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*Erode Road, Nathakadaiyur, Kangeyam, Tirupur - 638 108, Tamil Nadu.*
*Ph : 04257 241935, 241545 | Fax : 04257 241885, Email : info@builderscollege.edu.in, www.builderscollege.edu.in*

## Department of Mechanical Engineering

### B.E – Mechanical Engineering

### Academic Year: 2020 -2021



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| 3. | Metrology and Measurement | 25 |
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**ME8391** **ENGINEERING THERMODYNAMICS** **L T P C**
**3 2 0 4**

**OBJECTIVE**

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

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

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

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

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

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

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

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

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

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

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

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

**TOTAL : 75 PERIODS**

**OUTCOMES:**

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

| | |
|---|---|
| CO1 | Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions. |
| CO2 | Apply second law of thermodynamics to open and closed systems and calculate entropy and availability. |
| CO3 | Apply Rankine cycle to steam power plant and compare few cycle improvement methods |
| CO4 | Derive simple thermodynamic relations of ideal and real gases |
| CO5 | Calculate the properties of gas mixtures and moist air and its use in psychometric processes |

**TEXT BOOKS :**


1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics ",Fifth Edition,2017.
2. Yunus a. Cengel & michael a. Boles, "Thermodynamics", 8th edition 2015.




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**ME8493 THERMAL ENGINEERING - I L T P C**
**3 0 0 3**

**OBJECTIVES:**

 To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes

 To apply the thermodynamic concepts into various thermal application like IC engines, Steam.

 Turbines, Compressors and Refrigeration and Air conditioning systems

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

**UNIT I GAS AND STEAM POWER CYCLES 9**

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

**UNIT II RECIPROCATING AIR COMPRESSOR 9**

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

**UNIT III INTERNAL COMBUSTION ENGINES AND COMBUSTION 9**

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

**UNIT IV INTERNAL COMBUSTION ENGINE PERFORMANCE AND SYSTEMS 9**

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

**UNIT V GAS TURBINES 9**

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

**TOTAL: 45 PERIODS**

**OUTCOMES: Upon the completion of this course the students will be able to**

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

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**TEXT BOOKS:**

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

**REFERENCES:**

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

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| ME8595 | THERMAL ENGINEERING – II | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

 To apply the thermodynamic concepts for Nozzles, Boilers, Turbines, and Refrigeration & Air Conditioning Systems.

 To understand the concept of utilising residual heat in thermal systems.

**UNIT I STEAM NOZZLE 9**

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

**UNIT II BOILERS 9**

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

**UNIT III STEAM TURBINES 9**

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

**UNIT IV COGENERATION AND RESIDUAL HEAT RECOVERY 9**

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

**UNIT V REFRIGERATION AND AIR – CONDITIONING 9**

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

**TOTAL:45 PERIODS**

**OUTCOMES: Upon the completion of this course the students will be able to**

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

**TEXT BOOKS:**

1. Kothandaraman, C.P., Domkundwar .S and Domkundwar A.V.,"A course in Thermal Engineering", Dhanpat Rai & Sons, 2016.

2. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata Mc Graw Hill Publications, 2010.

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**REFERENCES:**

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

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**ME8091** **AUTOMOBILE ENGINEERING** **L T P C**
**3 0 0 3**

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

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

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**TEXT BOOKS:**

1. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

2. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014. .

**REFERENCES:**

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.

2. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.

3. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.

4. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978.

5. Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

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# THERMOPHYSICAL PROPERTIES OF BIOLUBRICATING OIL IN SINGLE CYLINDER FOUR STROKE IC ENGINE

A PROJECT REPORT

*Submitted by*


GOKUL P (730317114014)

GOWTHAM S (730317114018)

THANUJ KARTHIK C (730317114051)

VIVEK S (730317114059)


*in partial fulfillment for the award of the degree*

*of*

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING


BUILDERS ENGINEERING COLLEGE

KANGAYAM – 638 108


ANNA UNIVERSITY: CHENNAI 600 025

APRIL 2021



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# ANNA UNIVERSITY: CHENNAI 600 025

## BONAFIDE CERTIFICATE

Certified that this project report **"THERMOPHYSICAL PROPERTIES OF BIOLUBRICATING OIL IN SINGLE CYLINDER FOUR STROKE IC ENGINE"** is the bonafide work of **" GOKUL P (730317114014), GOWTHAM S (730317114018), THANUJ KARTHIK C (730317114051), VIVEK S (730317114059) "** who carried out the project work under my supervision.

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**The project report submitted for the viva voce held on** 06.08.2021

6/8/21
**INTERNAL EXAMINER**

**EXTERNAL EXAMINER**

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## ABSTRACT

Lubricants are a most important role to prevent friction and wear due contact surfaces of relative motion in the machine components (bearings, camshafts, piston, gearbox, lead screw etc). The lubrication oil is a major role in internal combustion engine to improve the working life and performance of the engine. This experimental study of thermo physical properties kinematic viscosity, kinematic viscosity index, calorific value, flash point, pour point, and hydrogen content. In this study, starting from mineral, synthetic and biobased lubricants; mineral, synthetic, biomineral and biosynthetic based four stroke motorcycle engine oils (20w40) are prepared, then lubricity properties of the motor oils are determined. The results show that 50 and 75 % per cent of bio lubricating oil mixing in base oil mixing with synthetic Also improvements in the lubricant properties with base oil, synthetic with bio lubricants are seen. The paper presents base syethetic, biomineral and biosynthetic 20W40 lubricating oil as alternative oil for enhance life and performance of IC engine.



**Keywords:** IC engine, BioLubricating oils, viscosity, temperature and overheating





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# CHAPTER 1
# INTRODUCTION

## 1.1 WEAR, FRICTION & LUBRICANT

The lubricant in an engine serves multiple purposes, which demands a complex formulation in order to fulfil its function. Aside from friction and wear reduction the oil protects engine parts against corrosion and oxidation, removes third bodies from sliding pairs, transfers heat away from core engine components and helps in achieving appropriate sealing and reducing vibration. The engine oil composes of a base oil and an additive package. Modern engine oils are mostly polyalphaolefin based, which has inferior properties as a lubricant, hence a selection of additives is needed to achieve the desired function. The most common additives are anti-wear, anti-oxidant, dispersant, detergent, friction modifier, viscosity modifier, extreme pressure agent, anti-foaming agent and emulsifier compounds. A certain property can be achieved through different chemical compounds, but the interaction and compatibility of these compounds with each other must be considered during the formulation of the lubricant. An engine oil encounters elevated temperatures, high mechanical load, multiple chemically active solids and gases and foreign contaminants during its service life which can contribute to its degradation. Therefore, the lubricant needs to be changed several times during the lifetime of the engine. The main reason of oil degradation is oxidation through the Oxygen content of fresh intake air and exhaust gas. The rate of oxidation will increase with rising temperature, which can also lead to the formation of peroxides and free radicals in the engine oil, which in turn can contribute to acid and sludge formation. Oxidation can also lead to an increase in viscosity due to polymerization between the base oil molecules. The passenger car and commercial vehicle engines implement direct injection fuel systems with high injection pressures and varied injection timing strategies.

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Injecting fuel directly inside the combustion chamber offers a more precise control over mixture formation and the combustion process which together with charging allows for higher specific power and torque, but also increases the phenomenon of fuel transport through the piston ring package. Fuel and fuel derivatives can contaminate the engine oil and cause further degradation mechanisms. Unburden hydrocarbons can get into the engine oil from the combustion chamber through blow-by gases. Defective injectors, bad fuel spray orientation and increased gaps between the piston, piston rings and cylinder wall due to wear may cause increased fuel transport into the crankcase. Fuel dilution can cause lubrication issues, although in normal operating conditions without any fuel line malfunction the fuel content of the engine oil should stay at a manageable level due to evaporation at higher operating temperatures. However, biofuels can alter these tendencies. The goal of this study is to describe the condition of the engine oil at consequent stages of use and to predict the behaviour of a specific engine oil after a given service life regarding friction and wear through chemical analysis of oil samples from three identical light-duty direct injection supercharged diesel engines.

### 1.1.1 FIVE BASIC LAWS OF FRICTION:

- When an object is moving, the friction is proportional and perpendicular to the normal force (N).
- Friction is independent of the area of contact so long as there is an area of contact.
- The coefficient of static friction is slightly greater than the coefficient of kinetic friction.
- Within rather large limits, kinetic friction is independent of velocity.
- Friction depends upon the nature of the surfaces in contact.



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### 1.2.2 FLUID FRICTION:

1. It is the force which resists the motion of object when it moves through liquid or gas.
2. All gases and liquids are fluids.
3. This resistance to flow is also termed as "viscosity".
4. The resistance varies from layer to layer in a fluid flow.
5. This velocity variation is termed as velocity gradient ($\Delta v$).
6. $\Delta v = \frac{\Delta u}{\Delta y}$ $\Delta u$ is velocity difference between the layers $y$ and $\Delta y$ is distance between the layers.

Fluid friction in a fluid along area A is given by:

$$F = \mu A \Delta v$$

$\mu$ is the constant called coefficient of dynamic friction

### 1.2.3 METHODS TO CONTROL FRICTION:

Controlling friction is an important parameter for smooth function of and improving their life. Various methods can be used for this :

- Add lubricant for smooth functioning.
- Keep the oil clean

## 1.3 WEAR

- Wear is the surface damage or removal of material from one or both of two solid surfaces in a sliding, rolling, or impact motion relative to one another.



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- Wear, as friction, is not a material property, but a system response.
- It is generally assumed that materials with high friction will exhibit high wear rate, which is not true. Interfaces with solid lubricants and polymers exhibit relatively low friction and relatively high wear, whereas ceramics exhibit moderate friction but extremely low wear.

- Corrosion may be included in wear phenomenon, but the damage is amplified and performed by chemical reactions.
- Wear can be either productive or undesirable.

### 1.3.1 STAGES OF WEAR:

**Primary stage** or early run-in period, where surfaces adapt to each other and the wear-rate might vary between high and low.

↓

**Secondary stage** or mid-age period, where a steady rate of ageing is in motion. Most of the components operational life is comprised in this stage

↓

**Tertiary stage** or old-age period, where the components are subjected to rapid failure due to a high rate of ageing



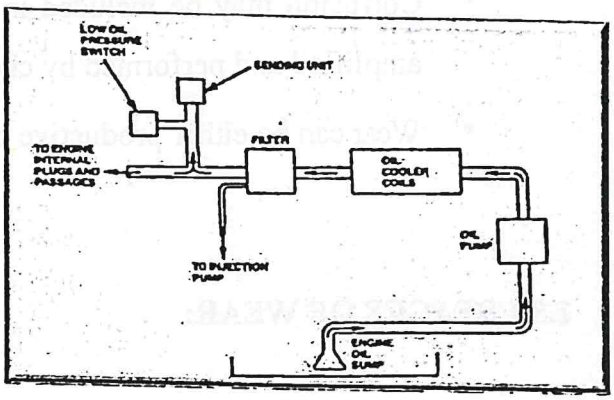
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## 1.4.2 LUBRICATION SYSTEM OPERATION:

A lubrication system is the setup that delivers control amount of lubricant to multiple locations on a machine while the machine is operating.

**Fig 1.8 LUBRICATION SYSTEM OPERATION**

- *Oil pump* pulls oil from the oil
- *Pump* pushes oil through the oil filter and
- *Oil filter* removes very small
- *Filtered oil* flows to engine internal plugs




## 1.5 FUNDAMENTAL ASPECTS OF THERMOPHYSICAL :

The thermophysical properties considered are the ones that influence the heat transfer and pressure drop performance potentials, and include the thermodynamic properties temperature, pressure, density, latent heat of vaporization, and specific heat, and the transport properties thermal conductivity and viscosity.The major components of thermal properties are:

- Heat capacity.
- Thermal Expansion.
- Thermal conductivity.
- Thermal stress.



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## 1.6 BIO – LUBRICANT

Today, more and more companies are opting for lubrication that considers aspects such as sustainability and environmental protection. We will discover what a bio-lubricant oil is best and what its main advantages. The term bio-lubricant applies to all lubricants that biodegrade easily and are not toxic to humans or aquatic environments. They can also be called sustainable, eco-friendly or biodegradable lubricants. A bio-lubricant is made up of Vegetable oils and Synthetic esters.

### 1.6.1 Main function of Bio - Lubricants :

- Reduce mechanical energy losses
- Reduce wear on friction parts
- Provide protection to the parts against corrosion
- Reduce the working temperatures of the machines
- Increase the tightness of seals
- Avoid spilling deposits of impurities and dirt

### 1.6.2 TYPES OF BIO - LUBRICANT :

| VEGETABLE/ ANIMAL OIL | COMMON APPLICATION |
|---|---|
| Sperm Whale oil | Spindle lubricant in textile mills, Automotive transmission fluids, Metal cutting fluids |
| Rapeseed | Metal forming processes |
| Castor oil Coconut oil | Gear lubricants agent gas and Petrol engine oil |

**Table 1.1 Types of bio lubricant**



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# CHAPTER 7

# CONCLUSION

In this project the Thermophysical and emission performance of vegetable and mineral oil based lubricants were carried out using a universal wear and friction machine and a Four-stroke engine. The vegetable (castor oil) based lubricant exhibited better performance in terms of wear and the mineral oil based lubricant exhibited better performance in terms of friction. The viscosity test results showed that the viscosity index of Vegetable based lubricant was higher than that of Mineral oil based lubricant.The vegetable oil based lubricant is more effective in reducing the emissions level for CO and HC. At the same time, the $CO_2$ and $O_2$ emissions for Vegetable based lubricant are higher than for Mineral oil based lubricant.



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**ME8491** **ENGINEERING METALLURGY** **L T P C**

**OBJECTIVES:** **3 0 0 3**

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

**UNIT I** **ALLOYS AND PHASE DIAGRAMS** **9**

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

**UNIT II** **HEAT TREATMENT** **9**

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

**UNIT III** **FERROUS AND NON-FERROUS METALS** **9**

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

**UNIT IV** **NON-METALLIC MATERIALS** **9**

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

**UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS** **9**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

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

**TEXT BOOKS:**

1. Avner,, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company,1994.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2007

**REFERENCES:**

1. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 2010.
2. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 2015.
3. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012
4. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.

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**CE8395 STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS** **9**

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

**UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM** **9**

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

**UNIT III TORSION** **9**

Torsion formulation stresses and deformation in circular and hollows 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 – Lame's theorem.

**TOTAL: 45 PERIODS**

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**OUTCOMES**

Students will be able to

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

**TEXT BOOKS:**

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

**REFERENCES:**

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

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**ME8501 METROLOGY AND MEASUREMENTS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To provide knowledge on various Metrological equipments available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

**UNIT I BASICS OF METROLOGY 9**

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

**UNIT II LINEAR AND ANGULAR MEASUREMENTS 9**

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

**UNIT III ADVANCES IN METROLOGY 9**

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

**UNIT IV FORM MEASUREMENT 9**

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

**UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE 9**

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

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**TOTAL : 45 PERIODS**

**OUTCOMES:**

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

CO1 Describe the concepts of measurements to apply in various metrological instruments

CO2 Outline the principles of linear and angular measurement tools used for industrial applications

CO3 Explain the procedure for conducting computer aided inspection

CO4 Demonstrate the techniques of form measurement used for industrial components

CO5 Discuss various measuring techniques of mechanical properties in industrial applications

**TEXT BOOKS:**

1. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.

2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.

**REFERENCES:**

1. Alan S. Morris, "The essence of Measurement", Prentice Hall of India 1996.

2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2014.

3. Charles Reginald Shotbolt, "Metrology for Engineers", 5 th edition, Cengage Learning EMEA,1990.

4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.

5. Raghavendra ,Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.

PRINCIPAL
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# TESTING OF COIR AND BANANA FIBER HYBRID COMPOSITE MATERIALS

**A PROJECT REPORT**

***Submitted by***


**PRABAKARAN.M (730317114036)**

**SRINATH.S (730317114049)**

**THARUNPRASATH.K (730317114052)**

**GOWERI SANKAR.G (730317114302)**


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

***of***

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**

**BUILDERS ENGINEERING COLLEGE,**

**KANGAYAM - 638108 .**

**ANNA UNIVERSITY : CHENNAI 600 025.**

**APRIL 2021**

PRINCIPAL
BUILDERS ENGINEERING COLLEGE
Kangayam-638 108,TN, India.

# ANNA UNIVERSITY: CHENNAI 600 025

## BONAFIDE CERTIFICATE

Certified that this project report "**TESTING OF COIR AND BANANA FIBER HYBRID COMPOSITE MATERIAL**" is the bonafide work of **PRABAKARAN.M (730317114036), SRINATH.S (730317114049), THARUNPRASATH.K (730317114052)** and **GOWRISANKAR.G (730317114302)** that carried out the project work under my supervision.

