010

REFERENCE BOOKS:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998.
2. Venkateshan. S.P., "Heat Transfer", Ane Books, New Delhi, 2004.
3. Ghoshdastidar, P.S, "Heat Transfer", Oxford, 2004,
4. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002
5. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2000
6. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
7. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 1998
8. Yadav, R., "Heat and Mass Transfer", Central Publishing House, 1995.
9. M.Thirumaleshwar, "Fundamentals of Heat and Mass Transfer", "Heat and Mass Transfer", First Edition, Dorling Kindersley, 2009



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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**5**

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**10**

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**12**

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**10**

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**8**

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 completion of this course, the Students can demonstrate different measurement technologies and use of them in Industrial Components

TEXT BOOKS:

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

REFERENCES:

1. Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA, 1990.
2. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2006.



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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 10

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 8

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:

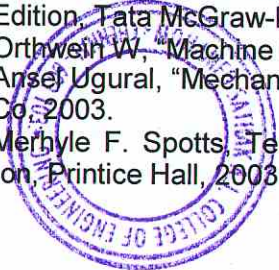
Upon completion of this course, the students can able to successfully design machine components

TEXT BOOK:

1. Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

REFERENCES:

1. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005
3. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010
4. Bernard Hamrock, Steven Schmid,Bo Jacobson, "Fundamentals of Machine Elements", 2nd Edition, Tata McGraw-Hill Book Co., 2006.
5. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
6. Ansel Ugural, "Mechanical Design - An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2003.
7. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2003



(Signature)
PRINCIPAL
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 34, Rajiv Gandhi Road (OMR), Siruseri, IT Park
 Chennai-603 103.

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

9

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.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS

9

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 GEARS

9

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 BOXES

9

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 BRAKES

9

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.

TOTAL : 45 PERIODS**OUTCOMES:**

- Upon completion of this course, the students can able to successfully design transmission components used in Engine and machines.

TEXT BOOKS:

- Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.
- Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

REFERENCES:

- Sundararamamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
- Gitin Maitra, L. Prasad "Hand book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001.
- Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
- C.S.Sharma, Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India, Pvt. Ltd., 2003.
- Bernard Hamrock, Steven Schmid, Bo Jacobson, "Fundamentals of Machine Elements", 2nd Edition, Tata McGraw-Hill Book Co., 2006.
- Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005
- Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo (Schaum's Outline), 2010



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MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
Siruseri, IT Park

34, Rajiv Gandhi

Chennai-600 119

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

9

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

9

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 SINGLE DEGREE FREE VIBRATION

9

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

9

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

9

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 : 45 PERIODS**OUTCOMES:**

Upon completion of this course, the Students can able to predict the force analysis in mechanical system and related vibration issues and can able to solve the problem

TEXT BOOK:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms" ,3rd Edition, Oxford University Press, 2009.
2. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009

REFERENCES:

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
3. Benson H. Tongue, "Principles of Vibrations", Oxford University Press, 2nd Edition, 2007
4. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
5. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961
6. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
7. Rao J.S. and Duggipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.

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

OBJECTIVES:

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

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

12

UNIT II 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER

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

10

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE

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

8

UNIT IV PROGRAMMABLE LOGIC CONTROLLER

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

7

UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN

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.

8

OUTCOMES:**TOTAL : 45 PERIODS**

- Upon completion of this course, the students can able to design mechatronics system with the help of Microprocessor, PLC and other electrical and Electronics Circuits.

TEXT BOOKS:

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

REFERENCES:

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



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

TOTAL: 45 PERIODS**OUTCOMES:**

- Upon completion of this course, the students will be able to identify the different components in automobile engineering.
Have clear understanding on different auxiliary and transmission systems usual.

TEXT BOOKS:

1. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

REFERENCES:

1. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 1989.
2. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
3. Martin W. Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals," The Good heart -Will Cox Company Inc, USA, 1978.
4. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
5. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.

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MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Siruseri, IT Park
Chennai-600 103.

OBJECTIVES

To understand the basics of welding and to know about the various types of welding processes

UNIT I GAS AND ARC WELDING PROCESSES:

9

Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations and applications.

UNIT II RESISTANCE WELDING PROCESSES:

9

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

UNIT III SOLID STATE WELDING PROCESSES:

9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

UNIT IV OTHER WELDING PROCESSES:

9

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

UNIT V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS

9

Various weld joint designs – Weldability of Aluminium, Copper, and Stainless steels. Destructive and non destructive testing of weldments.

OUTCOMES:**TOTAL : 45 HOURS**

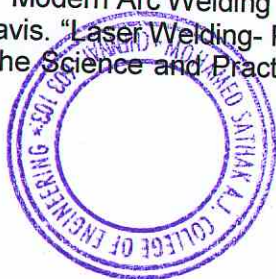
Upon completion of this course, the students can able to compare different types of Welding process for effective Welding of Structural components.

TEXT BOOKS:

1. Parmer R.S., "Welding Engineering and Technology", 1st edition, Khanna Publishers, New Delhi, 2008.
2. Parmer R.S., "Welding Processes and Technology", Khanna Publishers, New Delhi, 1992.
3. Little R.L., "Welding and welding Technology", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.

REFERENCES:

1. Schwartz M.M. "Metals Joining Manual". McGraw Hill Books, 1979.
2. Tylecote R.F. "The Solid Phase Welding of Metals". Edward Arnold Publishers Ltd. London, 1968.
3. AWS- Welding Hand Book. 8th Edition. Vol- 2. "Welding Process"
4. Nadkarni S.V. "Modern Arc Welding Technology", 1st edition, Oxford IBH Publishers, 2005.
5. Christopher Davis. "Laser Welding- Practical Guide". Jaico Publishing House, 1994.
6. Davis A.C., "The Science and Practice of Welding", Cambridge University Press, Cambridge, 1993



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

OBJECTIVES:

- To understand the fundamentals of composite material strength and its mechanical behavior
- Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
- Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

UNIT I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING 12
 Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes

UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 10
 Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT III LAMINA STRENGTH ANALYSIS 5
 Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure

UNIT IV THERMAL ANALYSIS 8
 Assumption of Constant C.T.E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

UNIT V ANALYSIS OF LAMINATED FLAT PLATES 10
 Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies.