**SIGNATURE**

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# ABSTRACT

Natural fibers (Banana and Coconut coir) reinforced Epoxy composites were subjected to various tests in order to study the effects of tensile strength, flexural strength, compression strength and impact test on the composite fiber. To analyze the mechanical properties such as tensile strength, flexural strength, compressive strength and impact strength for different aspect ratio of fibers and their effects on the fiber.

In recent times, increasing attention has been paid to the use of renewable resources particularly of plant origin keeping in view the ecological concerns, renewability and many governments passing laws for the use of such materials. These natural fibers are used as a suitable reinforcing material to satisfy the environmental and they are now fastly emerging as a potential alternative for glass fibers in engineering composites. The natural fibers are used as reinforcements for composite material due to its various advantages compared to conventional fibers.

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# CHAPTER 1

## INTRODUCTION

The availability of natural fibers is abundance and, they are very inexpensive when compared to other advanced man-made fibers. These natural fibers are used as a suitable reinforcing material environmental concern and they are now emerging as a potential alternative for glass fibers in engineering composites [1]. The natural fibers are used as reinforcements for composite materials due to its various advantages compared to conventional man-made fibers [2, 3]. The primary advantages of natural fibers are low density, low cost, biodegradability, acceptable specific properties, less wear during processing and low energy consumption during extracting as well as manufacturing composites and wide varieties of natural fibers are locally available. Natural fibers have a few disadvantages when used as reinforcements, such as lower impact strength, higher moisture absorption which leads to dimensional changes thus leading to micro-cracking. All polymer composites absorb moisture in humid atmosphere and alsowhen immersed in water.

The effect of this moisture absorbed leads to the degradation of fiber-matrix interface region creating poor stress transfer between fiber and matrix and resulting in reduction of mechanical properties along with dimensional changes. One of the main concerns for the use of natural fiber reinforced composite materials is their susceptibility to moisture absorption and the effect on physical and mechanical properties. It is important therefore that this problem is discussed in order that these natural fibers may be considered as a favorable reinforcement in composite materials. Many researches have studied in detail the effect of moisture absorption on the mechanical properties of the natural fiber reinforced composites, to mention a few; The water sorption characteristics and the effect of hybridization with glass fiber and the chemical modification of the fiber on the water absorption properties of banana fiber reinforced polyester composites by immersion in distilled water at 280–900C were studied [4].

Pine Needles of different dimensions were used to prepare bio composites with Phenol-Formaldehyde and the effects of different fiber dimension on the mechanical properties of the composites were determined. These polymer composites were further subjected to various standardized characterization tests such as moisture absorption and chemical resistance analysis [5]. The moisture absorption of short hemp fiber and hemp-glass hybrid reinforced



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thermoplastic composites was investigated to study their suitability in outdoor applications [6].

The mechanical properties of sisal fiber-reinforced epoxy composites aged in water and the moisture absorption behavior of sisal were investigated [7]. The relationship between the moisture absorption of pineapple-leaf fiber-reinforced low-density polyethylene composites and the fiber loadings were studied [8] and found that the moisture absorption increased almost linearly with the fiber loading. The mechanical properties of unsaturated polyester composites reinforced with different natural fibers such as sisal, jute and flax and glass fiber were reported. Jute composites showed the best flexural and tensile strength values but the lowest impact values as a consequence of the higher interface adhesion. On the other hand, sisal fiber composites showed the lowest mechanical and water resistance properties [9]. The hydrophilic nature of natural fibers provides weak interfacial adhesion in polymer-matrix composites. An experimental study of water absorption in unsaturated polyester composites reinforced with macambira natural fiber was done by V.C.A. Cruz et al [10].

They studied the samples with weight composition of 30% macambira fiber and 70% unsaturated polyester. Tests for water absorption were performed by immersing the samples in a bath of distilled water at 25, 50 and 70°C, and water uptake was measured gravimetrically along the process. Results of the micrographs (SEM), moisture content and area / volume relationships of the composites were analyzed. There are three different governing mechanisms of moisture diffusion in polymeric composites. The first involves of diffusion of water molecules inside the micro gaps between polymer chains. The second involves capillary transport into the gaps and flaws at the interfaces between fiber and the matrix. This is a result of poor wetting and impregnation during the initial manufacturing stage.

The third involves transport of micro-cracks in the matrix arising from the swelling of fibers as in the case of natural fiber composites. Generally, based on these mechanisms, diffusion behavior of polymeric composites can further be classified according to the relative mobility of the penetrant and of the polymer segments, which is related to either Fickian, non-Fickian or anomalous, and an intermediate behavior between Fickian and non-Fickian [11, 12]. In general moisture diffusion in a composite depends on factors such as volume fraction of fiber, voids, viscosity of matrix, humidity and temperature. The objectives of this work are (1) to study the water absorption behavior of the hybrid composites made by combining Sisal fibers



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and Coconut coir as reinforcements in the Epoxy matrix at Room Temperature and elevated temperature (1000C). (2) Studying the influence of fiber reinforcement and water uptake behavior on mechanical properties of hybrid-composites.



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# CHAPTER 7

# CONCLUSION

- The aim of this project is to fabricate a suitable alternative material for wood products and plastic products which is economically available alternative and should be easy to fabricate.
- The natural composite materials are very less in weight compare to other materials like wood, plastics etc. In this project, natural fiber composite materials are fabricated by using polyester resin with different weight ratio and different length of fiber were prepared.
- Then the mechanical properties of those fibers were analyzed such as tensile strength, compressive strength, flexural strength and impact strength for different volume fraction.
- We expect that the experimental values of mechanical properties are more than the other natural fibers that we had mentioned in above literature survey.
- Tensile Strength, Flexural Strength, Compression Strength and Impact Strength of fiber composite material were found to be increased with increase in volume of fraction.
- The highest mechanical properties were obtained on fiber about tensile strength of 25.761N/mm$^2$[PLATE D], compression strength of 14.073 N/mm$^2$[PLATE E], flexural modulus of 5592.711GPa [PLATE E]and impact strength of 0.383J/sq.mm [PLATE D].



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| ME8451 | MANUFACTURING TECHNOLOGY – II | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**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.

**OUTCOMES:** **TOTAL : 45 PERIODS**

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

CO1 Explain the mechanism of material removal processes.

CO2 Describe the constructional and operational features of centre lathe and other special purpose lathes.

CO3 Describe the constructional and operational features of shaper, planner, milling, drilling, sawing and broaching machines.

CO4 Explain the types of grinding and other super finishing processes apart from gear manufacturing processes.

CO5 Summarize numerical control of machine tools and write a part program.

**TEXT BOOKS:**


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


**REFERENCES:**


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



PRINCIPAL
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Kangayam-638 108,TN, India.

# MATERIAL INVESTIGATION AND ANALYSIS OF ATC PLUNGER PIN IN CNC MACHINE

**PROJECT REPORT**

Submitted by


| | |
|---|---|
| **ARUN K** | **(730317114004)** |
| **NIHILL ARAVIND S** | **(730317114033)** |
| **SIDDHARTH L** | **(730317114045)** |
| **SIVAKUMAR S** | **(730317114046)** |


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

**of**

**BACHELOR OF ENGINEERING**

**in**

**MECHANICAL ENGINEERING**


**BUILDERS ENGINEERING COLLEGE, KANGAYAM – 638108**


**ANNA UNIVERSITY: CHENNAI 600025**

**APRIL 2021**

PRINCIPAL
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# ANNA UNIVERSITY: CHENNAI 600 025

## BONAFIDE CERTIFICATE

Certified that this project report "**MATERIAL INVESTIGATION AND ANALYSIS OF ATC PLUNGER PIN IN CNC MACHINE**" is a bonafide work of "**ARUN K (730317114004), NIHILL ARAVIND S (730317114033), SIDDHARTH L (730317114045) And SIVAKUMAR S (730317114046)**" that carried out the project /work under my supervision.

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**Dr.N. SATHISH KUMAR, M.E.,**
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We wish his every success in her life and carrier .

For Bharani CNC center

Authorized signatory



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We wish his every success in her life and carrier .

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We wish his every success in her life and carrier .

For Bharani CNC center

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Machining Division ★ All kinds of Job Works ★ Consultancy Works

# ABSTRACT

Computer Numerical Control machine plays vital role in manufacturing of machine components. Very accurate and good surface finish can be obtained by CNC machines. The basic model is developed in to high comfortable machine like APC, ATC etc. the tool changing manually loads to time consumption, so that it is overcome by ATC.

Automatic tool change provides easier method of changing the tool, the load time is also less even though it provides easier handling, and the plunger pin gets wear out after a period of time. This project deals with the methods to overcome the worn out of plunger pin in ATC. This project gives the solution by changing the existing material by new wear resistance material. Analysis is also done to understand the stress distribution. The materials are used in the project and their properties are compared to give the solution.

The plunger pin wear is the major problem in the CNC MAZAK H 400 facing. The CNC centers are periodically changing the plunger pin. Our project may give them permanent solution to the CNC centers. We have come to know that BHARANI CNC CENTER faces the problem and we have given the solution for their problem.



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# CHAPTER 1

## INTRODUCTION

The BHARANI CNC CENTER is an organization using more no of horizontal and vertical type CNC machines for producing various types of machining spare parts to customers. The BHARANI CNC CENTER facing problem on horizontal machining centre (HMC MAZAK/400). The problem arise in the location of machine where ATC. In the ATC the tool arbor is hold by plunger pin at the right position. Due to the hydraulic pressure the tool arbor is impact against the spring tension of the plunger pin, so wear is occur more in the plunger pin, within the short period of time the pin worn-out quickly and also the tool arbor doesn't hold properly by the plunger pin and this will create fall over the tool arbor from the ATC at the time of changing the tool arbor. This will affect the mass production of (HMC MAZAK/400).

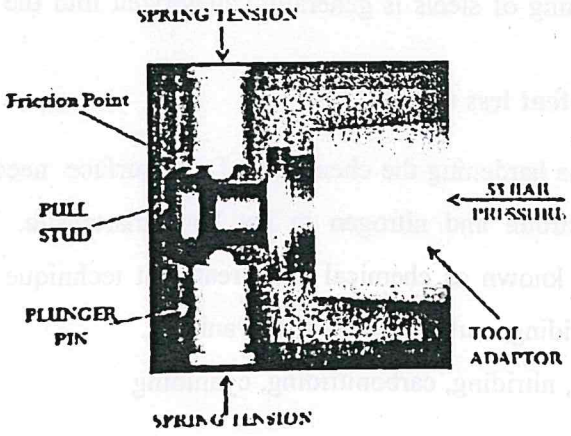



*Figure 1.1 meeting of plunger pin and tool holder*



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## CASE HARDENING

Case hardening is a simple method of hardening steel. This technique is used for steels with low carbon content. Carbon is added to the outer surface of the steel, to a depth of approximately 0.03mm. This hardening process includes a wide variety of techniques is used to improve the mechanical properties and wear resistance of parts without affecting the softer, tough interior of the part. This combination of hard surface and resistance and breakage upon impact is useful in parts such as a cam or ring gear that must have a very hard surface to resist wear, along with a tough interior to resist the impact that occurs during operation. Further, the surface hardening of steels has an advantage over through hardening because less expensive low-carbon and medium- carbon steels can be surface hardened without the problems of distortion and cracking associated with the through hardening of thick sections. One advantage of this method of hardening steel is that the inner core is left untouched and so still processes properties such as flexibility and is still relatively soft.

## TYPES OF CASE HARDENING

The case hardening of steels is generally categorized into the two different types.

**1. Steel with carbon content less than 0.25%**

For this kind of case hardening the chemistry of the surface needs to be change by adding carbon and nitrogen to get hard martensite. This category of treatment is known as chemical heat treatment technique and involves carburizing, nitriding, carbonitriding and cyaniding.

**Examples: -** Carburizing, nitriding, carbonitriding, cyaniding



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**2. Steel with carbon content more than 0.35%**

For this kind of steel the surface can be hardened by flame, induction and laser hardening techniques.

**Examples: -** Flame hardening, induction hardening, and laser hardening.

## FLAME HARDENING

This is the simplest form of heat treatment process. The workpiece is heated by means of a gas torch (oxy-acetylene flame) followed by a water spray on the heated parts. The heat from the torch penetrates only to small depth on the surface and consequently the steel in the outer layers gets quenched to martensite and bainite. Case depth up to 3mm can be achieved by this process. This process can be followed by heating to about 200°C for the purpose of stress relieving. The surface hardness is not appreciably affected by these reheating operations. This process is suitable for any complex shape of component such as crank shaft, large gears, cam, etc. with carbon percentage ranging from 0.3 to 0.6%. Though high carbon steel can also be flame hardened, greater care is needed to avoid surface cracking.

## INDUCTION HARDENING

This is similar to flame hardening process where the heating of component surface is achieved by the electromagnetic induction. The workpiece such as crank shaft is enclosed in the magnetic field of an alternating (10 kHz to 2MHz) current conductor to obtain case depth of the order of 0.25 to 1.5 mm. This causes induction heating of the workpiece, The heated workpiece then quenched by water spray. The induction heat penetrates only outer surface of the workpiece as a result only the skin gets hardened by the quenching process. The whole process is very fast (5s to 4 minutes) and result in hard outer surface (50 to 60 Rc ) which is wear resistant.



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## CHROMIUM PLATING

### PLATING MECHANISM

Chromium metal is deposited on metallic surfaces submerged in a chromic acid plating bath. Since the process is electrolysis, two electrodes exist. The part to be plated is made cathodic by connection to the negative terminal of the rectifier. Inert lead anodes are made electrically positive. When voltage is applied across the two, current flows through the solution and metal is deposited. Actual rates of deposition for commercial parts range from .0005:/hour to .003". Proper control of various plating parameters result in bright, hard, adherent deposits.

### CHEMISTRY

Practical industrial hard chrome plating baths now in common use have only two or three chemical constituents. Chromic acid is formed when chromium trioxide crystals are dissolved in water. Some form of catalyst is also necessary for the process to occur. The most widely used catalyst is sulfate ion, usually added to the bath as reagent grade sulfuric acid. Varying the absolute and relative concentrations of these two constituents will alter the deposit characteristics significantly. Routine bath analyses are performed at High Tech Chrome Plating's in-house lab every 15 to 30 days to ensure proper chemical levels. This routine analysis is very important in producing bright industrial hard chrome.



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## HARDNESS TEST

Rockwell hardness testing is a general method for measuring the bulk hardness of metallic and polymer materials. Although hardness testing does not give a direct measurement of any performance properties, hardness correlates with strength, wear resistance, and other properties. Hardness testing is widely used for material evaluation due to its simplicity and low cost relative to direct measurement of many properties.

This method consists of indenting the test material with a diamond cone or hardened steel ball indenter. The indenter is forced into the test material under a preliminary minor load *F0* usually 150kg. When equilibrium has been reached, an indicating device, which follows the movements of the indenter and so responds to changes in depth of penetration of the indenter, is set to a datum position. While the preliminary minor load is still applied an additional major load is applied with resulting increase in penetration. When equilibrium has again been reach, the additional major load is removed but the preliminary minor load is still maintained. Removal of the additional major load allows a partial recovery, so reducing the depth of penetration. The permanent increase in depth of penetration, resulting from the application and removal of the additional major load is used to calculate the Rockwell hardness number.



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# CHAPTER 13

# CONCLUSION

We conclude the minimum stress developed and good wear resistance material of EN 9 is the best material when compare to other materials by experimentally and analytically method. As a final point we suggest to manufacture the plunger pin in EN 9 material to the organization of BHARANI CNC CENTER

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| ME8693 | HEAT AND MASS TRANSFER | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |

**OBJECTIVES:**

- To understand the mechanisms of heat transfer under steady and transient conditions.
- To understand the concepts of heat transfer through extended surfaces.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer.

(Use of standard HMT data book permitted)

**UNIT I CONDUCTION** **9+6**

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

**UNIT II CONVECTION** **9+6**

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

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

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

**UNIT IV RADIATION** **9+6**

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

**UNIT V MASS TRANSFER** **9+6**

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

**OUTCOMES:** **TOTAL : 75 PERIODS**

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

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

**TEXT BOOKS:**


1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2000
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# INVESTIGATION ON THE THERMAL CONDUCTIVITY AND MECHANICAL PROPERTIES OF ACACIA ARABICA FIBER POLYMER MATRIX COMPOSITE MATERIALS

**A PROJECT REPORT**

***Submitted by***


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

***degreeof***

**BACHELOR OF ENGINEERING**

***IN***

**MECHANICAL ENGINEERING**


**BUILDERS ENGINEERING COLLEGE,**

**KANGAYAM – 638 108**

***ANNA UNIVERSITY: CHENNAI 600 025***


**APRIL 2021**



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**BONAFIDE CERTIFICATE**

Certified that this project report **"INVESTIGATION ON THE THERMAL CONDUCTIVITY OF ACACIA ARABICA FIBRE POLYMER MATRIX COMPOSITE MATERIALS"** is the bonafide work of **HARIHARAN. P (730317114019), JEEVANANTHAM. M (730317114020), KANNAN. K (730317114022), KARTHIKEYAN. M (730317114023)** who carried out the project work undermy supervision.

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Submitted for the Anna university viva-voce held on 06.08.2021 .

**Internal Examiner** **External Examiner**



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## ABSTRACT

Natural fibers have been used to reinforce materials for over 3000 years. More currently they have been employed in combination with plastics. Many types of natural fibers have been investigated for use in plastics including flax, hemp, jute, sisal, acacia and banana. Natural fibers have the advantage that they are renewable resources and have marketing appeal. In our project, Acacia Arabica fibers were selected as the reinforcement and unsaturated polyester resin are used as the matrix. The Acacia Arabica fibers were extracted from bark of Acacia Arabica tree. The hand layup method was used for fabricate the composite plate for 25% volume fraction and 50mm length of fiber. Thermal conductivity test were taken in guarded plate apparatus.

These agricultural wastes can be used to prepare fiber reinforced polymer composites for commercial use. Application of composite materials to structures has presented the need for the engineering analysis the present work focuses on the fabrication of polymer matrix composites by using natural fiber like Acacia which are abundant in nature.




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# CHAPTER-1

## 1.1INTODUCTIONION

The availability of natural fibers is abundance and also they are very inexpensive when compared to other advanced man-made fibers. These natural fibers are used as a suitable reinforcing material environmental concern and they are now emerging as a potential alternative for glass fibers in engineering composites. The natural fibers are used as reinforcements for composite materials due to its various advantages compared to conventional man-made fibers.

The primary advantages of natural fibers are low density, low cost, biodegradability, acceptable specific properties, less wear during processing and low energy consumption during extracting as well as manufacturing composites and wide varieties of natural fibers are locally available. Natural fibers have a few disadvantages when used as reinforcements, such as lower impact strength, higher moisture absorption which leads to dimensional changes thus leading to micro-cracking.

In this the composite material is made of unsaturated polyster resin reinforced with Acacia Arabica fiber. These fibers are taken from the Acacia Arabica tree. With this composite material the thermal conductivity of the Acacia Arabica fiber polymer matrix composite material has can test.

## 1.2COMPOSITES

Fibers or particles embedded in matrix of another material are the best example of modern day composite materials, which are mostly structural. Laminates are composite material where different layers of materials give them the specific character of a composite material having a specific function to perform.



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Fabrics have no matrix to fall back on, but in them, fibers of different compositions combine to give them a specific character. Reinforcing materials generally withstand maximum load and serve the desirable properties.

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# CHAPTER-7

# CONCLUSION

The aim of this project is to fabricate a suitable alternative material for wood products and plastic products which is economically available alternative and should be easy to fabricate.

The natural composite materials are very less in weight compare to other materials like wood, plastics etc. In this project, natural fiber composite materials are fabricated by using polyester resin with different weight ratio and different length of fiber were prepared. Then the thermal conductivity for volume fraction was identified.

When the thermal properties were observed, they were compared with properties like plastics materials, wood and other natural fibers etc. We expect that the experimental values thermal conductivity are more than the other natural fibers that we had mentioned in above literature survey.

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| ME8593 | DESIGN OF MACHINE ELEMENTS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

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

**UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9**

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

**UNIT II SHAFTS AND COUPLINGS 9**

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

**UNIT III TEMPORARY AND PERMANENT JOINTS 9**

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

**UNIT IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9**

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

**UNIT V BEARINGS 9**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

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

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1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
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# DESIGN AND FABRICATION OF WALL PAINTING MACHINE

## PROJECT REPORT

Submitted by


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| **SANJAY M** | **(730317114041)** |
| **SHYAM M** | **(730317114044)** |


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

**of**

**BACHELOR OF ENGINEERING**

**in**

**MECHANICAL ENGINEERING**

**BUILDERS ENGINEERING COLLEGE, KANGAYAM – 638108**

**ANNA UNIVERSITY: CHENNAI 600025**

**APRIL 2021**



PRINCIPAL
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## ANNA UNIVERSITY: CHENNAI 600 025

### BONAFIDE CERTIFICATE

Certified that this project report "**DESIGN AND FABRICATION OF WALL PAINTING MACHINE**" is a bonafide work of "**ARUNKUMAR R (730317114005), KABILESH S (730317114021), SANJAY M (730317114041)** And **SHYAM M (730317114044)**" that carried out the project work under my supervision.

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Internal Examiner 6/8/21

External Examiner



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TN, India.

## ABSTRACT

India is a developing country in all aspects including construction technology. Every individual house or apartments are painted as per the requirement of the customer. For that huge labour is required and they work for long time. To reduce the labor cost and time we designed a machine.

Wall is painted by means of machine in order to reduce human effort and labour cost. The machine usestwo stepper motor in order to move the spray gun both in horizontal and vertical direction. It also has sensorunit and control unit to sense the wall. This can be used to paint the interior of the house.

For controlling we use Arduino mega controller board based on ATmega2560. It has 54 digital input output pins. We are using limit switch to define the end position up to which the spray gun is to travel along the lead screw which guides the tool holder both in horizontal and in vertical direction.

The machine is not complicated and can be easily operated by even an unskilled person. The fabrication of this project is also simple and can be done at low cost. By using this machine panting can be done at faster rate as compared to the manual painting method. As we use a spray gun for painting process the efficiency will be high and good surface finish can be obtained.


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# CHAPTER 1
# INTRODUCTION

The development of service robots became popular recently due to the fact that the society needs robots to relax humans from tedious and dangerous jobs. In Egypt, as well as other developing countries, the increasing population stimulates the construction-related activities such as interior finishing and painting. Painting is classically done by humans and generally requires exhaustive physical efforts and involves exposure to dangerous chemicals. Chemicals can seriously impair the vision, respiratory system and general health of the human painter.

These factors make painting an ideal candidate process for automation. More than 100,000 apartments are built annually in Egypt, with an average painting area of 40 million square meters (based on an average 100 $m^2$ apartment area with 400 $m^2$ painting area). The surface area of painting is more due to the renovation work and expected population increase in the future. This demand imposes challenges that will hardly be met using human painters only in the next decade. Therefore, development of a painting machine that can perform the painting task with minimum human intervention is needed and will improve the quality of painting. The need for an autonomous painting robot is both clear and strong. Automated painting had been realized successfully in the automotive industry to paint millions of cars in the assembly lines. This industry uses spray painting and the robotic system is fixed in the assembly line. The domestic painting robots should be different in the sense that robots should have mobility so that it can move to paint the fixed walls.



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## COMPONENTS USED

First the design for the machine is planned and the following components are used for making the machine.

- Frame
- Leadscrew
- Tool post
- Roller Bearing
- Pillow block bearing
- Arduino mega
- IR sensor
- Limit switch
- Stepper motor
- Arduino mega
- Spray gun

### 1.1 Frame

Frame plays a vital role in wall painting machine as it is the base of the machine which carries the whole structure. The frame is made using a mild steel L cross section rod which makes it strong enough to carry the whole structure. The wheels are attached to the bottom of the frame with help of bearing which makes it possible to move along the floor.



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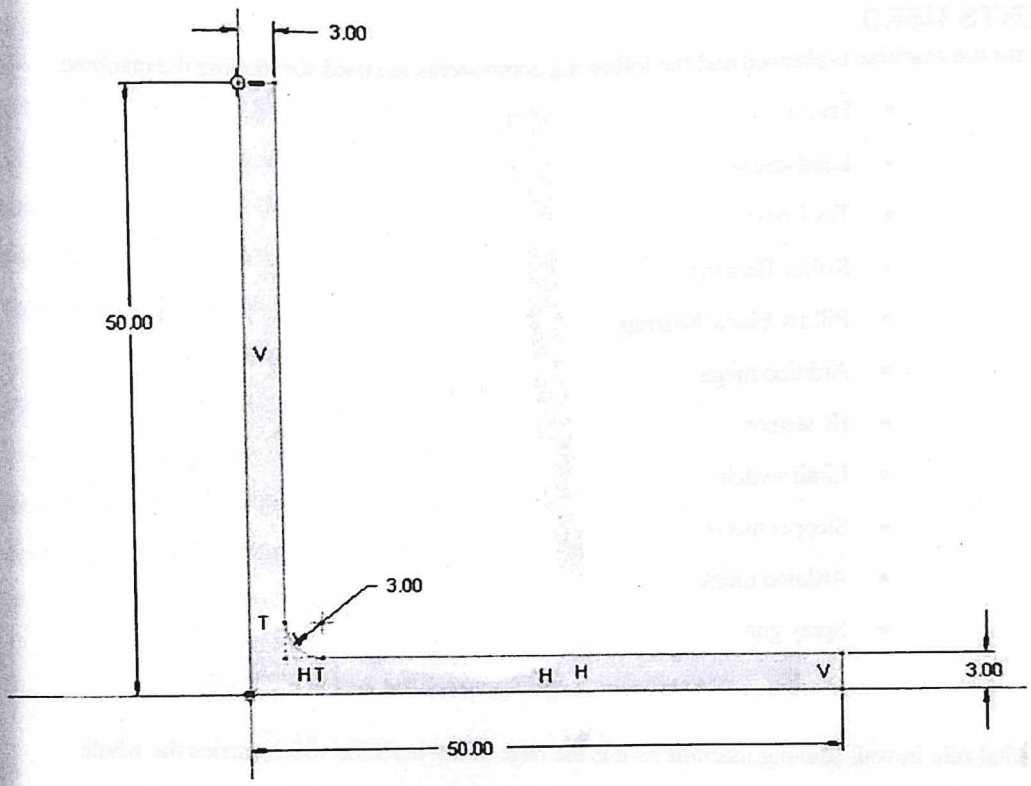



Fig no1.1- Frame cross section

Steel frame is built in a customized shape in order to support the tool post by means of support rod and leadscrew which is moved along the horizontal direction. The tool holder is placed inside the tool post



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Fig 1.2-Frame

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## 1.2 LEAD SCREW

A lead screw, also known as a power screw or translation screw, is a screw used as a linkage in a machine, to translate turning motion into linear motion. Because of the large area of sliding contact between their male and female members, screw threads have larger frictional energy losses compared to other linkages. They are not typically used to carry high power, but more for intermittent use in low power actuator and positioner mechanisms. Leadscrews are commonly used in linear actuators, machine slides such as in machine tools, vises, presses, and jacks. Leadscrews are a common component in electric linear actuators.

Leadscrews are manufactured in the same way as other thread forms they may be rolled, cut, or ground.

A lead screw is sometimes used with a split nut also called half nut which allows the nut to be disengaged from the threads and moved axially, independently of the screw's rotation, when needed such as in single-point threading on a manual lathe. A split nut can also be used to compensate for wear by compressing the parts of the nut.



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Fig 2 -lead screw

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## 1.3 TOOL POST

The tool post is the supporting member for to tool holder. It is driven by the stepper motor in horizontal direction. We have used mild steel square section rod of thickness 2mm.

The tool post has another lead screw at the center to drive the spray gun in the vertical direction.

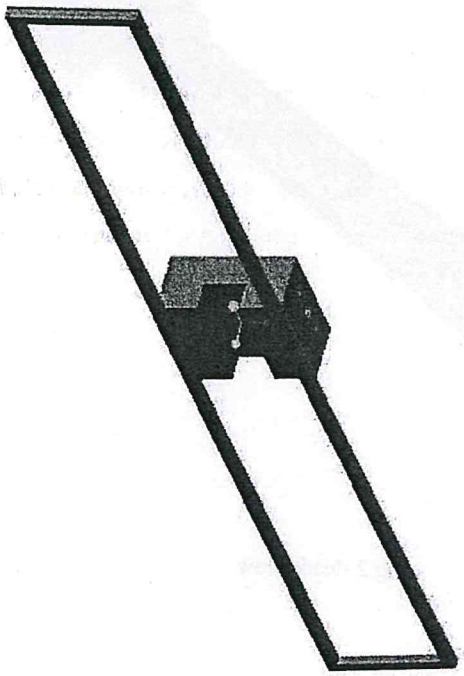


Fig 3 –Tool post



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## 1.4 ROLLER BEARING

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts.

Rotary bearings hold rotating components such as shafts or axles within mechanical systems, and transfer axial and radial loads from the source of the load to the structure supporting it. The simplest form of bearing, the plain bearing, consists of a shaft rotating in a hole. A wide variety of bearing designs exists to allow the demands of the application to be correctly met for maximum efficiency, reliability, durability and performance.

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# CHAPTER 6

# CONCLUSION

The wall painting machine was designed and fabricated. This machine is found to be effective in painting interior wall. The spray gun is to be given a separate connection during the operation. The painting is done on the linear manner in both horizontal and vertical direction.

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**ME8351** **MANUFACTURING TECHNOLOGY – I** **L T P C**
**3 0 0 3**

**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:**

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

**TEXT BOOKS:**

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008

2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2013

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**REFERENCES:**


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

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| | | L | T | P | C |
|---|---|---|---|---|---|
| PH8251 | **MATERIALS SCIENCE**<br>(Common to courses offered in Faculty of Mechanical Engineering<br>Except B.E. Materials Science and Engineering ) | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

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

**UNIT I PHASE DIAGRAMS** 9

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

**UNIT II FERROUS ALLOYS** 9

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

**UNIT III MECHANICAL PROPERTIES** 9

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

**UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS** 9

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

**UNIT V NEW MATERIALS** 9

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

**OUTCOMES:** **TOTAL : 45 PERIODS**

Upon completion of this course,

- the students will have knowledge on the various phase diagrams and their applications
- the students will acquire knowledge on Fe-$Fe_3C$ phase diagram,various microstructures and alloys
- the students will get knowledge on mechanical properties of materials and their measurement
- the students will gain knowledge on magnetic, dielectric and superconducting properties of materials
- the students will understand the basics of ceramics, composites and nanomaterials.

**TEXT BOOKS:**


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


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1. Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010.
2. Smith, W.F., Hashemi, J. & Prakash, R. "Materials Science and Engineering". Tata McGraw Hill Education Pvt. Ltd., 2014.
3. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.




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# TESTING IN CHASSIS MATERIAL AND WELDING PROCESS FOR E VEHICLE

## A PROJECT REPORT

*Submitted by*


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| MAHANIDHISAKTHIVEL B | (730317114028) |
| NIRMALKUMAR J | (730317114306) |


*in partial fulfilment for the award of the degree*

*of*

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINERING**

**BUILDERS ENGINEERING COLLEGE, KANGAYAM**

**ANNA UNIVERSITY::CHENNAI 600 025**

**APRIL 2021**



PRINCIPAL
BUILDERS ENGINEERING COLLEGE
Kangayam

## ANNA UNIVERSITY : CHENNAI:600 025

### BONAFIDE CERTIFICATE

Certified that this project report **"TESTING IN CHASSIS MATERIAL AND WELDING PROCESSFOR E VEHICLE"** is the bonafide work of **"BALAKUMAR V (730317114006) GOKULNATH M (730317114016) MAHANIDHISAKTHIVEL B (730317114028) NIRMALKUMAR J (730317114306)"**, Who have carried out this project under my supervision.

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Submitted for the project viva voice held on ..06.:08.:2021.....

**INTERNALEXAMINAR** 6/8/21

**EXTERNALEXAMINER**



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## ABSTRACT

Electric vehicle drives offer a number of advantages over conventional internal combustion engines, especially in terms of lower local emissions, higher energy efficiency, and decreased dependency upon oil. Yet there are significant barriers to the rapid adoption of electric cars, including the limitations of battery technology, high purchase costs, and the lack of recharging infrastructure. With intelligently controlled charging operations, the energy needs of potential electric vehicle fleets could be covered by existing German power plants without incurring large price fluctuations. Over the long term, electric vehicles could represent a sustainable technology path. In the short to mid-term, however, exceedingly optimistic expectations should be avoided, especially with respect to the reduction of greenhouse gas emissions. Electric vehicles as such will not be able to solve all current problems of transportation policy. Yet they may constitute an important component of a larger roadmap for sustainable transportation.

In 21st century, Electric vehicle (EV) as a green transportation tool, EV has won great attention from researchers, leading to a series of intensive and extensive studies. With the development of high-storage battery and EV, the number of the EV will rise dramatically, so that the random charging and discharging behavior will bring new challenges to safe and stable operation of power grids. The paper introduces briefly some aspect of EV, including studies on the government policies, charging methods, key techniques, impacts of charging, and solutions to the related issues. Based on the current development status and problems, discuss the trend of EV.




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# CHAPTER 1

## 1.1 INTRODUCTION

The automotive chassis is tasked it holding all the components together while driving, and transferring vertical and lateral loads, caused by accelerations, on the chassis through the wheels,Most engineering student will have an understanding of forces and torques long before they read this .some people stress full with material choice but once you are familiar with this it is the key to a good space frame .while this will make the design section of the book will talk more about these item.