TOTAL: 45 PERIODS**OUTCOMES:**

- Upon completion of this course, the students can able to analyse the fiber reinforced Laminate for optimum design
- Apply classical laminate theory to study and analyse the residual stresses in Laminate.

TEXT BOOKS:

- Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, CRC press in progress, 1994, -.
- Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw Hill, 1998

REFERENCES:

- Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
- Mallick, R.K., Fiber, "Reinforced Composites: Materials, Manufacturing and Design", Maneeel Dekker Inc, 1993.

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MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
 No. 1, Rajiv Gandhi Road (OMR), Siruseri, IT Park
 Chennai-603 103.

OBJECTIVES:

To understand the underlying principles of operation of different IC Engines and components.
To provide knowledge on pollutant formation, control, alternate fuel etc.

UNIT I SPARK IGNITION ENGINES

9

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers.

UNIT II COMPRESSION IGNITION ENGINES

9

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Introduction to Turbocharging.

UNIT III POLLUTANT FORMATION AND CONTROL

9

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

UNIT IV ALTERNATIVE FUELS

9

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

UNIT V RECENT TRENDS

9

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Adsorbers - Onboard

Diagnostics.

TOTAL : 45 PERIODS**OUTCOME:**

- Upon completion of this course, the students can able to compare the operations of different IC Engine and components and can evaluate the pollutant formation, control, alternate fuel

TEXT BOOKS:

1. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.
2. Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.

REFERENCES:

1. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons 2007.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
3. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995




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MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Siruseri, IT Park
Chennai-600 103.

**ESTABLISHMENT OF ACTIVATED TIG IN ORBITAL WELDING
MACHINE IN BHARAT HEAVY ELECTRICALS LIMITED**

A PROJECT REPORT

Submitted by

MIZSAL AHAMED.K

311814114040

MOHAMED NOOH IMRAN.M

311814114045

MOHAMED RIYAS.B

311814114046

In partial fulfilment for the award of the degree

Of

BACHELOR OF ENGINEERING

IN

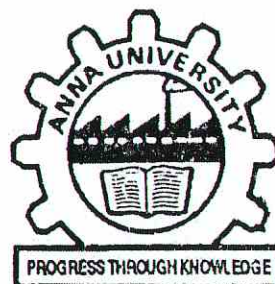
MECHANICAL ENGINEERING

MOHAMED SATHAK A.J.COLLEGE OF ENGINEERING

CHENNAI-603103

PRINCIPAL

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



ANNA UNIVERSITY: CHENNAI 600 025

APRIL 2018

BONAFIDE CERTIFICATE

Certified that this project report "ESTABLISHMENT OF ACTIVATED TIG IN ORBITAL WELDING MACHINE" is the Bonafide work of (MIZSAL AHAMED.K, MOHAMED NOOH IMRAN.M & MOHAMED RIYAS.B) who carried out the project work under my supervision.

SIGNATURE

Dr.R.GANESA MOORTHY, B.E., M.E.,PhD.,
HEAD OF THE DEPARTMENT

Dept. of Mechanical Engineering

MSAJCE

Chennai-603103

SIGNATURE

J.MOHAMED YAZZIR, M.Tech.,
ASSISTANT PROFESSOR

Dept. of Mechanical Engineering

MSAJCE

Chennai-603103

SIGNATURE

MO. SADIK
SR. ENGINEER
OP & C / UNIT-II
BHEL, TRICHY - 620 014

MO.SADIK

SENIOR ENGINEER

OP&C/UNIT-II

BHEL,TRICHY-620014



PRINCIPAL

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

Submitted for VIVA – VOICE Examination held on19./04./2018...at Mohamed Sathak A.J.College of Engineering, Chennai.

S.P.
19/4/18
INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

In the current scenario one of the major concerns in all the industries is reducing the defects and wastes in an optimized manner. Coil manufacturing process which produces the lot of defects and time lagging. We had deeply analyzed the process of orbital TIG welding and found that preparation and welding process faces many defects and economics loss through money wastages. Defects like porosity, lack of penetration often occur. We stated that Ultimately the solution to the problem is application of flux material which has Titanium composition on weld surface after that the process could results in reduction of above stated defects and efficiency of TIG welding process in improved.



1082

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

CHAPTER 7

CONCLUSION

Comparing the results of orbital TIG welding, we conclude that Activated orbital TIG will improve weld quality, increase weld speed, and reduce scrap and rework costs. The activated flux reduces the porosity and increases the penetration which were the major defects of orbital TIG welding. Thus it reduces the cycle time and the overall manufacturing cost simultaneously.



Wsk

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

DESIGN AND MODIFICATION OF ROTARY KICK-OFF SYSTEM WITH PNEUMATIC SYSTEM IN THE TRANSFER OF BOILER TUBES

A PROJECT REPORT

Submitted by

AJITH KUMAR R.S

311814114003

AYYAPPAN.A

311814114010

KARTHIK.K

311814114032

MANI GANDAN.J

311814114037

In partial fulfilment for the award of the degree

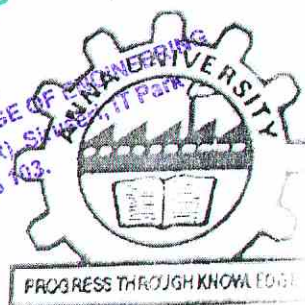
of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING


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



MOHAMED SATHAK A.J.COLLEGE OF ENGINEERING,

CHENNAI-603103.

ANNA UNIVERSITY: CHENNAI 600 025

APRIL 2018

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "DESIGN AND MODIFICATION OF ROTARY KICK-OFF SYSTEM WITH PNEUMATIC SYSTEM IN THE TRANSFER OF BOILER TUBES" is the bonafide work of AJITHKUMAR.R.S (311814114003), AYYAPPAN.A (311814114010), KARTHIK.K (311814114032), MANIGANDAN.J (311814114037) who carried out the project work under my supervision.

SIGNATURE

Dr.R.GANESAMOORTHY. M.E, Ph.D

HEAD OF THE DEPARTMENT

Dept. of Mechanical Engineering

MSAJCE

Chennai-603103

SIGNATURE

MOHAMED YAZZIR. M.Tech,

SUPERVISOR

Dept. of Mechanical Engineering

MSAJCE

Chennai-603103

Submitted for VIVA – VOICE Examination held on 19/4/18 at Mohamed Sathak A.J. College of Engineering, Chennai.