The chassis takes a load of the operator, engine, brake systemfuel, system and steering mechanism, so chassis should have adequate strength to protect the operator in the event of an impact. the driver cabin must have the capacity to resist all the forces exerted upon it. This can be achieved either by using high strength material or better cross section against the load applied load .but the most feasible way to balance the dry mass of chassis with the optimum number of longitudinal and lateral member

The chassis must be constructed of steel tubing with minimum dimensional and strength requirements dictated by ISNEE. The NGK Cvehicle development manual also restricts us about the vehicle weight. shape, size, and dimensions.

Circular cross-section is employed for the chassis development as it helps to overcome difficulties as increment in dimension, rise, in the overall weight and decrease in performance due to reduction in acceleration. circular section is a preferred over other cross section become it resist the twisting effects. Circular section is selected for torsional rigidity.



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## 1.2 OBJECTIVES OF CHASSIS ARE

- Provide full protection of the driver, by obtaining required strength and torsional rigidity ,while reducing weight through diligent tubing selection
- Design for manufacturability,as well as cost reduction ,to ensure both material and manufacturing costs are competitive with with other E –vechicle
- Improve drive comfort by providing more lateral space in the driver compartment
- Maintain ease of serviceability by ensuring that chassis members do not interfere with other subsystem

This study attempted to analyze stress on the chassis design using finite element analysis. This is important because the simulation data are useful for further design improvement and subsequently leads to cost effectiveness.

A typical dictionary definition of chassis usually includes terms such as framework on which body or working parts of a vechicle, radio or television are built. There are three basic design used today :frame, unit body, and space frame construction.



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## 1.3 FRAME CONSTRUCTION

The frame construction usually consists of channel-shaped steel beams welded and fastened. The frame of vehicle will supportsll the running gear mounted on it. It also including the engine, transmission, rear axle assembly, and all the suspension components .the type of frame construction that is referred to as full frame, is so complete that most vehicle are as follow:

### 1.3.1 LADDER FRAME

This type of frame is common for the type of perimeter frame where the transversely connected members are straight across. The frame resembled a ladder frame of common vehicle.

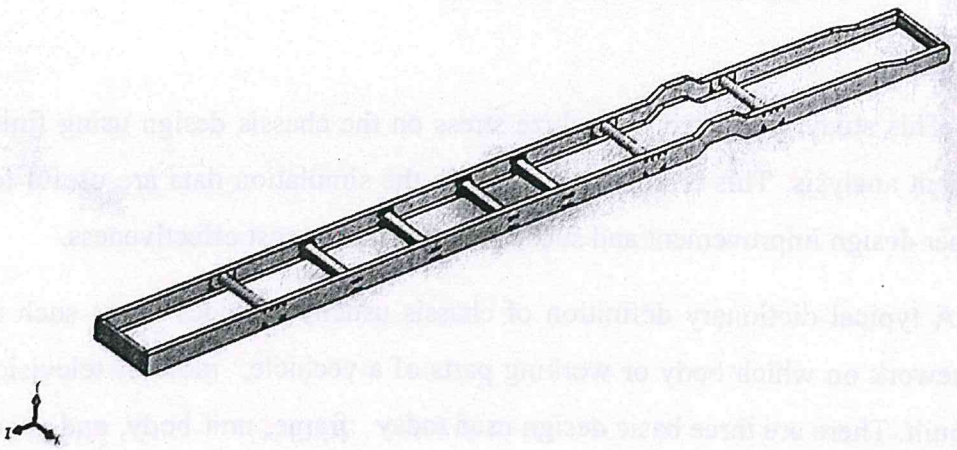


**FIGURE1.1 LADDER FRAME OF COMMON VEHICLE**

(source from automotive chassis system)

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Perimeter frame This type of frame consists of welded or riveted frame members around the entire perimeter of the body as shown fig1.2. The frame members will provide support underneath the side as well as for the suspension component.

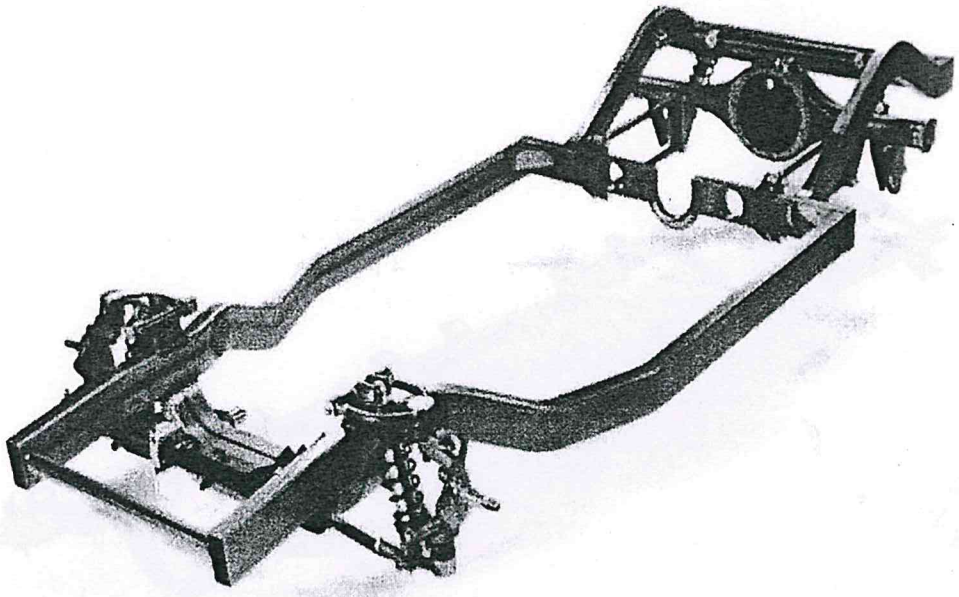


**FIG1.2 PERIMETER FRAME OF COMMON VEHICLE**

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### 1.1.3 STUB –TYPE

Frame stub-type is a partial frame often used on unit-body vechicle, a type of vehicle construction, first used by the budd company of troy, Michigan ,that does not use a separate frame. The body is built strong enough to support the engine and the power train, as well as the suspension and steering system .the outside body panels are part of the structure to support the power train and suspension components. It is called cradle.

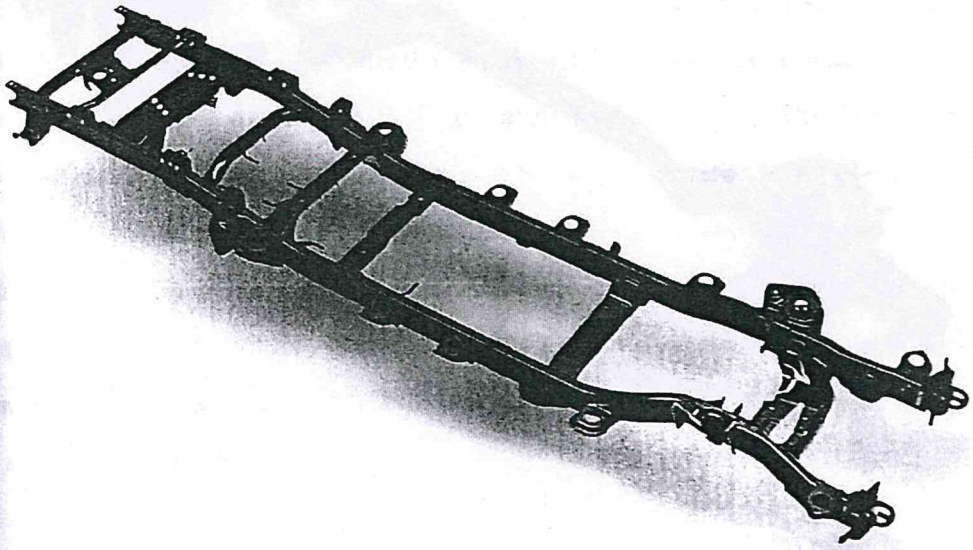


Fig 1.3 stub tube frame of common vehicle.

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## 1.1.4 UNIT BODY CONSTRUCTION

A type of body/frame construction in which the body of the vehicle, its floor plan and chassis form a single structure. Such a design is generally lighter and more rigid than a vehicle having a separate body and frame.

Vehicle structure has shifted from the traditional body - on - frame architecture to the lighter unitized / integrated body structure that is now used for most cars.

Integral frame and body construction requires more than simply welding an unstressed body to a conventional frame. In a fully integrated body structure, the entire car is a load-carrying unit that handles all the loads experienced by the vehicle – forces from driving as well as cargo loads. Integral-type bodies for wheeled vehicles are typically manufactured by welding preformed metal panels and other components together by forming or casting whole sections as one piece, or by a combination of these techniques. Although this is sometimes also referred to as a monocoque structure, because the car's outer skin and panels are made load-bearing, there are still ribs, bulkheads, and box sections to reinforce the body, making the description semi-Monocoque more appropriate



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# CHAPTER-10

## CONCLUSION

Static analysis using finite element method was successfully carried out to determine maximum deflection and its location on chassis structure. The results of analysis revealed that the location of maximum deflection agrees well with theoretical maximum location of simple beam. This study found out that there is discrepancy between the theoretical (2-D) and numerical (ANALYSIS) results.

When comparing the displacement value of three types of chassis (chassis1, modification chassis 1, modification chassis 2),the chassis with minimum displacement value is consider to be safe.

While consider front impact test , rear impact, side impact test(left and right), the modification chassis 1 hold the minimum displacement value than the chassis1, and modified chassis 2 holds the minimum displacement value that the other two for front impact test and modified chassis 1 holds the minimum displacement value for rear and side impact test, therefore, the modified chassis 1 is the best chassis among the three of chassis analyzed using CATIA software

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**ME8651** **DESIGN OF TRANSMISSION SYSTEMS** **L T P C**
**3 0 0 3**

**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 PSG 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 the completion of this course the students will be able to**

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

**TEXT BOOKS:**

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

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2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4thEdition,Wiley, 2005
5. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

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**ME8492** **KINEMATICS OF MACHINERY** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I** **BASICS OF MECHANISMS** **9**

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

**UNIT II** **KINEMATICS OF LINKAGE MECHANISMS** **9**

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

**UNIT III** **KINEMATICS OF CAM MECHANISMS** **9**

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

**UNIT IV** **GEARS AND GEAR TRAINS** **9**

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

**UNIT V** **FRICTION IN MACHINE ELEMENTS** **9**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of this course, the students can able to

CO1 Discuss the basics of mechanism
CO2 Calculate velocity and acceleration in simple mechanisms
CO3 Develop CAM profiles
CO4 Solve problems on gears and gear trains
CO5Examine friction in machine elements

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5. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.

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# DESIGN AND ANALYSIS OF E- VEHICLE ANATOMY

**A PROJECT REPORT**

*Submitted by*


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*of*

**BACHELOR OFENGINEERING**

*in*

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# INTODUCTION

- This vehicle model was made on the actual model and its technical documentation.
- Aerodynamics represents a special scientific field that has a huge impact on modern automotive engineering.
- Vehicle design in this context is primarily concerned with developing the visual appearance or aesthetics of the vehicle, through it is involved in the creation of the product concept.
- Electric Vehicles (EVs), compared to classic internal combustion engine (ICE) vehicles, are fairly simple and easy to operate.
- The simplest power train architecture consists in a high voltage battery, an electric motor with power electronics controller and a single speed gearbox.
- EVs are also called pure electric vehicle
- Battery electric vehicle are increasing their market share because they are the most viable way towards a clean and efficient transport system.
- Design is the process of developing the appearance, and to some extent the ergonomics.
- Design as a professional vocation is practiced by designers who may have an art background and a degree in industrial design or transportation design.
- Automotive design in this context is primarily concerned with developing the visual appearance or aesthetics of the vehicle, though it is also involved in the creation of the product concept.
- The functional design and development of a modern motor vehicle is typically done by a large team from many different disciplines included within automotive engineering, however, design roles are not associated with requirements for Professional or Chartered-Engineer qualifications.



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- The design focuses not only on the isolated outer shape of automobile parts, but concentrates on the combination of form and function, starting from the vehicle package.
- The aesthetic value will need to correspond to ergonomic functionality and utility features as well.
- The design team(s) responsible for the exterior of the vehicle develops the proportions, shape, and surface details of the vehicle.
- Exterior design is first done by a series of manual sketches and digital drawings.
- Consumer feedback is generally sought at this point to help iteratively refine vehicle concepts according to the targeted market and will continue throughout the rest of the design refinement process.
- After more progressive refinement, industrial plasticine and or digital models are developed from and along with the drawings and images.
- The sketches and rendering are transformed into 3D Digital surface modeling and rendering for real-time evaluation with Math data in initial stages.
- During the development process succeeding phases will require the 3D model fully developed to meet the aesthetic requirements of a designer and well as all engineering and manufacturing requirements.
- Aesthetics of E-vehicles can be quite different from what we see today in fuel cars or hybrid vehicles to depict the uniqueness of this breed of products.

## 1.1 OBJECTIVE OF WORK

The introduction of better material, design optimization and better manufacturing processes can cause new design of vehicle.

1) Static analysis of standard ASIS1008 carbon Steel E-vehicle anatomy using FEA. Finding out the deflection and bending stress for the same.



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2) Comparison of the results of standard Steel E-vehicle anatomy.

3) Validation of results by theoretical calculations

The aim of this paper is to represent a study on the design, analysis of E-vehicle anatomy.The main objective of having this new design is to improve quality and increase the overall E-vehicle anatomy.

The present study describes design and comparative analysis of E-vehicle anatomy. The modelling of the E-vehicle anatomyhas been done in commercially used FEM software ANSYS 14.0, and for finite element analysis the model was imported in the Static Structural analysis and Harmonic Response workbench of ANSYS 14.0. The Materials used for the E-vehicle anatomyis A588 mild Steel. Harmonic analysis for vibrations due to road irregularity is carried out for all the materials. von-Mises stress and deformation is the output parameters in static structural analysis.

## 1.2 PROJECT ENHANCEMENT

Aesthetics of E-vehicles can be quite different from what we see today in fuel cars or hybrid vehicles to depict the uniqueness of this breed of products.

Only using the scrab materials to build a anatomy.Three dimensional models of leaf spring are prepared in PRO E. Static structural analysis of leaf spring models is performed in ANSYS 15

## 1.3 HISTORY OF E-VEHICLE

Electric vehicles first appeared in the mid-19th century. An electric vehicle held the vehicular land speed record until around 1900. The high cost, low top speed, and short-range of battery electric vehicles, compared to 20th century internal combustion engine vehicles, led to a worldwide decline in their use as private motor vehicles; although electric vehicles have continued to be used in the form of loading and freight equipment and public transport –



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especially rail vehicles. At the beginning of the 21st century, interest in electric and other alternative fuel vehicles in private motor vehicles has increased due to growing concern over the problems associated with hydrocarbon-fueled vehicles, including damage to the environment caused by their emissions, and the sustainability of the current hydrocarbon-based transportation infrastructure as well as improvements in electric vehicle technology.

### 1.3.1 Electric model cars

The invention of the first model electric vehicle is attributed to various people. In 1828, Ányos Jedlik invented an early type of electric motor, and created a small model car powered by his new motor.

Between 1832 and 1839, Scottish inventor Robert Anderson also invented a crude electric carriage. In 1835, Professor Sibrand us Stratingh of Groningen, the Netherlands and his assistant Christopher Becker from Germany also created a small-scale electric car, powered by non-rechargeable primary cells.

### 1.3.2 First practical electric cars

Rechargeable batteries that provided a viable means for storing electricity on board a vehicle did not come into being until 1859, with the invention of the lead–acid battery by French physicist Gaston Planet.

Camille Alphonse Faure, another French scientist, significantly improved the design of the battery in 1881; his improvements greatly increased the capacity of such batteries and led directly to their manufacture on an industrial scale



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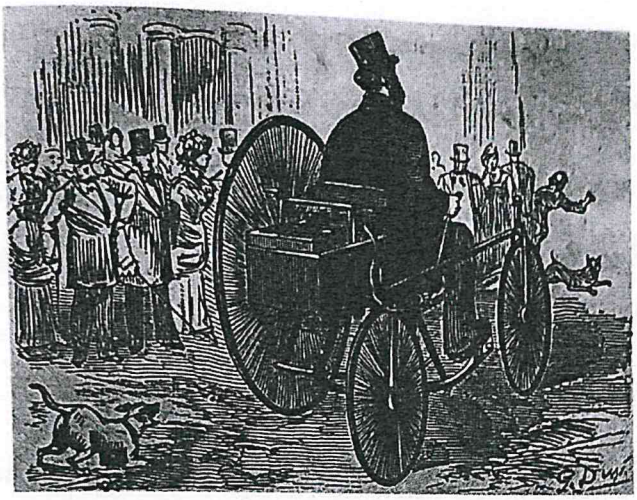


**Figure 1.1:** Gustave Trouvé's tricycle (1881), world's first electric car

### 1.3.3 Power as a service and General Vehicle

To overcome the limited operating range of electric vehicles, and the lack of recharging infrastructure, an exchangeable battery service was first proposed as early as 1896.The concept was first put into practice by Hartford Electric Light Company through the GeVeCo battery service and initially available for electric trucks. The vehicle owner purchased the vehicle from General Vehicle Company (GVC, a subsidiary of the General Electric Company) without a battery and the electricity was purchased from Hartford Electric through an exchangeable battery.