PRINCIPAL
MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Tiruvallur, IT Park
Chennai-603103.

INTERNAL EXAMINER



INTERNAL EXAMINER

ABSTRACT

In boiler tubes material handling system, existing state methodology, the motor drive was used to drive the motor to transfer the boiler tubes of 108 meters from the roller to storage rack through the motor connected kick-off system. Due to the misalignment of tubes and frequent breakdown occurrences, we had proposed the concept implementation of pneumatic kick-off system. In this proposed state, the pneumatic kick-off system of boiler tubes which comprises of double acting pneumatic cylinder with the range of pressure 0.5 to 1.0 bar is supplied through the solenoid valve which tends the piston to move forward, thus lifting the fulcrum at a sustained state. This tends to lift the material holder up to the transfer the boiler tubes to the sustained level in the storage rack without the occurrences of misalignment of boiler tubes. Hence, this proposed concept of pneumatic kick-off system reduce the frequent breakdown, misalignment of boiler tubes and less electrical consumption. The present paper is focused on pneumatic actuator in material handling system, underling the limitation or the specific application of pneumatic actuators.


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



CHAPTER - 1

CONCLUSION AND FUTURE SCOPE

CONCLUSION

The project carried out by us made an attempt to reduce risk in transferring the tubes results in reduction in downtime of machine.

Pneumatically driven Kick-off arms take the tubes without misalignment and hence improves the productivity.

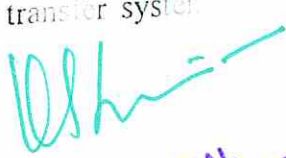
This project will reduce the cost and effort in the concern. Project has been designed to perform the entire required work without misalignment and hence results in reduction of breakdown.

FUTURE SCOPE OF THIS PROJECT

Pneumatic transfer system are the best alternative to the conventional motor used transfer system and conventional material handling systems, by using pneumatics huge amount of energy and time is saved.

This pneumatic transfer system will be used in various industries and where the tubes can be transfer to one conveyor to another.

In future this type of transfer system can be used to transfer all the material other than the tubes.


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

INVESTIGATION OF FORMING PROPERTIES OF AA5052 BY INCREMENTAL FORMING IN SQUARE PYRAMID MODEL

A PROJECT REPORT

Submitted by

ARUNVANAN.K

1814114009

KUMARESAN.M

1814114036

MOHAMED IBRAHIM.S.S

1814114044

*In partial fulfilment for the requirements of the degree
of*

BACHELOR OF ENGINEERING
IN
MECHANICAL ENGINEERING


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



MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING,

CHENNAI

ANNA UNIVERSITY, CHENNAI - 600 025

BONAFIDE CERTIFICATE

Certified that this project report on **ANALYSIS OF FORMING PROPERTIES OF AA 5052 D119 ALUMINUM ALLOY IN THE SQUARE PYRAMID MODEL** submitted by **ARUNVANAN.K (311814114009), KUMARESAN.M (311814114036), MOHAMED IBRAHIM.S.S(311814114040)** who have done the project work under my supervision.

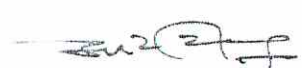

SIGNATURE

Dr. GANESAMOORTHY, M.E.

HEAD OF THE DEPARTMENT

Dept. of Mechanical Engineering

Mohamed Sathak A. J. College of
Engineering, Chennai-603103


SIGNATURE

Dr. N. DURAJ, M.E.,

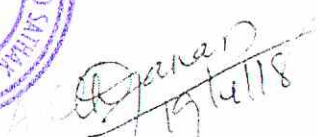
HEAD OF THE DEPARTMENT

Dept. of Mechanical Engineering

Mohamed Sathak A. J. College of
Engineering, Chennai-603103

Submitted for VIVA-VOICE Examination on 19.4.18 at
Mohamed Sathak A.J. College of Engineering, Chennai-603103.


INTERNAL EXAMINER


EXTERNAL EXAMINER

PRINCIPAL
MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
24, Rajiv Gandhi Road (OMR), Siruseri, Chennai-603103.



Sheet metal forming is a vital manufacturing process used in automobile, aerospace, agricultural industries etc. Hot forming is a promising process providing a short and inexpensive way of forming complex three dimensional parts without using die. The aim of this research is to study the forming behaviour of AA 5052 Aluminium Alloy using hot forming and also to study the FLD of square pyramid shape AA 5052 Aluminium alloy at room temperature and annealing temperature. The step depth, feed rate and spindle speed were considered as input parameters in this study. The grain size and surface roughness are taken for minimum surface roughness and maximum wall thickness. Formability Limit Diagram is constructed on AA 5052 Aluminium Alloy at room temperature and annealing temperature by using optimization techniques from response surface methodology. The Comparison of FLD of hot forming process is compared. Finally the microstructure of deformed AA 5052 Aluminium alloy at room temperature and annealing temperature is compared.


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



CONCLUSIONS

In this study, formability of AA5052 aluminium alloy sheet metal with 1mm thickness at room temperature and annealing temperature is investigated through formation of pyramid by single point incremental forming process. The formability analysis by D, thickness distribution and microstructure study is carried out over sheet metal. The conclusions are

- FLD comparison between deformed sheet metal at room temperature and annealing temperature shows that higher formability is obtained when the sheet metal is heat treated at annealing temperature.
- Thickness distribution comparison between room temperature and heat treated sheet metal shows thickness distribution is more uniform in heat treated sheet metal.
- From the microstructure testing of square pyramid shaped deformed sheet metal at room temperature and annealing temperature, the grains undergo more elongation in heat treated sheet metal, so heat treated sheet metal have more formability. And heat treated sheet metal have more ductility due to its small grain structure so chance of undergoing fracture is low.


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



**ESTABLISHMENT OF ACTIVATED TIG IN ORBITAL WELDING
MACHINE IN BHARAT HEAVY ELECTRICALS LIMITED**

A PROJECT REPORT

Submitted by

MIZSAL AHAMED.K

311814114040

MOHAMED NOOH IMRAN.M

311814114045

MOHAMED RIYAS.B

311814114046

In partial fulfilment for the award of the degree

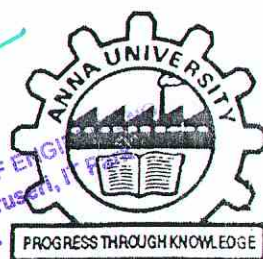
Of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

**MOHAMED SATHAK A.J.COLLEGE OF ENGINEERING,
CHENNAI-603103**



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



ANNA UNIVERSITY: CHENNAI 600 025

APRIL 2018

BONAFIDE CERTIFICATE

Certified that this project report "ESTABLISHMENT OF ACTIVATED TIG IN ORBITAL WELDING MACHINE" is the Bonafide work of (MIZSAL AHAMED.K, MOHAMED NOOH IMRAN.M & MOHAMED RIYAS.B) who carried out the project work under my supervision.


SIGNATURE

Dr.R.GANESA MOORTHY, B.E., M.E.,PhD.,

HEAD OF THE DEPARTMENT

Dept. of Mechanical Engineering

MSAJCE

Chennai-603103


SIGNATURE

J.MOHAMED YAZZIR, M.Tech.,

ASSISTANT PROFESSOR

Dept. of Mechanical Engineering

MSAJCE

Chennai-603103


SIGNATURE

MO.SADIK

SENIOR ENGINEER

OP&C/UNIT-II

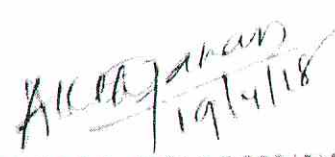
BHEL, TRICHY-620014

MO. SADIK
SR. ENGINEER
OP & C / UNIT-II
BHEL, TRICHY - 620 014




Submitted for VIVA – VOICED SATHAK A.J.COLLEGE OF ENGINEERING
34, Rajagopal Gandhi Road (OMR), Siruseri, IT Park
Chennai-603103. held on 19/04/18 at Mohamed
Sathak A.J.College of Engineering, Chennai


INTERNAL EXAMINER


EXTERNAL EXAMINER

ABSTRACT

In the current scenario one of the major concerns in all the industries is reducing the defects and wastes in an optimized manner. Coil manufacturing process which produces the lot of defects and time lagging. We had deeply analyzed the process of orbital TIG welding and found that preparation and welding process faces many defects and economics loss through money wastages. Defects like porosity, lack of penetration often occur. We stated that Ultimately the solution to the problem is application of flux material which has Titanium composition on weld surface after that the process could results in reduction of above stated defects and efficiency of TIG welding process in improved.



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



CHAPTER 7

CONCLUSION

Comparing the results of orbital TIG welding, we conclude that activated orbital TIG will improve weld quality, increase weld speed, and reduce scrap and rework costs. The activated flux reduces the porosity and increases the penetration which were the major defects of orbital TIG welding. Thus it reduces the cycle time and the overall manufacturing cost simultaneously.



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



MECHANICAL ANALYSIS OF NATURAL FIBER REINFORCED COMPOSITE

A PROJECT REPORT

Submitted by

MANOJ KRISHNA.P	311814101005
MOHAMED MARJUK.J	311814101007
SYED ASIF PEERAN.G	311814101012

In partial fulfillment for the award of degree

Of

BACHELOR OF ENGINEERING

IN

AERONAUTICAL ENGINEERING

MOHAMED SATHAK A.J COLLEGE OF ENGINEERING

EGATTUR

CHENNAI- 603103


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



ANNA UNIVERSITY: CHENNAI -- 600 025

APRIL 2018

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "MECHANICAL ANALYSIS OF NATURAL FIBER REINFORCED COMPOSITE" is the bonafide work of MANOJ KRISHNA.P (311814101005), MOHAMED MARJUK.J (311814101007) and SYED ASIF PEERAN.G (311814101012) who carried out the project work under my supervision.


SIGNATURE

Mr.G.CHANDRABOSE M.E.,
HEAD OF THE DEPARTMENT,
AERONAUTICAL ENGG.,
M.S.A.J.C.E.,
CHENNAI-603103.


SIGNATURE

Mrs.C.SHALIN DEVI M.Tech,
ASSISTANT PROFESSOR,
AERONAUTICAL ENGG.,
M.S.A.J.C.E.,
CHENNAI-603103.

Submitted for the "viva-voce" examination held at MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING on 19.04.2018


INTERNAL EXAMINER


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


EXTERNAL EXAMINER



ABSTRACT

In aircraft manufacturing mostly metals play vital role in every aspects from structural support to main aircraft components like wings, fuselage etc. But in time we are in need of aircraft materials with much simplicity and availability than metals. On enquiring materials to that fulfillment we come across composite materials. Composites are made of polymer matrix and fiber matrix in which it is the basic component. But composites can also be made of natural fiber reinforcement. In aircrafts like Boeing 787 50% of main airframe component is made up of composite. In this thesis we have analyzed the Natural Fiber Reinforced Polymer Composite(NPFC) lamina in order to obtain an efficient aircraft material by reinforcing kenaf fiber. The fiber is treated in alkali water and in order to further increase strength it is soaked in H_2SO_4 .


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



Chapter 7

Conclusion

The material is thus manufactured and tested for the usage of aircraft material manufacturing. The material obtained is light weight with high strength and toughness further it cannot be used in the high temperature applications like jet engine turbines, reentry vehicles rockets etc. Further developments in the field of material manufacturing may lead to usage in high temperature applications. By introducing the natural fibers in the composite manufacturing the availability of the material may increase and it would lead to an era of eco-friendly auto motives and aircraft manufacturing. And the wastage may also be easily recycled thus it becomes a renewable resource.

Even though their usage is limited to low temperature application the NFC can be used in UAV's, low speed civil aircrafts, and other low speed air transports. The main advantage of using NFC is its low cost and low weight with required strength.

From the experiment we conclude that Kenaf fiber can also be used as a fiber reinforcement in NFC's.


PRINCIPAL
MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (Opp. Suresh IT Park)
Chennai - 600 033.