The owner paid a variable per-mile charge and a monthly service fee to cover the maintenance and storage of the truck. Both vehicles and batteries were modified to facilitate a fast battery exchange. The service was provided between 1910 and 1924 and during that period covered more than 6 million miles.

Beginning in 1917 a similar successful service was operated in Chicago for owners of Milburn Wagon Company cars who also could buy the vehicle without the batteries.

In New York City, in the pre-World War I era, ten electric vehicle companies banded together to form the New York Electric Vehicle Association. The association included



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manufacturers and dealers, among them General Motors' truck division, and the aforementioned General Vehicle division of General Electric, which claimed to have almost 2,000 operating vehicles in the metropolitan region. When opening their flagship department store, Lord and Taylor boasted of its electric vehicle fleet – numbering 38 trucks – and the conveyor system to efficiently load and unload goods.

### 1.3.4 1920s–1950s

After enjoying success at the beginning of the 20th century, the electric car began to lose its position in the automobile market. A number of developments contributed to this situation. By the 1920s an improved road infrastructure improved travel times, creating a need for vehicles with a greater range than that offered by electric cars.

Worldwide discoveries of large petroleum reserves led to the wide availability of affordable gasoline, making gas-powered cars cheaper to operate over long distances.

Electric cars were limited to urban use by their slow speed (no more than 24–32 km/h or 15–20 mph) and low range (50–65 km or 30–40 miles), and gasoline cars were now able to travel farther and faster than equivalent electrics.

### Power as a service and General Vehicle

To overcome the limited operating range of electric vehicles, and the lack of recharging infrastructure, an exchangeable battery service was first proposed as early as 1896.The concept was first put into practice by Hartford Electric Light Company through the GeVeCo battery service and initially available for electric trucks. The vehicle owner purchased the vehicle from General Vehicle Company (GVC, a subsidiary of the General Electric Company) without a battery and the electricity was purchased from Hartford Electric through an exchangeable battery.

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**Figure 1.2**

Electric vehicle TAMA, produced by Tachikawa Aircraft Company in 1947. Mechanical Engineering Heritage (Japan)

### 1.3.51960s–1990s: Revival of interest

In 1959, American Motors Corporation (AMC) and Sono tone Corporation announced a joint research effort to consider producing an electric car powered by a "self-charging" battery.



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AMC had a reputation for innovation in economical cars while Sonotone had technology for making sintered plate nickel-cadmium batteries that could be recharged rapidly and weighed less than traditional lead-acid versions. That same year, Nu-Way Industries showed an experimental electric car with a one-piece plastic body that was to begin production in early 1960.

In the mid1960s a few battery-electric concept cars appeared, such as the Scottish Aviation Scamp (1965), and an electric version of General Motors gasoline car, the Electrovair (1966). None of them entered production. The 1973 Enfield 8000 did make it into small-scale production, 112 were eventually produced.In 1967, AMC partnered with Gulton Industries to develop a new battery based on lithium and a speed controller designed by Victor Wouk. A nickel-cadmium battery supplied power to an all-electric 1969 Rambler American station wagon. Other "plug-in" experimental AMC vehicles developed with Gulton included the Amitron (1967) and the similar Electron (1977).

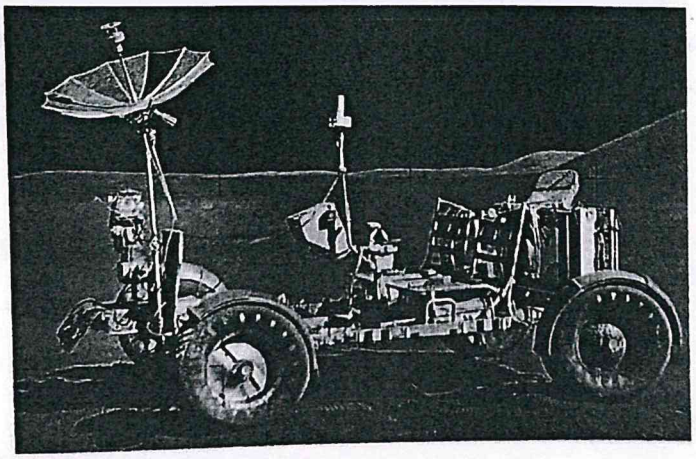


**Figure 1.3:** Three Lunar Roving Vehicles are currently parked on the Moon 2000s: Modern highway-capable electric cars



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# 7.CONCLUSION

We conclude the topic of design and analysis of e-vehicle anatomy did by the Creo modelling.Analyzing results for E-vehicle anatomy under force are listed in the Table. Analysis has been carried out by ASIS1008 carbon steel.

The results such as total deformation, equivalent elastic strain and equivalent stress for each material are determined. Comparing the optimized materials and the conventional materialASIS1008 carbon steel material has the low values of total deformation and strain. Hence it is concluded that ASIS1008 carbon steel material can be used for the E- vehicle anatomy. The project carried out by us will make an impressing mark in the field of automobile. While carrying out this project we are able to study about the 3Dmodelling software (PRO-E) and Study about the analyzing software (Ansys) to develop our basic knowledge to know about the industrial design.



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**OBJECTIVES:**

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

**UNIT I INTRODUCTION** **9**

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

**UNIT II ONE-DIMENSIONAL PROBLEMS** **9**

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

**UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS** **9**

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

**UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS** **9**

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

**UNIT V ISOPARAMETRIC FORMULATION** **9**

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

**TOTAL : 45 PERIODS**

**OUTCOMES**

CO1 Summarize the basics of finite element formulation.

CO2 Apply finite element formulations to solve one dimensional Problems.
CO3 Apply finite element formulations to solve two dimensional scalar Problems.
CO4 Apply finite element method to solve two dimensional Vector problems.
CO5 Apply finite element method to solve problems on iso parametric element and dynamic Problems.

**TEXT BOOKS:**


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# ANALYSIS ON CHASSIS FOR E-VEHICLE USING ANSYS SOFTWARE

## A PROJECT REPORT

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*in partial fulfilment for the award of the degree*

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**in**

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**APRIL 2021**



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**BONAFIDE CERTIFICATE**

Certified that this project report **"ANALYSIS IN THE SUSPENSION SYSTEM OF ELECTRIC VEHICLE USING ANSYS SOFTWARE"** is the bonafide work of **RAMESHPANDIAN M (730317114038),RANJITH KUMAR (730317114039), NAVEEN C (730317114205), SANKAR M (730316114207)** who carried out the project work under my supervision.

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**Internal Examiner**

**External Examiner**

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# ABSTRACT

Chassis consists of an internal vehicle frame that supports a manmade object in its construction and use. An example of a chassis is the under part of a motor vehicle, consisting of the frame on which the body is mounted. If the running gear such as wheels and transmission, and sometimes even the driver's seat, are included, then the assembly is described as a rolling chassis. Car chassis is a major component in a vehicle. In car chassis different type of failures are occur due to static loading condition. In this present work static load characteristics are analyzed using FE models from this work. It is found that identifying location of high stress area, displacement and strain. Modal updating of car chassis model will be done by adjusting the selective properties such as different materials. Thus modeling of a car chassis is done in solid works 2016 software and analysis is carried out in ansys 14.5 work bench

The first part of this paper deals with the structural analysis of automobile frame and design modification to reduce weight of the chassis, the second part is the study of rolling over effect and the multiple axle drives with active bogies for chassis levelling and the final part is the implementation of the active bogies and multiple axle drives for the prevention of rolling over. A method has been suggested to overcome the rolling over by design modification of the chassis. Active weights are used in order to prevent the rolling over of a vehicle.

# CHAPTER 1

# INTRODUCTION

## 1.1 Chassis and Frame

Many composite materials offer a combination of strength and comparable to or better than any traditional metallic metals,because of their low specific gravities, the strength to weight-ratio and modulus to weight ratio of these composite materials are markedly superior to the fatigue strength weight ratio as well as fatigue damage tolerances of many composite laminates are excellent. For these reasons, fiber composite have emerged as a major class of structural material and are either used or being considered as substitutions for metal in critical components in aerospace, automotive and other industries. High damping capacity of composite materials can be beneficial in many automotive applications in which noise, vibration, and hardness is a critical issue for In the present work, the pertinent information of an existing heavy vehicle chassis is design and analysis with different cross sections for different materials like steel. The model of steel and polymeric composite heavy vehicle E and analysed with ANSYS for same load conditions. After analysis a comparison is made conventional steel chassis and terms of deflections and stresses, to select the best one.

Automotive chassis is a skeletal frame on which mechanical parts like engine, axle assemblies, brakes, steering etc, are fastened. Automotive chassis or automobile chassis helps to keep an automobile rigid, stiff and unbending. Chassis ensures low levels of noise, vibrations and harshness throughout the automobile. The chassis is considered to be the most significant component of an automobile. It is the most crucial element that gives strength and stability to the vehicle under different conditions. The backbone of any automobile. It is the supporting frame to which the body of an engine, axle assemblies are affixed. Tie bars are essential parts of



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automotive frames, are fasteners that bind different auto parts together. Automotive frames are basically manufactured from steel. It is usually made of a steel frame, which holds the body and engine of an automotive vehicle. It provide needed for supporting vehicular components and payload placed upon it. At the time of manufacturing, the body of a vehicle is flexibly molded according to the structure of chassis. It provides strength needed for supporting vehicular components and payload placed upon it. Automobile chassis is usually made of light sheet metal. Paper describes the design and analysis of heavy vehicle chassis considering weight reduction as the prime objective of any automobile industries in today's fast changing world.

Chassis refers to the lower body of the vehicle including the tires, engine, frame, driveline and suspension. Out of these, the frame provides necessary support to the vehicle components placed on it. Also the frame should be strong enough to withstand shock, twist, vibrations and other stresses. The chassis frame consists of side members attached with a series of cross members Stress analysis using Finite Element Method (FEM) can be used to locate the critical point which has the highest stress. This critical point is one of the factors that may cause the fatigue failure. The magnitude of the stress can be used to predict the life span of the truck chassis.The accuracy of prediction life of truck chassis is depending on the result of its stress analysis.

## 1.2 LAYOUT OF CHASSIS AND ITS MAIN COMPONENTS:

The following main components of the Chassis are

1. Frame: it is made up of long two members called side members riveted together with the help of number of cross members.
2. Engine or Power plant: It provides the source of power
3. Clutch: It connects and disconnects the power from the engine fly wheel to the transmission system.



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4. Gear Box 2 Automobile Chassis And Body Engineering.doc Chapter 1
5. U Joint
6. Propeller Shaft
7. Differential

## 1.3 FUNCTIONS OF THE CHASSIS FRAME:

1. To carry load of the passengers or goods carried in the body
2. To support the load of the body, engine, gear box etc.,
3. To withstand the forces caused due to the sudden braking or acceleration
4. To withstand the stresses caused due to the bad road condition
5. To withstand centrifugal force while cornering

## 1.4 TYPES OF CHASSIS FRAMES:

There are three types of frames

1. Ladder chassis
2. Monocoque Chassis
3. Back bone chassis

### 1.4.1.Ladder frame:

- It has two long side members and 5 to 6 cross members joined together with the help of rivets and bolts.
- This is considered to be one of the oldest forms of automatic chassis and used by the most of the SUV's till today.
- As its name ladder chassis resembles a shape of a ladder two longitudinal rails inter linked by several lateral and cross braces.

The lateral and cross members provides rigidity to the structure



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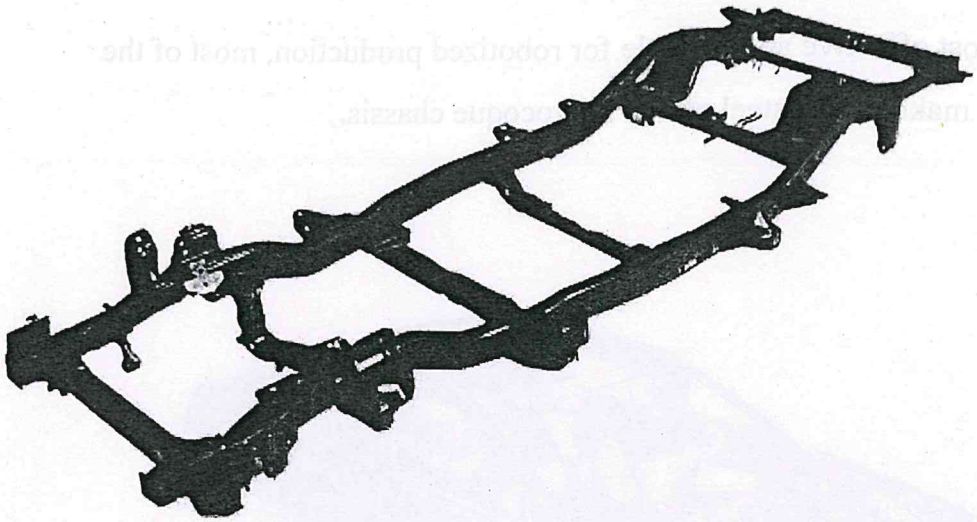


Fig 1.1 . Ladder chassis

**Advantages:**

- It has no much advantage these days.
- Easy and cheap for hand built.

**Disadvantage**

- Since two dimensional structure.
- Torsional rigidity is much lower than other chassis especially with veritical loads or bumps.

**Applications:**

- Most SUVs,classic cars,heavy duty,bus trucks .

**1.4.2.Monocoque :**

- This is a one-piece structure that prescribes the overall shape of a vehicle.



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- This type of chassis is manufactured by welding floor pan and other pieces together.
- Since this is cost effective and suitable for robotized production, most of the vehicles today make use of steel plated monocoque chassis.

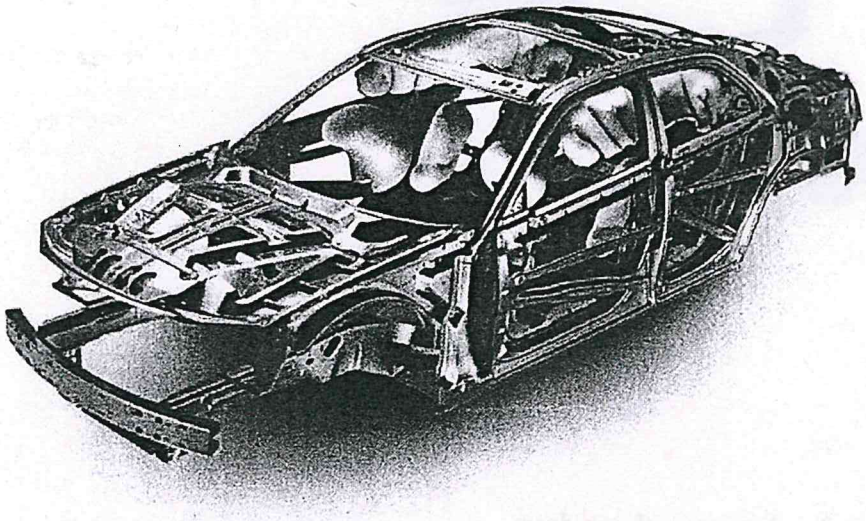


Fig 1.2. Monocoque Chassis

**Advantages:**

- Inherently good crash protection.
- It is space efficient and chaep for mass production..

**Disadvantages:**

- Heavy loaded vehicle,impossible for small volume production.



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**Applications:**

- Nearly all mass production trucks and Heavy loaded vehicle.

### 1.4.3.Backbone chassis:

- It has a rectangular tube like backbone, usually made up of glass fibre that is used for joining front and rear axle together.
- This type of chassis is strong and powerful enough to provide support smaller sports car.
- This is easy to make and cost effective

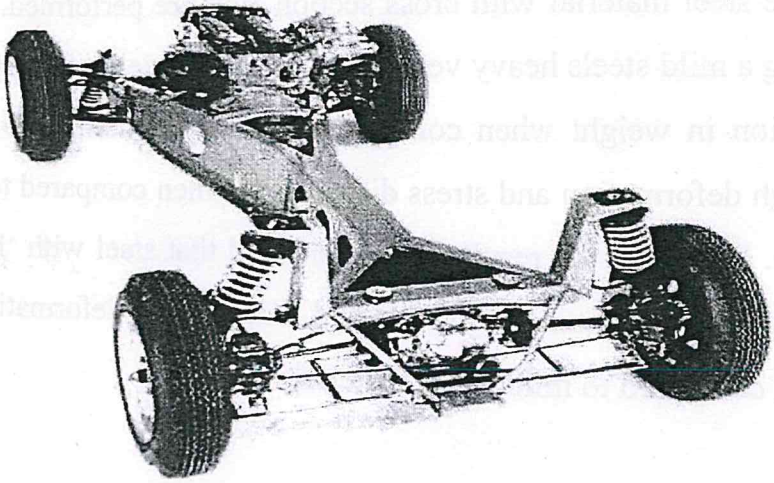


Fig 1.3 Backbone chassis

**Advantages:**

- Strong enough for smaller sports cars.
- The most space saving other than monocoque chassis.