MECHANICAL ANALYSIS OF NATURAL FIBER REINFORCED COMPOSITE

A PROJECT REPORT

Submitted by

MANOJ KRISHNA.P	311814101005
MOHAMED MARJUK.J	311814101007
SYED ASIF PEERAN.G	311814101012

In partial fulfillment for the award of degree

Of

BACHELOR OF ENGINEERING

IN

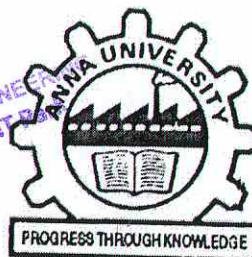
AERONAUTICAL ENGINEERING

MOHAMED SATHAK A.J COLLEGE OF ENGINEERING

EGATTUR

CHENNAI- 603103


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



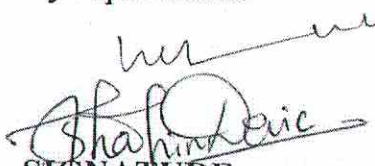
ANNA UNIVERSITY: CHENNAI – 600 025

APRIL 2018

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "MECHANICAL ANALYSIS OF NATURAL FIBER REINFORCED COMPOSITE" is the bonafide work of MANOJ KRISHNA.P (311814101005), MOHAMED MARJUK.J (311814101007) and SYED ASIF PEERAN.G (311814101012) who carried out the project work under my supervision.


SIGNATURE

Mr.G.CHANDRABOSE M.E.,
HEAD OF THE DEPARTMENT,
AERONAUTICAL ENGG.,
M.S.A.J.C.E.,
CHENNAI-603103.


SIGNATURE

Mrs.C.SHALIN DEVI M.Tech,
ASSISTANT PROFESSOR,
AERONAUTICAL ENGG.,
M.S.A.J.C.E.,
CHENNAI-603103.

Submitted for the "viva-voce" examination held at MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING on 19.04.2018


INTERNAL EXAMINER


EXTERNAL EXAMINER


PRINCIPAL
MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Siruseri, IT Park
CHENNAI-603103.



ABSTRACT

In aircraft manufacturing mostly metals play vital role in every aspects from structural support to main aircraft components like wings, fuselage etc. But in time we are in need of aircraft materials with much simplicity and availability than metals. On enquiring materials to that fulfillment we come across composite materials. Composites are made of polymer matrix and fiber matrix in which it is the basic component. But composites can also be made of natural fiber reinforcement. In aircrafts like Boeing 787 50% of main airframe component is made up of composite. In this thesis we have analyzed the Natural Fiber Reinforced Polymer Composite(NPFC) lamina in order to obtain an efficient aircraft material by reinforcing kenaf fiber. The fiber is treated in alkali water and in order to further increase strength it is soaked in H_2SO_4 .



Chapter 7

Conclusion

The material is thus manufactured and tested for the usage of aircraft material manufacturing. The material obtained is light weight with high strength and toughness further it cannot be used in the high temperature applications like jet engine turbines, reentry vehicles rockets etc. Further developments in the field of material manufacturing may lead to usage in high temperature applications. By introducing the natural fibers in the composite manufacturing the availability of the material may increase and it would lead to an era of eco-friendly auto motives and aircraft manufacturing. And the wastage may also be easily recycled thus it becomes a renewable resource.

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From the experiment we conclude that Kenaf fiber can also be used as a fiber reinforcement in NFC's.



MOHAMMED SATHAK A.J.C. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road, (Opposite to Museum), Park
Chennai-603 003.

ACCIDENT ALERT AND INDICATION SYSTEM

A PROJECT REPORT

Submitted by

SATHISH KUMAR.M

311814114065

HAROON AHAMED.S

311814114305

MOHAMED HASIR.M

311814114901

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING



Principal
PRINCIPAL
MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Siruseri, IT
Chennai-600 025

APRIL/MAY 2018



ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "ACCIDENT ALERT AND INDICATION SYSTEM" is the bonafide work of "SATHISH KUMAR (311814114065), HAROON AHAMED (311814114305), MOHAMED HASIR (311814114901)" who carried out the project work under my supervision.

SIGNATURE

Dr.R.GANESAMOORTHY, PhD

HEAD OF THE DEPARTMENT

Dept. of Mechanical Engineering

M.S.A.J.C.E.

Egattur, Chennai - 603103

SIGNATURE

Mr.M.GOPI KRISHNAN, M.E.,

ASSISTANT PROFESSOR

Dept. of Mechanical Engineering

M.S.A.J.C.E.

Egattur, Chennai - 603103

Submitted for VIVA-VOICE examination held on 20/04/18

INTERNAL EXAMINER

EXTERNAL EXAMINER



ABSTRACT OF THE PROJECT WORK

The main intention of this project is to find the accident spot at any place and intimating it to ambulance helplines through the GSM networks and GPS. The GPS based vehicle accident identification module contain SENSORS, GSM module and a GPS modem connected to the microcontroller. Global system for mobile (GSM) technology is used to establish cellular connection. GPS is used to trace the position of the vehicle. Nowadays, it is very difficult to know that an accident has occurred and to locate the position where it has happened. There is no system of identification and intimation regarding an accident in previous. Later on the SMS service begins for intimation purpose, GPS and GSM makes the usage for intimation and identification of place, by this we can also send information to neighbors as many possible. By this we can save the life of persons who meet with an accident. In previous system, when an accident occurs the information only is sent through GSM but there is no possibility to locate the spot, but this project provides an automotive localization system using GPS and GSM-SMS services, in addition to this there is a speed control system which reduces the vehicle speed when an obstruction is detected by the ultrasonic waves. So that there is lesser possibilities for collision.


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



CHAPTER 8

CONCLUSION

The use of smartphones as a road vehicle crash detection platform presents a low cost and portable solution compared to vendor specific built in system. A working model of Automatic vehicle accident detection and messaging system using a GPS and GSM modems has been implemented successfully. The biggest advantage of our research is whenever the sensor is activated we will be immediately getting the acknowledgement from GSM modem to our mobile numbers which are stored in EEPROM without any delay. This system locates the accident spot realizing the automation of accident detection and messaging system. Consequently it will save the precious time required to save the accident victims. Further this system can be implemented using the vibration sensors as well as the sound sensors in order to make it more accurate and efficient to detect an accident.


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



**INVESTIGATION OF MECHANICAL AND MICROSTRUCTURE
PROPERTIES OF HYBRID NATURAL FIBRE REINFORCED PMC**

A PROJECT REPORT

Submitted by

DHARANI.P	311814114015
KAMAL.A	311814114029
KANNAN.R	311814114030
KARTHIK KUMAR.D.J	311814114034

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING



Handwritten signature in blue ink.

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

ANNA UNIVERSITY:CHENNAI 600 025

APRIL/MAY 2018



ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "INVESTIGATION OF MECHANICAL AND MICROSTRUCTURE PROPERTIES OF HYBRID NATURAL FIBRE REINFORCED PMC" is the bonafide work of " DHARANI. P(311814114015), KAMAL.A(311814114029), KANNAN.R(311814114030),KARTHIK KUMAR D.J (311814114034) " who carried out the project work under my supervision.

SIGNATURE

Dr. R. GANESAMOORTHY, PhD

HEAD OF THE DEPARTMENT

Dept. of Mechanical Engineering

M.S.A.J.C.E.

Egattur, Chennai - 603103

SIGNATURE

Mr. M. GOPI KRISHNA, M.E.,

ASSISTANT PROFESSOR

Dept. of Mechanical Engineering

M.S.A.J.C.E.

Egattur, Chennai - 603103

Submitted for VIVA-VOICE examination held on 19.04.18

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

INTERNAL EXAMINER

EXTERNAL EXAMINER



ABSTRACT

The implementation of natural fibres is the fast approaching "green" economy based materials that are used in polymer matrix composites that are intended to replace the conventional synthetic polymer composites. Being plenteous fundamentally, Natural fibres are the primary form of natural resources for centuries. Considering that mechanical properties of composites are strongly influenced by the quality of the fibre/matrix interface and with eco-friendly properties like excellent energy absorption, low cost, bio degradability, non-toxicity and light weight. Natural fibres are strong, light weight, renewable cheap, completely or partially recyclable and biodegradable. The various types of the natural fibres are flax, cotton, jute, etc. In this project work an investigation will be carried out to make use of natural fibre i.e: (luffa, coir & E glass fiber) in addition with as a reinforcement material. The composite will be fabricated using hand lay-up technique and are characterized with respect to various physical properties and mechanical properties such as water absorption test, hardness test, impact test and tensile test are made. Natural fibres have steered the attention of scientists and researchers towards them to find their application by replacing the synthetic fibres and plastic composites. Utilizing the combination of luffa and coir fibres by using hand layup methods, the matrix composite are prepared. Following with the proper pre-treatment processes have proved to featuring good mechanical properties of significant parameters which can be ultimately equipped in desired applications according to our needs.



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

CHAPTER 6

CONCLUSION

- This work shows that of a luffa, coir and e glass fiber filled epoxy based composites by hand lay-up techniques could be fabricated successfully.
- The samples with different composition were cut as per ASTM standards using water jet machining for conducting physical and mechanical tests such as tensile strength, flexural, hardness, impact strength and water absorption.
- Similar tests were also conducted on both the reinforcement materials.
- Epoxy based coir fiber and LUFFA fiber composites with E Glass were fabricated by hand lay-up process. After testing and characterization the following observations are made from this study follows:
 - The comparison of tensile strength reveals that ELC has 56.5 MPa exhibit higher tensile strength than EC fiber 20 MPa. Whereas banana bi directional fiber/epoxy composite has exhibit better tensile property. When fiber concentration increases the tensile strength also increases.
 - Impact tests reveal that ELC exhibit higher impact strength than 3.2 than coir and e glass composites which possess only 2.5 KJ/m².
 - The flexural strength of ELC/epoxy exhibits better flexural strength of 371.33MPa than other compositions. The Coir E glass/ epoxy exhibits 126.67MPa where as to Luffa E glass/ epoxy has only 96.375 MPa.



PERFORMANCE AND EMISSION ANALYSIS OF FUEL MAGNETIZATION

A PROJECT REPORT

Submitted by

M. NISHATHUL HASAN

(311814114054)

S. MOHAMED SALEEM

(311814114307)

C. ABDULSUBAKHAN

(311814114703)

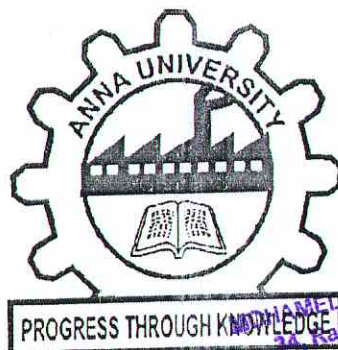
In partial fulfillment for the award of degree

Of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING



[Handwritten signature]

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

MOHAMED SATHAK A.J COLLEGE OF ENGINEERING

SIRUSERI, CHENNAI-603103

ANNA UNIVERSITY, CHENNAI 600 025

APRIL 2018



ANNA UNIVERSITY : CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report titled **"PERFORMANCE AND EMISSION ANALYSIS OF FUEL MAGNETIZATION"** is the bonafide work of **"M. NISHATHUL HASAN (311814114054), S.MOHAMED SALEEM (311814114307), C. ABDULSUBAKHAN (311814114703)"** who carried out the project work under my supervision.


SIGNATURE

Dr.GANESAMOORTHY,M.E.,Ph.D.,

HEAD OF THE DEPARTMENT

Associate Professor

Department of Mechanical Engineering

Mohamed Sathak A.J College

of Engineering.


SIGNATURE

Mr.A.A.MUHAMMAD IRFAN, M.E.,

SUPERVISOR

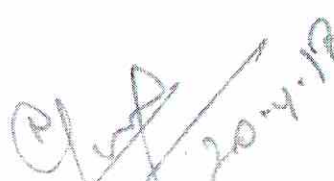
Assistant Professor

Department of Mechanical Engineering

Mohamed Sathak A.J College

of Engineering.


Submitted for the VIVA VOICE examination held on 20.4.18 at
Mohamed Sathak A.J College Of Engineering, Chennai.