**Disadvantages:**

- Does not provide protection against side impact or off-set crash.



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# CHAPTER 8

## CONCLUSION

The existing heavy vehicle chassis is considered for design and analysis with different cross sections for different materials like mild steels performed. The model of the chassis was created in cero and analysed with ANSYS software. After analysis a comparison is made between existing conventional steel chassis and mild steel composite materials in terms of deformation and stresses, to select the best one. The results of the steel material with cross section Box are performed. It is inferred that by employing a mild steels heavy vehicle chassis for same load carrying capacity, there is a reduction in weight when compared to steel but main downside is mild steels induces high deformation and stress distribution when compared to steel except in 'BOX' section. Based on the results it was inferred that steel with 'BOX' section has superior strength to withstand high load and induced low deformation and stress distribution when compared to mild steels material.



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**BE8253 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING** **L T P C 3 0 0 3**

**OBJECTIVES:**

To impart knowledge on

- Electric circuit laws, single and three phase circuits and wiring
- Working principles of Electrical Machines
- Working principle of Various electronic devices and measuring instruments

**UNIT I ELECTRICAL CIRCUITS** **9**

Basic circuit components -, Ohms Law - Kirchoff's Law – Instantaneous Power – Inductors - Capacitors – Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis- Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem- Linearity and Superposition Theorem.

**UNIT II AC CIRCUITS** **9**

Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits – Three phase loads - housing wiring, industrial wiring, materials of wiring

**UNIT III ELECTRICAL MACHINES** **9**

Principles of operation and characteristics of ; DC machines, Transformers (single and three phase ) ,Synchronous machines , three phase and single phase induction motors.

**UNIT IV ELECTRONIC DEVICES & CIRCUITS** **9**

Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias –Semiconductor Diodes –Bipolar Junction Transistor – Characteristics – Field Effect Transistors – Transistor Biasing –Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier –DAC – ADC .

**UNIT V MEASUREMENTS & INSTRUMENTATION** **9**

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - ,Classification of instruments - Types of indicating Instruments - multimeters –Oscilloscopes- – three-phase power measurements – instrument transformers (CT and PT )

**TOTAL : 45 PERIODS**

**OUTCOMES:**

Ability to

- Understand electric circuits and working principles of electrical machines
- Understand the concepts of various electronic devices
- Choose appropriate instruments for electrical measurement for a specific application

**TEXT BOOKS**


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# COMPUTATION FOR THE SELECTION OF ELECTRIC MOTOR WITH BATTERY SET UP TO TRANSMITTE POWER FOR E-VEHICLE

A PROJECT REPORT

*Submitted by*


| | |
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*In partial fulfillment for the award of the degree*

*Of*

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

BUILDERS ENGINEERING COLLEGE, KANGAYAM -638108

ANNA UNIVERSITY : CHENNAI 600 025

APRIL 2021




PRINCIPAL
BUILDERS ENGINEERING COLLEGE
Kangayam-638 108,TN, India.

# ANNA UNIVERSITY: CHENNAI 600 025

## BONAFIDE CERTIFICATE

Certified that this project report "**COMPUTATION FOR THE SELECTION OF ELECTRIC MOTOR WITH BATTERY SET UP TO TRANSMITTE POWER FOR E-VEHICLE**" is the bonafide word of **GOKUL.S (730317114015),KAVINKUMAR.P(730317114024), MANOJ.R(730317114029),VIGNESH.V (730317114056)** who carried out the project work under my supervision

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Submitted for the Anna university viva-voce held on .06.08.2021

**Internal Examiner** 6/8/21

**External Examiner**



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# ABSTRACT

This paper proposes a design for a multi-speed transmission for electric vehicles (EVs).In the present scenario, current electricvehicle manufacturers have deviated from the inclusion of multi-speed transmission systems from their vehicles, keeping in mind the additional bulk, complexity and cost that it adds. But considering the characteristics of an electric motor various modifications (making the system clutch-less and limiting the gear selection to 3-speed) can be made to make the conventionaltransmission systems suitable for electric vehicles, as multi-speed transmission systems do promise to provide reduced energy consumption and increased efficiency for EVs, hence increasing the "range" of the EV. Also, the benefits of downsizing of the motor and battery components can be gained.

.In the growing market of electric vehicles (EVs), the lithium-ion (Li-ion) battery technology has a main role due to its characteristics in terms of power and energy density. However, the aging of the batteries and their expected lifetime, which are other two key parameters for their utilization, are still under investigation. Battery aging is influenced by many factors like temperature, state of charge (SOC) and current rates (C-rates), whether the batteries are used or not. This paper presents an overview of the aging mechanisms and current models to describe them, going from the electrochemical approach to the empirical one. In the end, the possibility of vehicle-to-grid (V2G) services is discussed according to the aging models of the batteries




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# CHAPTER-1

# INTRODUCTION

## 1.1Electric vehicle (EV)

A Vehicle that uses one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels, fuel cells or an electric generator to convert fuel to electricity.[1] EVs include, but are not limited to, road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft.

EVs first came into existence in the mid-19th century, when electricity was among the preferred methods for motor vehicle propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. Modern internal combustion engines have been the dominant propulsion method for motor vehicles for almost 100 years, but electric power has remained commonplace in other vehicle types, such as trains and smaller vehicles of all types.

Commonly, the term EV is used to refer to an electric car. In the 21st century, EVs have seen a resurgence due to technological developments, and an increased focus on renewable energy and the potential reduction of transportation's impact on climate change and other environmental issues. Project Drawdown describes electric vehicles as one of the 100 best contemporary solutions for addressing climate change. Government incentives to increase adoption were first introduced in the late-2000s, including in the United States and the European Union, leading to a growing market for the vehicles in the 2010s. And increasing



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consumer interest and awareness and structural incentives is expected to greatly increase the electric vehicle market. Much of this market growth is expected in markets like North America and Europe; a 2020 literature review, suggested that growth in use of electric vehicles, especially electric personal vehicles, currently appears economically unlikely in developing economies.

## 1.2 HISTORY

Electric motive power started in 1827, when Hungarian priest Ányos Jedlik built the first crude but viable electric motor, provided with stator, rotor and commutator, and the year after he used it to power a tiny car.A few years later, in 1835, professor Sibrandus Stratingh of the University of Groningen, the Netherlands, built a small-scale electric car, and between 1832 and 1839 (the exact year is uncertain), Robert Anderson of Scotland invented the first crude electric carriage, powered by non-rechargeable primary cells. Around the same period, early experimental electrical cars were moving on rails, too. American blacksmith and inventor Thomas Davenport built a toy electric locomotive, powered by a primitive electric motor, in 1835. In 1838, a Scotsman named Robert Davidson built an electric locomotive that attained a speed of four miles per hour (6 km/h). In England a patent was granted in 1840 for the use of rails as conductors of electric current, and similar American patents were issued to Lilley and Colten in1847.



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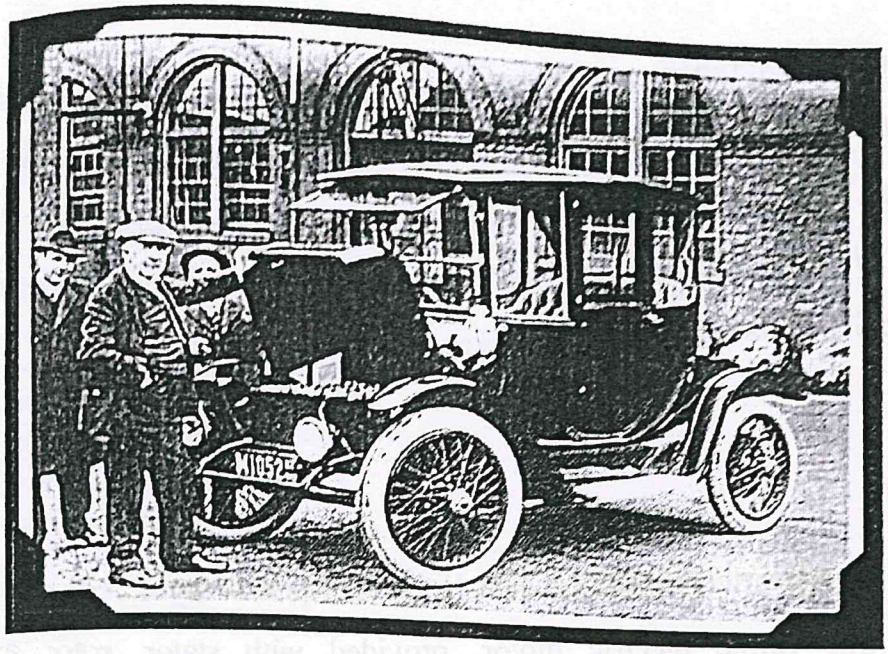


Fig.1.1 First Electrical vehicle

## 1.3 Advantages and disadvantages of EVs

### 1.3.1Environmental

EVs release no tailpipe air pollutants at the place where they are operated. However, EVs are charged with electricity that is generated by means that have health and environmental impacts, and the air emissions associated with manufacturing an electric vehicle can be greater than those of manufacturing a conventional vehicle. Overall, the air emissions from producing and operating an EV can be less than or greater than those of producing and operating a conventional vehicle, depending on the regional electricity grid mix, timing of EV charging, driving patterns, climate, the set of air emissions under consideration, and the specific electric and conventional vehicle designs being compared. Depending on the scope and assumptions of a given study, authors may claim that EVs are environmentally superior to conventional vehicles, that they cause more pollution, or that the answer depends on a variety of factors. In general,



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in regions where the electricity grid is low-emitting, EVs can reduce health and environmental costs from air emissions; however, because electricity is traded across regions and the mix of generators in the electricity grid respond to demand and market signals in complex ways, it can be difficult to unambiguously identify marginal emissions generated from power plants when an EV is charged.

Socio-Economic

Since its first commercial release in 1991, Lithium Ion Batteries have become an important technology for achieving low-carbon transportation systems. Electric-powered engines have been claimed to be more sustainable than traditionally used internal combustion engines. The sustainability of production process of batteries has not been fully assessed in either economic, social or environmental terms.

The resources are considered to be owned by the society at large. However, business processes of raw material extraction in practice raise issues of transparency and accountability of the management of extractive resources. In the complex supply chain of lithium technology, there are diverse stakeholders representing corporate interests, public interest groups and political elites that are concerned with outcomes from the technology production and use. One possibility to achieve balanced extractive processes would be the establishment of commonly agreed standards on the governance of technology worldwide.

The compliance of these standards can be assessed by the Assessment of Sustainability in Supply Chains Frameworks (ASSC). Hereby, the qualitative assessment consists of examining governance and social and environmental commitment. Indicators for the quantitative assessment are management systems and standards, compliance and social and environmental indicators.



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### 1.3.2Mechanical

Cutaway view of a Tesla Model S drive motor

Electric motors are mechanically very simple and often achieve 90% energy conversion efficiency over the full range of speeds and power output and can be precisely controlled. They can also be combined with regenerative braking systems that have the ability to convert movement energy back into stored electricity. This can be used to reduce the wear on brake systems (and consequent brake pad dust) and reduce the total energy requirement of a trip. Regenerative braking is especially effective for start-and-stop city use.

They can be finely controlled and provide high torque from rest, unlike internal combustion engines, and do not need multiple gears to match power curves. This removes the need for gearboxes and torque converters.

EVs provide quiet and smooth operation and consequently have less noise and vibration than internal combustion engines. While this is a desirable attribute, it has also evoked concern that the absence of the usual sounds of an approaching vehicle poses a danger to blind, elderly and very young pedestrians. To mitigate this situation, automakers and individual companies are developing systems that produce warning sounds when EVs are moving slowly, up to a speed when normal motion and rotation (road, suspension, electric motor, etc.) noises become audible.

Electric motors don't require oxygen, unlike internal combustion engines; this is useful for submarines and for space rovers.

### 1.3.3Energy resilience

Electricity can be produced from a variety of sources, therefore it gives the greatest degree of energy resilience.



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### 1.3.4Energy efficiency

EV 'tank-to-wheels' efficiency is about a factor of 3 higher than internal combustion engine vehicles. Energy is not consumed while the vehicle is stationary, unlike internal combustion engines which consume fuel while idling. However, looking at the well-to-wheel efficiency of EVs, their total emissions, while still lower, are closer to an efficient gasoline or diesel in most countries where electricity generation relies on fossil fuels.

Well-to-wheel efficiency of an EV has less to do with the vehicle itself and more to do with the method of electricity production. A particular EV would instantly become twice as efficient if electricity production were switched from fossil fuel to a wind or tidal primary source of energy. Thus, when "well-to-wheels" is cited, one should keep in mind that the discussion is no longer about the vehicle, but rather about the entire energy supply infrastructure – in the case of fossil fuels this should also include energy spent on exploration, mining, refining, and distribution.

The lifecycle analysis of EVs shows that even when powered by the most carbon intensive electricity in Europe, they emit less greenhouse gases than a conventional diesel vehicle.

### 1.3.5Cost of recharge

The cost of operating an EV varies wildly depending on location. In some parts of the world, an EV costs less to drive than a comparable gas-powered vehicle, as long as the higher initial purchase price is not factored in. In the US, in states which have a tiered electricity rate schedule, "fuel" for EVs today costs owners significantly more than fuel for a comparable gas-powered vehicle. A 2011 study done by Purdue University found that in California most users already reach the third pricing tier for electricity each month, and adding an EV could push them



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into the fourth or fifth (highest, most expensive) tier, meaning that they will be paying in excess of $0.45 per kWh for electricity to recharge their vehicle. At this price, which is higher than the average electricity price in the US, it is dramatically more expensive to drive a pure-EV than it is to drive a traditional pure-gas powered vehicle. "The objective of a tiered pricing system is to discourage consumption. It's meant to get you to think about turning off your lights and conserving electricity. In California, the unintended consequence is that plug-in hybrid cars won't be economical under this system," said Tyner (the author), whose findings were published in the online version of the journal Energy Policy.

### 1.3.6Stabilization of the grid

Since EVs can be plugged into the electric grid when not in use, there is a potential for battery-powered vehicles to even cut the demand for electricity by feeding electricity *into* the grid from their batteries during peak use periods (such as mid afternoon air conditioning use) while doing most of their charging at night, when there is unused generating capacity. This vehicle-to-grid (V2G) connection has the potential to reduce the need for new power plants, as long as vehicle owners do not mind reducing the life of their batteries, by being drained by the power company during peak demand. It is also proved that an electric vehicle parking lot was able to well play the role of an agent that provides demand response. Furthermore, our current electricity infrastructure may need to cope with increasing shares of variable-output power sources such as wind and solar PV. This variability could be addressed by adjusting the speed at which EV batteries are charged, or possibly even discharged.

Some concepts see battery exchanges and battery charging stations, much like gas/petrol stations today. Clearly these will require enormous storage and charging



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potentials, which could be manipulated to vary the rate of charging, and to output power during shortage periods, much as diesel generators are used for short periods to stabilize some national grids.

### 1.3.7 Range

Most owners opt to charge their vehicles primarily at their houses while not in use due to their typically slower charging times, and added convenience.

### 1.3.8 Heating of EVs

In cold climates, considerable energy is needed to heat the interior of a vehicle and to defrost the windows. With internal combustion engines, this heat already exists as waste combustion heat diverted from the engine cooling circuit. This process offsets the green house gases' external costs. If this is done with battery EVs, the interior heating requires extra energy from the vehicles' batteries. Although some heat could be harvested from the motor or motors and battery, their greater efficiency means there is not as much waste heat available as from a combustion engine.

Newer designs are focused on using super-insulated cabins which can heat the vehicle using the body heat of the passengers. This is not enough, however, in colder climates as a driver delivers only about 100 W of heating power. A heat pump system, capable of cooling the cabin during summer and heating it during winter, seems to be the most practical and promising way of solving the thermal management of the EV. Ricardo Arboix introduced (2008) a new concept based on the principle of combining the thermal-management of the EV-battery with the thermal-management of the cabin using a heat pump system.



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# CHAPTER-7

# CONCLUSION

Battery technology development None of the commercially available batteries suitable for EVs can meet the minimum goals from the USABC for long term commercialisation. Especially the price of a battery pack is a large burden for successful commercialisation. The lithium-ion battery has the potential the meetthe required goals required for long term commercialisation except for the price of the battery. The coming decade it is expected that the lithium ion battery will be the dominant battery type for BEVs. Also the zebra battery will be close to meet the required minimum goals and is a possible candidate as an EV battery. A drawback of this battery type is the high operating temperature. Breakthroughs in the metal air battery technology are not expected within the next decade. The metal air battery, especially the lithium air, has a potential for high specific energy batteries. The small specific power and recharging however remains a problem for the use in EVs. A hybrid configuration of different types of batteries and ultra capacitors can solve the low power problem of the metal air batteries. It is possible that during this decade hybrid battery configuration in BEVs will emerge. The prices of the batteries will go down as a result of technological learning but according to the USABC goals this will not be enough for successful commercialisation of the BEV. On the other hand it can be doubted whether these goals are set too high and higher battery prices are also possible for successful commercialisation.