INTERNAL EXAMINER




EXTERNAL EXAMINER

ABSTRACT

Typically I.C. engine used in automobiles have a problem of pollutant emission, which mainly depends on combustion process occurs in I.C. engines. Incomplete combustion produces large amount of emission gases & gives lower efficiency. The method of fuel magnetization enhance fuel properties such as it aligns & orients, hydrocarbon molecules, better atomization of fuel (Proper mixing of air with fuel). The main objective of our project work is to increase the performance of the Engine and reducing the emissions by mounting the permanent magnet in the path of fuel lines. In this report one case study is presented in which Neodymium magnets are used to improve efficiency and reduce emission. A permanent magnet is mounted the in path of fuel lines. Use of such fuel conditioners improves mileage & better emission of vehicle. In this project, the commercially available pure diesel (PD), Diesel (90%) – Ethanol (10%) (by volume) (D90E10), Diesel (80%) – Ethanol (20%) (by volume) (D80E20) fuels were tested to evaluate the effects of fuel with and without magnet on the performance and exhaust emissions of the diesel engine. Engine performance and exhaust gas emissions such as nitrogen oxides (NO_x), carbon monoxide (CO), Unburned Hydrocarbon (HC) and smoke were measured. The results showed that the magnetization of fuel improved the brake thermal efficiency and the emissions were reduced.


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



CHAPTER-9

CONCLUSION

The performance and emission characteristics of a engine incorporated with magnetic ionization method has been studied experimentally. The adopted magnetic fuel ionization method was seem to be promising in enhancing engine efficiency as well as reducing emission levels in a engine. The magnets mounted on fuel line resulted in enhancement of fuel properties such as its aligns and orients, hydrocarbon molecules, better atomization of fuel (proper mixing of air with fuel), etc.

This has resulted in improved efficiency due to better atomization and reduced emissions because of complete combustion. Implementation of such magnetic fuel ionization fuel method also improves mileage of vehicle at high load conditions. The Brake Thermal Efficiency (BTE) is increased by 3.3% and 4.7% in Diesel and E10 samples, when they are magnetized. It may be due to better atomization of the fuel, orientation of fuel molecules and better combustion of fuel in the chamber. The incorporation of magnetic fuel ionization method in a engine has resulted in an increase in brake power apart from a reduction in brake specific fuel



ACCIDENT ALERT AND INDICATION SYSTEM

A PROJECT REPORT

Submitted by

SATHISH KUMAR.M

311814114065

HAROON AHAMED.S

311814114305

MOHAMED HASIR.M

311814114901

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING



ANNA UNIVERSITY:CHENNAI-600 025

PRINCIPAL
MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (2nd Floor), Siruseri, IT Park
Chennai-603 103.

APRIL/MAY 2018



ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "ACCIDENT ALERT AND INDICATION SYSTEM" is the bonafide work of "SATHISH KUMAR (311814114065), HAROON AHAMED (311814114305), MOHAMED HASIR (311814114901)" who carried out the project work under my supervision.


SIGNATURE

Dr.R.GANESAMOORTHY, PhD

HEAD OF THE DEPARTMENT

Dept. of Mechanical Engineering

M.S.A.J.C.E.

Egattur, Chennai - 603103


SIGNATURE

Mr.M.GOPI KRISHNAN, M.E.,

ASSISTANT PROFESSOR

Dept. of Mechanical Engineering

M.S.A.J.C.E.

Egattur, Chennai - 603103

Submitted for VIVA-VOICE examination held on 20/04/18


INTERNAL EXAMINER


PRINCIPAL
MOHAMED SATHAK A.J.COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Siruseri, IT Park
Chennai - 605009




EXTERNAL EXAMINER

CHAPTER 8

CONCLUSION

The use of smartphones as a road vehicle crash detection platform presents a low cost and portable solution compared to vendor specific built in system. A working model of Automatic vehicle accident detection and messaging system using a GPS and GSM modems has been implemented successfully. The biggest advantage of our research is whenever the sensor is activated we will be immediately getting the acknowledgement from GSM modem to our mobile numbers which are stored in EEPROM without any delay. This system locates the accident spot realizing the automation of accident detection and messaging system. Consequently it will save the precious time required to save the accident victims. Further this system can be implemented using the vibration sensors as well as the sound sensors in order to make it more accurate and efficient to detect an accident.


PRINCIPAL
MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (GMR) Sri, IT Park
Chennai - 600 003


ABSTRACT OF THE PROJECT WORK

The main intention of this project is to find the accident spot at any place and intimating it to ambulance/helplines through the GSM networks and GPS. The GPS based vehicle accident identification module contain SENSORS, GSM module and a GPS modem connected to the microcontroller. Global system for mobile (GSM) technology is used to establish cellular connection. GPS is used to trace the position of the vehicle. Nowadays, it is very difficult to know that an accident has occurred and to locate the position where it has happened. There is no system of identification and intimation regarding an accident in previous. Later on the SMS service begins for intimation purpose, GPS and GSM makes the usage for intimation and identification of place, by this we can also send information to neighbors as many possible. By this we can save the life of persons who meet with an accident. In previous system, when an accident occurs the information only is sent through GSM but there is no possibility to locate the spot, but this project provides an automotive localization system using GPS and GSM-SMS services, in addition to this there is a speed control system which reduces the vehicle speed when an obstruction is detected by the ultrasonic waves. So that there is lesser possibilities for collision.


PRINCIPAL
MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road, IT Park
Chennai-600 088



FAILURE ANALYSIS OF HYDRAULIC RETARDER IN HEAVY COMMERCIAL VEHICLES

FINAL YEAR PROJECT REPORT

Submitted by

JAMAL SHAGUL AMEEDH J M	311814114024
MD ATEEQ UL HUQ A	311814114038
S.MOHAMED AZARUDEEN	311814114042

In partial fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

MOHAMED SATHAK A.J.COLLEGE OF ENGINEERING,

CHENNAI-603103


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



ANNA UNIVERSITY: CHENNAI

APRIL 2018



ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

This is to certify that this project report " **FAILURE ANALYSIS OF HYDRAULIC RETARDER IN HEAVY COMMERCIAL VEHICLES** " is the bonafide work of **JAMAL SHAGUL AMEEDH J M, MD ATEEQ UL HUQ A, MOHAMED AZARUDEEN. S** who carried out the project work under my supervision.


SIGNATURE

Dr.R.GANESA MOORTHY, M.E.,PhD.,

HEAD OF THE DEPARTMENT

Mechanical Engineering

MSAJCE, Chennai-603103.


SIGNATURE

Mr.S.DEEPAK KUMAR, M.E.,

SUPERVISOR

ASSISTANT PROFESSOR

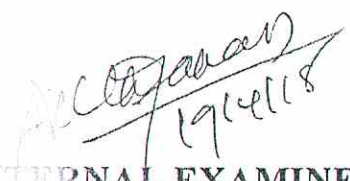
Mechanical Engineering

MSAJCE, Chennai-603103.

Submitted for viva - voice Examination held on 19/04/18
at **Mohamed Sathak A.J. College of Engineering, Chennai.**


INTERNAL EXAMINER




EXTERNAL EXAMINER

ABSTRACT

Retarder is one of the integrated braking components in Heavy Commercial Vehicles. Retarder is used to slow down the vehicle speed or maintain steady speed during downhill ride in Heavy Commercial Vehicles. This project summarizes the failure analysis of major problems of Hydraulic Retarder and the retarders efficiency drastically. In this work we present the study of the Existing state defect analysis for the major failures such as Overheating of Retarder Shaft, Retarder oil modification and Modification of Breather pipe with the Proposing data's and interpretations. By Undergoing Failure Analysis in Hydraulic Retarder, it is observed that frequent problem occurrences such as Oil Leakage, Formation of Emulsion Particles, Retarder Shaft Overheating, Rotary Shaft Seal Carbonized, Gearbox Oil mixing with Retarder Oil in Retarder Braking Unit etc. Thereby, implementing root cause for rectifying those frequent problem occurrences by undergoing failure analysis in Hydraulic Retarder to improve Retarder Brake Efficiency in Heavy Commercial Vehicles.

Keywords:



CHAPTER 09

CONCLUSION

This report highlights the Hydraulic Retarder study of the existing state problem, Defect Analysis , Rectification Of The Defects, Function Of The Improved System In Proposed State based on study.

Thus we conclude the following as result and discussion separately,

9.1.Replacement Of Retarder Oil SAE 15/40 to Dexron III Automatic Transmission Fluid:

9.1.1Based on viscosity Index:

Existing oil	SAE 15W-40	140
Proposed	ATF DEXTRON III	185

Since we know the higher the Viscosity Index, the more stable the viscosity across a range of temperatures (more desirable) so ATF Dextron III is preferable based on viscosity index.

9.1.2 Based on Design Study:

Existing oil	SAE 15W-40	It is designed to absorb moisture and release it when hot.
Proposed	ATF DEXTRON III	It is designed for outstanding resistance to oxidation, corrosion, and high temperature deposits so it should never put water in it.

Based on study we know that Once the amount of water exceeded the maximum level for it to remain dissolved the oil is saturated resulting in both additive mortality and the formation of acidic by-products. This results in sludge and sediment build-up, filter plugging and poor oil. So based on design we conclude that DEXTRON III is best when compare to Existing oil.



ANALYSIS OF REPLACING SPRING BRAKE ACTUATOR WITH BRAKE CHAMBER IN REAR DEAD AXLE

A PROJECT REPORT

Submitted by

TAMILMUTHU.S

1814114075

UDAYAPRAKASH.S

1814114077

UDHAYA KUMAR.D

1814114078

in partial fulfillment for the award of the degree

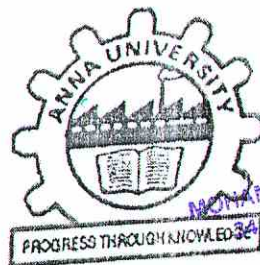
of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING
CHENNAI-603103



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

ANNA UNIVERSITY: CHENNAI
APRIL/MAY 2018



ANNA UNIVERSITY: CHENNAI - 600 025

BONAFIDE CERTIFICATE

Certified that this project report "ANALYSIS OF REDUCING SPRING BRAKE ACTUATOR WITH BRAKE CHAMBER IN DEAD AXLE" is the bonafide work of TAMILMUTHU.S(311814114077),UDAYAPRAKASH.S(311814114077),UDHAYAKUMAR.D(311814114077) who carried out the project work under my supervision.

SIGNATURE

Dr.R.GANESAMOORTHY,M.E., PhD.,
HEAD OF THE DEPARTMENT

Department of Mechanical
Engineering

M.S.A.J.C.E.

Egattur, Chennai - 603103.

SIGNATURE

M.GOLAKRISHNA, M.E.,
ASSISTANT PROFESSOR

Department of Mechanical
Engineering

M.S.A.J.C.E.

Egattur, Chennai - 603103.

Submitted for VIVA-VOICE examination held on 20-04-2018

INTERNAL EXAMINER

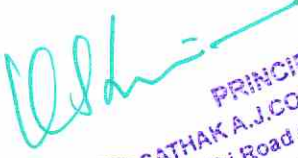


EXTERNAL EXAMINER

PRINCIPAL
MOHAMED SATHAK A.J.COLLEGE OF ENGINEERING
34, Rajiv Gandhi Road (OMR), Siruseri, IT Park
Chennai-603103.

ABSTRACT

In this fast moving Technology world the competition among the automobile industries has been increased abruptly in the mean time. There is increase in the project of the automobile as well as the expectation of a customer. Customer satisfaction plays an important role within your business. Not only is it a leading indicator to measure the customer loyalty, identify unhappy customers, reduce churn and increase the revenue; it is also a key Point of differentiation that helps you to attract new customers in competitive business environment. Customer are considered as the customers, or end user, by their purchase of goods, the contracting of services. But the word "customer" is the most commonly used to define "end user" of a product. The cost and quality of the products are the two significant factors which play major roles in retaining the existing customer and attracting the new customers. This project is aimed to deal with the replacement of spring brake actuator with the disc brake drums in the tag (rear dead axle) of a multi axle vehicles without any reduction in braking efficiency of the wheels, our project aims to reduce the overall cost of the end product by applying the concept of the value engineering. so that we can easily retain the existing customers and attract new customers.


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


CHAPTER CONCLUSION

In this project, we studied up pneumatic braking system in a multi axle vehicle and proposed an idea of replacing spring brakes with air brakes on rear dead axle. The main objective of the proposal is to reduce over all cost and any changes in quality and function by the application of the value engineering. After testing, we also found that here is an increase in braking efficiency. Hence this project can be successfully implemented in multi axle vehicles.


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