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**OBJECTIVES:**

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

**UNIT I PROPERTIES OF MATTER 9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

**UNIT II WAVES AND FIBER OPTICS 9**

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

**UNIT III THERMAL PHYSICS 9**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

**UNIT IV QUANTUM PHYSICS 9**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

**UNIT V CRYSTAL PHYSICS 9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its



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applications in tunneling microscopes, and

- the students will understand the basics of crystals, their structures and different crystal growth techniques.

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# THERMOPHYSICAL PROPERTIES OF VARIOUS LUBRICATING OIL IN SINGLE CYLINDER FOUR STROKE IC ENGINE

A PROJECT REPORT

*Submitted by*


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*in partial fulfillment for the award of the degree*

*of*

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

BUILDERS ENGINEERING COLLEGE

KANGAYAM – 638 108

ANNA UNIVERSITY: CHENNAI 600 025

APRIL 2021


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## BONAFIDE CERTIFICATE

Certified that this project report **"THERMOPHYSICAL PROPERTIES OF VARIOUS LUBRICATING OIL IN SINGE CYLIDER FOUR STROKE IC ENGINE "** is the bonafide work of **"GOKUL. M (730317114013), KIRUBAKARAN. S (730317114026), PRAVEENKUMAR. M (730317114037), SELVAKUMAR. S (730317114042)"** who carried out the project work under my supervision.

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The project report submitted for the viva voce held on 6.9.2021

6/9/21

**INTERNAL EXAMINER**

**EXTERNAL EXAMINER**



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# ABSTRACT

Lubricants are a most important role to prevent friction and wear due contact surfaces of relative motion in the machine components (bearings, camshafts, piston, gearbox, lead screw etc). The lubrication oil is a major role in internal combustion engine to improve the working life and performance of the engine. This experimental study of thermo physical properties kinematic viscosity, kinematic viscosity index, calorific value, flash point, pour point, and hydrogen content. In this study, starting from conventional, synthetic and mixture of lubricants; mixture of lubricant based four stroke motorcycle engine oils (20w40) are prepared, then lubricity properties of the motor oils are determined. The results show that 25%,50% and 75 % of mixture of conventional oil with synthetic lubricating. Also improvements in the lubricant property with mixture of conventional oil and synthetic are seen. The paper presents base conventional, synthetic, mixture of lubricant. As alternative oil for enhance life and performance of IC Engine.



Keywords: IC engine, Lubricating oils, viscosity, temperature and overheating.



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# CHAPTER 1

# INTRODUCTION

## 1.1 IC ENGINE

An internal combustion engine (ICE) is a heat engine in which the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit. In an internal combustion engine, the expansion of the high-temperature and high-pressure gases produced by combustion applies direct force to some component of the engine. The force is applied typically to pistons, turbine blades, a rotor, or a nozzle. This force moves the component over a distance, transforming chemical energy into useful work. This replaced the external combustion engine for applications where weight or size of the engine is important.

The first commercially successful internal combustion engine was created by Étienne Lenoir around 1860 and the first modern internal combustion engine was created in 1876 by Nicolaus Otto (see Otto engine).

The engine consists of a fixed cylinder and a moving piston. The expanding combustion gases push the piston, which in turn rotates the crankshaft. ... After the piston compresses the fuel-air mixture, the spark ignites it, causing combustion. The expansion of the combustion gases pushes the piston during the power stroke.

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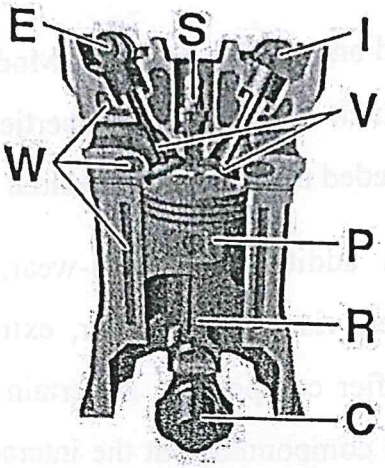



FIG 1.1 IC ENGINE

Diagram of a cylinder as found in an overhead cam 4-stroke engines :

- C – crankshaft
- E – exhaust camshaft
- I – inlet camshaft
- P – piston
- R – connecting rod
- S – spark plug
- V – valves. red: exhaust, blue: intake.
- W – cooling water jacket
- gray structure – engine block

## 1.2 WEAR, FRICTION & LUBRICANT

The lubricant in an engine serves multiple purposes, which demands a complex formulation in order to fulfil its function. Aside from friction and wear reduction the oil protects engine parts against corrosion and oxidation, removes third bodies from sliding pairs, transfers heat away from core engine components and helps in achieving appropriate sealing and reducing vibration. The engine oil



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composes of a base oil and an additive package. Modern engine oils are mostly polyalphaolefin based, which has inferior properties as a lubricant, hence a selection of additives is needed to achieve the desired function.

The most common additives are anti-wear, anti-oxidant, dispersant, detergent, friction modifier, viscosity modifier, extreme pressure agent, anti-foaming agent and emulsifier compounds. A certain property can be achieved through different chemical compounds, but the interaction and compatibility of these compounds with each other must be considered during the formulation of the lubricant. An engine oil encounters elevated temperatures, high mechanical load, multiple chemically active solids and gases and foreign contaminants during its service life which can contribute to its degradation. Therefore, the lubricant needs to be changed several times during the lifetime of the engine. The main reason of oil degradation is oxidation through the O2 content of fresh intake air and exhaust gas. The rate of oxidation will increase with rising temperature, which can also lead to the formation of peroxides and free radicals in the engine oil, which in turn can contribute to acid and sludge formation. Oxidation can also lead to an increase in viscosity due to polymerization between the base oil molecules.

State of the art passenger car and commercial vehicle engines implement direct injection fuel systems with high injection pressures and varied injection timing strategies. Injecting fuel directly inside the combustion chamber offers a more precise control over mixture formation and the combustion process which together with charging allows for higher specific power and torque, but also increases the phenomenon of fuel transport through the piston ring package.

Fuel and fuel derivatives can contaminate the engine oil and cause further degradation mechanisms. Unburden hydrocarbons can get into the engine oil from the combustion chamber through blow-by gases. Defective injectors, bad



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fuel spray orientation and increased gaps between the piston, piston rings and cylinder wall due to wear may cause increased fuel transport into the crankcase.

Fuel dilution can cause lubrication issues, although in normal operating conditions without any fuel line malfunction the fuel content of the engine oil should stay at a manageable level due to evaporation at higher operating temperatures. However, biofuels can alter these tendencies. The goal of this study is to describe the condition of the engine oil at consequent stages of use and to predict the behaviour of a specific engine oil after a given service life regarding friction and wear through chemical analysis of oil samples from three identical light-duty direct injection supercharged diesel engines.

### 1.2.1 FIVE BASIC LAWS OF FRICTION:

- When an object is moving, the friction is proportional and perpendicular to the normal force (N).
- Friction is **independent of the area of contact** so long as there is an area of contact.
- The coefficient of static friction is slightly greater than the coefficient of kinetic friction.
- Within rather large limits, kinetic friction is independent of velocity.
- **Friction** depends upon the nature of the surfaces in contact.

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## FRICNTION

Friction is the force resisting the relative motion of solid surface, fluid layer, and material elements sliding against each other.

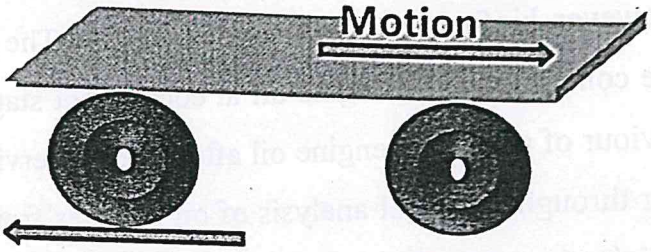



FIG 1.2 FRICTION

## WEAR

Wear is erosion or sideways displacement of material from its "derivative" and original position on a solid surface performed by the action of another surface.

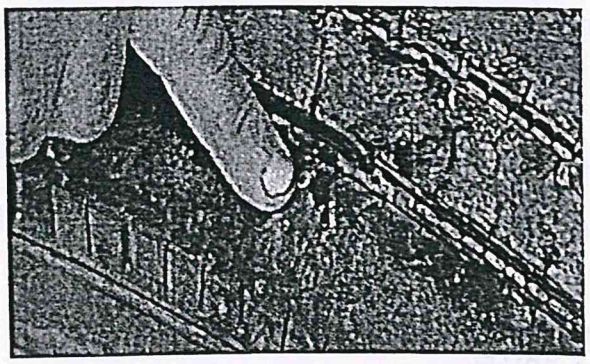


FIG 1.3 WEAR

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## LUBRICANT

Lubrication is the process employed to reduce friction between surface in proximity and moving relative to each other, by interposing a substance called a lubricator between them.

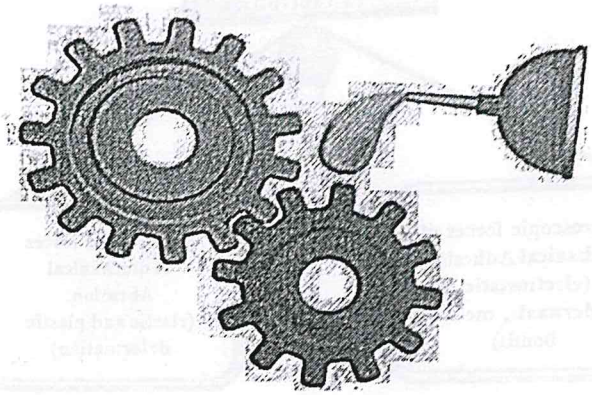


**FIG 1.4 LUBRICANT**

## 1.3 FRICTION

1. Friction is the tangential resistance to motion.
2. Occurrence of friction is a part of everyday life and it has both merits and demerits.
3. Various attempts have been made to reduce it by lubricating surfaces with oil or greases and changing design so that sliding can be reduced

### 1.3.1 MAIN CAUSE:

When objects touch there are forces between them. It is a **resistive force** between object and its surrounding.

Resistance comes into play due to:



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Friction force strength also depends on type of surface, as rough surface offer more friction than smooth surface.

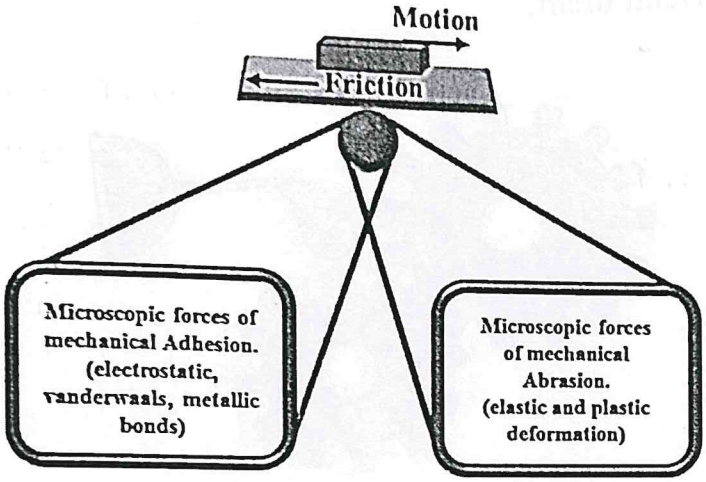



**FIG 1.5 MAIN CAUSE DIAGRAM**

### 1.3.2 FLUID FRICTION:

1. It is the force which resists the motion of object when it moves through liquid or gas.
2. All gases and liquids are fluids.
3. This resistance to flow is also termed as "viscosity".
4. The resistance varies from layer to layer in a fluid flow.
5. This velocity variation is termed as velocity gradient ($\Delta v$).
6. $\Delta v = \frac{\Delta u}{\Delta y}$ $\Delta u$ is velocity difference between the layers $y$ and $\Delta y$ is distance between the layers.

Fluid friction in a fluid along area A is given by:



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$$F = \mu A \Delta v$$

$\mu$ is the constant called coefficient of dynamic friction

### 1.3.3 METHODS TO CONTROL FRICTION:

Controlling friction is an important parameter for smooth function of and improving their life. Various methods can be used for this:

- Add lubricant for smooth functioning.

## 1.4 WEAR

- Wear is the surface damage or removal of material from one or both of two solid surfaces in a sliding, rolling, or impact motion relative to one another.
- Wear, as friction, is not a material property, but a system response.
- It is generally assumed that materials with high friction will exhibit high wear rate, which is not true. Interfaces with solid lubricants and polymers exhibit relatively low friction and relatively high wear, whereas ceramics exhibit moderate friction but extremely low wear.
- Corrosion may be included in wear phenomenon, but the damage is amplified and performed by chemical reactions.
- Wear can be either productive or undesirable.

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# CHAPTER 7

## CONCLUSION

In this project, the performance of synthetic-based lubricant with viscosity in aged conditions in comparison to conventional oil and mixture of oil was investigated.The results generally reveal that the aged (due to temperature) synthetic lubricant provides a different behaviour. The following conclusions can be drawn. The variation of the dynamic and kinematic viscosity for the engine oil SAE10W40 is more than conventional and mixture of oils.The variation of flash point and fire point of synthetic oil is more than the conventional and mixture of oil.

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| ME8594 | DYNAMICS OF MACHINES | L T P C |
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**OBJECTIVES:**

- ✓ To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- ✓ To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- ✓ To understand the effect of Dynamics of undesirable vibrations.
- ✓ To understand the principles in mechanisms used for speed control and stability control.

**UNIT I FORCE ANALYSIS 12**

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

**UNIT II BALANCING 12**

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

**UNIT III SINGLE DEGREE FREE VIBRATION 12**

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

**UNIT IV FORCED VIBRATION 12**

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

**UNIT V MECHANISM FOR CONTROL 12**

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

**TOTAL: 60 PERIODS**

**OUTCOMES:**

Upon completion of this course, the students can able to

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

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# DESIGN AND ANALYSIS IN THE BRAKING SYSTEM OF ELECTRICAL VEHICLE USING ANSYS SOFTWARE

PROJECT REPORT

Submitted by


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| DEEPAK C | (730317114009) |
| DEEPANRAJ S | (730317114011) |
| ROKESH S | (730317114040) |


*in partial fulfillment for the award of the degree*

*of*

BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING


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APRIL 2021



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## BONAFIDE CERTIFICATE

Certified that this project report **"DESIGN AND ANALYSIS IN THE BREAKING SYSTEM OF ELECTRICAL VEHICLE USING ANSYS SOFTWARE"** is a bonafide work of **"AJAY B (730317114001), DEEPAK C (730317114009), DEEPANRAJ S (730317114011) And ROKESH S (730317114040)"** that carried out the project work under my supervision.

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Internal Examiner

External Examinar

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# ABSTRACT

A brake is a mechanical device which inhibits motion. A drum brake is a brake that uses friction caused by a set of shoes or pads that press against a rotating drum-shaped part called a brake drum. The brake drum is a critical component that experiences high temperatures and develop thermal stresses during application of brakes. In addition, the application of shoe pressure gives rise to mechanical loads. So the analysis takes into account both the thermal stresses and mechanical stresses together. Brakes in cars and trucks are safety parts. Requirements not only in performance but also in comfort, serviceability and working lifetime are high and rising. i.e. the brake pad with the friction material, the counter body and caliper, can be modeled. So in this project we design the model of drum brake (drum, liners, springs etc.,) And perform the structural and thermal analysis in solid works premium 2016.

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# CHAPTER 1

## INTRODUCTION

A brake is a device which is used to bring to rest or slow down a moving body. Safe operation of vehicle demands dependable brakes is required to absorb the kinetic energy of the moving parts or the potential energy of the object being lowered by host when the rate of descent is controlled.The energy absorbed by brakes is dissipated in the form of heat. This heat is dissipated in the surrounding atmosphere to stop the vehicle, so the brake system should have following requirements:

- The brakes must be strong enough to stop the vehicle with in a minimum distance in an emergency.
- The driver must have proper control over the vehicle during braking and vehicle must not skid.The brakes must have well anti fade characteristics i.e. their effectiveness should not decrease with is constant prolonged application.The brakes should have well anti wear properties.
- The important requirements of the brake drum are following:It should provide a surface having well anti wear qualities.It should allow the optimum rate of heat transfer.
- Heat is generated during each brake application and it must be dissipated to the atmosphere immediately, because the next brake application would again produce more heat. Any excessheating of brakes would cause the drum to expand resulting in loss of effective pedal travel and fading of brake lining.
- It should have sufficient strength but minimum weight. It should be able to be accommodated within the wheel space available

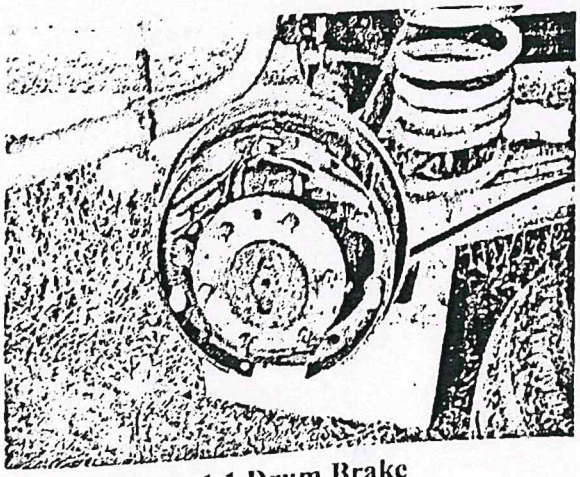


**Figure 1.1 Drum Brake**

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## 1.1 HISTORY OF ELECTRIC VEHICLE

Electric vehicles first appeared in the mid-19th century. An electric vehicle held the vehicular land speed record until around 1900.The high cost, low top speed , and short-range of battery electric vehicles, compared to 20th century internal combustion engine vehicles, led to a worldwide decline in their use as private motor vehicles;

- Though electric vehicles have continued to be used in the form of loading and freight equipment and public transport – especially rail vehicles.At the beginning of the 21st century
- interest in electric and other alternative fuel vehicles in private motor vehicles has increased due to growing concern over the problems associated with hydrocarbon-fueled vehicles.
- including damage to the environment caused their emissions, and the sustainability of the current hydrocarbon – based transportation infrastructure as well as improvements in electric vehicle technology.

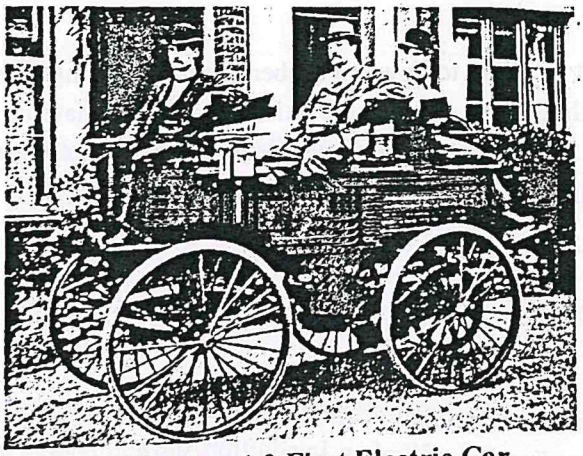


**Figure 1.2 First Electric Car**

## 1.2 Functions of Drum Brake

- To stop the vehicle in shortest possible distance in case of emergency.
- To control the vehicle when it is travel along the hills.
- To keep the vehicle in desired position after bringing it in complete rest when there is no driver.

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## 1.3 Objective of work

- Brake drums are an essential component of drum brakes. Together with the brake shoe, a brake drum forms a friction pair, which decelerates the rotation of the wheel.
- The brake drum also has the job of absorbing and discharging the heat generated during braking.
- Brake shoes fitted with brake linings which press against the drums from the inside to generate braking force are set inside of the drums.
- With this system, friction is generated by pressing the brake linings against the inside surfaces of the drums. This friction converts kinetic energy into thermal energy.
- Drum rotation helps to press the shoes and the lining against the drum with more force, offering superior braking force in comparison with disc brakes.On the other hand, it is very important to design the components so that the heat from the thermal energy is dissipated efficiently into the atmosphere.

## 1.4 PROJECT ENHANCEMENT

In this work, an attempt is made to develop a fiber reinforced composite material with optimum properties so that it can replace the existing cast iron material in automobile drum brake application. Three dimensional models of drum brake are prepared in Creo 2.0 . Static structural analysis of drum brake models is performed in ANSYS 14.5 considering different .

## 1.5 NEED FOR ANALYSIS

The brake drum is a critical component that experiences high temperatures and develop thermal stresses during application of brakes. In addition, the application of shoe pressure gives rise to mechanical loads. So the analysis takes into account both the thermal stresses and mechanical stresses together.materials.

## 1.6 INTRODUCTION TO CREO2.0

CREO2.0 is a parametric, integrated 3d cad/ cam/ cae solution created by parametric technology corporation (ptc). It was the first to market with parametric, feature-based, associative solid modeling software.



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- the application runs on Microsoft windows platforms, and provides solid modeling, assembly modeling and drafting, finite element analysis, and tooling functionality for mechanical engineers. the pro/engineer name was changed to creo elements/pro on October 28, 2010, coinciding with ptc's announcement of creo, a new design software solution.Creo Elements/Pro (formerly Pro/ENGINEER), PTC's parametric, integrated 3D CAD/CAM/CAE solution, is used by discrete manufacturers for mechanical engineering, design and manufacturing. Created by Dr. Samuel P. Geisberg in the mid-1980s,Pro/ENGINEER was the industry's first successful rule-based constraint (sometimes called "parametric" or "variational") 3D CAD modeling system.
- The parametric modeling approach uses parameters, dimensions, features, and relationships to capture intended product behavior and create a recipe which enables design automation and the optimization of design and product development processes.
- This design approach is used by companies whose product strategy is family-based or platform-driven, where a prescriptive design strategy is fundamental to the success of the design process by embedding engineering constraints and relationships to quickly optimize the design, or where the resulting geometry may be complex or based upon equations.
- Creo Elements/Pro provides a complete set of design, analysis and manufacturing capabilities on one, integral, scalable platform.
- These required capabilities include Solid Modeling, Surfacing, Rendering, Data Interoperability, Routed Systems Design, Simulation, Tolerance Analysis, and NC and Tooling Design.
- Companies use Creo Elements/Pro to create a complete 3D digital model of their products.
- The models consist of 2D and 3D solid model data which can also be used downstream in finite element analysis, rapid prototyping, tooling design, and CNC manufacturing.
- All data is associative and interchangeable between the CAD, CAE and CAM modules without conversion.
- A product and its entire bill of materials (BOM) can be modeled accurately with fully associative engineering drawings, and revision control information.



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# CHAPTER 9

# CONCLUSION

The use of finite element analysis in product design Validation has been explored in this research work.

Computer Aided Analysis was employed to determine the Structural integrity and thermal effects using Finite Element method on motorcycle drum brake and brake pad. The result of the analysis using ANSYS software showed.

- Modeling and analysis of drum brake and brake pad is done.
- Using solid works software with various commands. These components are modeled
- Then the file is saved as IGS to import in Ansys software.
- The drum brake model is imported to Ansys 16.0 work bench software.
- Thermal analysis at 119°C and Structural analysis at 2610N force with four different materials such as Aluminum alloy, Grey cast iron, aluminum oxide, Aluminum silicon carbide is done.
- Structural deformations such as stress, deformation, strain and Thermal calculations of temperature distribution and total heat flux are found and tabulated.
- Similar to that Static analysis of brake pad with three different materials such as Alumina, Zirconia, Cfrp materials is done.
- Structural deformations such as stress, deformation and strain are found and tabulated.
- From the final results we found the Aluminum silicon carbide has less deformations and better heat flux of brake drum as well as Zirconia has less deformations and stress value of brake pad.

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**GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

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

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

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

**UNIT II ENVIRONMENTAL POLLUTION** **8**

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

**UNIT III NATURAL RESOURCES** **10**

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

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**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 – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- 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 – 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

**TEXTBOOKS:**


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


**REFERENCES :**


1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.



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# TESTING OF COIR AND KENAF FIBER HYBRID COMPOSITE MATERIALS

A PROJECT REPORT

*Submitted by*


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| MOHAN RAJ.S | (730317114031) |
| SELVAM.P | (730317114043) |


*In partial fulfillment for the award of the degree*

*of*

BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING

BUILDERS ENGINEERING COLLEGE, KANGAYAM -638108

ANNA UNIVERSITY : CHENNAI 600 025

APRIL 2021

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# ANNA UNIVERSITY: CHENNAI 600 025

## BONAFIDE CERTIFICATE

Certified that this project report **"TESTING OF COIR AND KENAF FIBER HYBRID COMPOSITE MATERIAL"** is the bonafide word of **AKASH.G (730317114003), BARATHKUMAR.S (730317114007), MOHAN RAJ.S (730317114031), SELVAM.P (730317114043)** who carried out the project work under my supervision.

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# ABSTRACT

Natural fibers (Kenaf and Coconut coir) reinforced Epoxy composites were subjected to various tests in order to study the effects of tensile strength, flexural strength, compression strength and impact test on the composite fiber. To analyze the mechanical properties such as tensile strength, flexural strength, compressive strength and impact strength for different aspect ratio of fibers and their effects on the fiber.

In recent times, increasing attention has been paid to the use of renewable resources particularly of plant origin keeping in view the ecological concerns, renewability and many governments passing laws for the use of such materials. These natural fibers are used as a suitable reinforcing material to satisfy the environmental and they are now fast emerging as a potential alternative for glass fibers in engineering composites. The natural fibers are used as reinforcements for composite material due to its various advantages compared to conventional fibers.

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# CHAPTER 1
# INTRODUCTION

The availability of natural fibers is abundance and, they are very inexpensive when compared to other advanced man-made fibers. These natural fibers are used as a suitable reinforcing material environmental concern and they are now emerging as a potential alternative for glass fibers in engineering composites [1]. The natural fibers are used as reinforcements for composite materials due to its various advantages compared to conventional man-made fibers [2, 3]. The primary advantages of natural fibers are low density, low cost, biodegradability, acceptable specific properties, less wear during processing and low energy consumption during extracting as well as manufacturing composites and wide varieties of natural fibers are locally available. Natural fibers have a few disadvantages when used as reinforcements, such as lower impact strength, higher moisture absorption which leads to dimensional changes thus leading to micro-cracking. All polymer composites absorb moisture in humid atmosphere and alsowhen immersed in water.

The effect of this moisture absorbed leads to the degradation of fiber-matrix interface region creating poor stress transfer between fiber and matrix and resulting in reduction of mechanical properties along with dimensional changes. One of the main concerns for the use of natural fiber reinforced composite materials is their susceptibility to moisture absorption and the effect on physical and mechanical properties. It is important therefore that this problem is discussed in order that these natural fibers may be considered as a favorable reinforcement in composite materials. Many researches have studied in detail the effect of moisture absorption on the mechanical properties of the natural fiber reinforced composites, to mention a few; The water sorption characteristics and the effect of hybridization with glass fiber and the chemical modification of the fiber on the water absorption properties of banana fiber reinforced polyester composites by immersion in distilled water at 280–900C were studied [4].

Pine Needles of different dimensions were used to prepare bio composites with Phenol-Formaldehyde and the effects of different fiber dimension on the mechanical properties of the composites were determined. These polymer composites were further subjected to various standardized characterization tests such as moisture absorption and chemical resistance analysis [5]. The moisture absorption of short hemp fiber and hemp-glass hybrid reinforced thermoplastic composites was investigated to study their suitability in outdoor applications [6].



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The mechanical properties of sisal fiber-reinforced epoxy composites aged in water and the moisture absorption behavior of sisal were investigated [7]. The relationship between the and the fiber loadings were studied [8] and found that the moisture absorption increased almost linearly with the fiber loading. The mechanical properties of unsaturated polyester composites reinforced with different natural fibers such as sisal, jute and flax and glass fiber were reported. Jute composites showed the best flexural and tensile strength values but the lowest impact values as a consequence of the higher interface adhesion. On the other hand, sisal fiber composites showed the lowest mechanical and water resistance properties [9]. The hydrophilic nature of natural fibers provides weak interfacial adhesion in polymer-matrix composites. An experimental study of water absorption in unsaturated polyester composites reinforced with macambira natural fiber was done by V.C.A.Cruz et al [10].

They studied the samples with weight composition of 30% macambira fiber and 70% unsaturated polyester. Tests for water absorption were performed by immersing the samples in a bath of distilled water at 25, 50 and 70°C, and water uptake was measured gravimetrically along the process. Results of the micrographs (SEM), moisture content and area / volume relationships of the composites were analyzed. There are three different governing mechanisms of moisture diffusion in polymeric composites. The first involves of diffusion of water molecules inside the micro gaps between polymer chains. The second involves capillary transport into the gaps and flaws at the interfaces between fiber and the matrix. This is a result of poor wetting and impregnation during the initial manufacturing stage.

The third involves transport of micro-cracks in the matrix arising from the swelling of fibers as in the case of natural fiber composites. Generally, based on these mechanisms, diffusion behavior of polymeric composites can further be classified according to the relative mobility of the penetrant and of the polymer segments, which is related to either Fickian, non-Fickian or anomalous, and an intermediate behavior between Fickian and non-Fickian [11, 12]. In general moisture diffusion in a composite depends on factors such as volume fraction of fiber, voids, viscosity of matrix, humidity and temperature. The objectives of this work are (1) to study the water absorption behavior of the hybrid composites made by combining Sisal fibers and Coconut coir as reinforcements in the Epoxy matrix at Room Temperature and elevated temperature (1000C). (2) Studying the influence of fiber reinforcement and water uptake behavior on mechanical properties of hybrid-composites.



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# CHAPTER 7

# CONCLUSION

- The aim of this project is to fabricate a suitable alternative material for wood products and plastic products which is economically available alternative and should be easy to fabricate.
- The natural composite materials are very less in weight compare to other materials like wood, plastics etc. In this project, natural fiber composite materials are fabricated by using polyester resin with different weight ratio and different length of fiber were prepared.
- Then the mechanical properties of those fibers were analyzed such as tensile strength, compressive strength, flexural strength and impact strength for different volume fraction.
- We expect that the experimental values of mechanical properties are more than the other natural fibers that we had mentioned in above literature survey.
- Tensile Strength, Flexural Strength, Compression Strength and Impact Strength of fiber composite material were found to be increased with increase in volume of fraction.
- The highest mechanical properties were obtained on fiber about tensile strength of25.761N/mm$^2$[PLATE C], compression strength of 21.474 N/mm$^2$[PLATE D], flexural strength of 87.624 MPa[PLATE E], flexural modulus of 6944.712GPa and impact strength of 0.50J/sq.mm [PLATE C].

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**ME8791** **MECHATRONICS**

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**OBJECTIVE:**

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

**UNIT I INTRODUCTION** **9**

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

**UNIT II MICROPROCESSOR AND MICROCONTROLLER** **9**

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

**UNIT III PROGRAMMABLE PERIPHERAL INTERFACE** **9**

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

**UNIT IV PROGRAMMABLE LOGIC CONTROLLER** **9**

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

**UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN** **9**

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

**TOTAL : 45 PERIODS**

**OUTCOMES:**

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

CO1 Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.

CO2 Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller.

CO3 Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing

CO4 Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronic engineering.

CO5 Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies

**TEXT BOOKS:**


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


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



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| OIE751 | ROBOTICS | L | T | P | C |
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**OBJECTIVES:**

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

**UNIT I FUNDAMENTALS OF ROBOT** **6**

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

**UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS** **9**

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers,

Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

**UNIT III SENSORS AND MACHINE VISION** **12**

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

**UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING** **13**

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

**UNIT V IMPLEMENTATION AND ROBOT ECONOMICS** **5**

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

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

**TEXT BOOKS:**


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



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**REFERENCES:**


1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 1994.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.
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6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
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# FABRICATION OF ARDUINO BASED AUTONOMOUS BASED FIRE FIGHTING ROBOT

**PROJECT REPORT**

Submitted by


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| **MANOJKUMAR M** | **(730317114303)** |


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

**of**

**BACHELOR OF ENGINEERING**

**in**

**MECHANICAL ENGINEERING**


**BUILDERS ENGINEERING COLLEGE, KANGAYAM – 638108**


**ANNA UNIVERSITY: CHENNAI 600025**

**APRIL 2021**




PRINCIPAL
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# ANNA UNIVERSITY: CHENNAI 600 025

## BONAFIDE CERTIFICATE

Certified that this project report "**FABRICATION OF ARDUINO BASED AUTONOMOUS FIRE FIGHTING ROBOT**" is a bonafide work of "**MEMATHAN C(730317114030),SIVAMAHESHWARAN K(730317114047),VARUN KUMAR R(730317114054) And MANOJKUMAR M(730317114303)**" that carried out the project work under my supervision.

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Submitted for the Anna University Viva Voce held on .06.08.2021...

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## ABSTRACT

In this modern era the field of robotics is turned to be an ingredient over which many people have shown their interest. Robotics has gained popularity by having the advantages over many technologies of computing and Nano technologies. Therefore we the team have decided to design the project that can make humans life easier and comfortable. In this project a fully automated fire fighting robot is designed. which can help in dealing with many fire problems in households and small scale industries. A small scale project is designed and fabricated to specify the task .This design can be used to fabricate large scale-real time project to specify the practical difficulties. Most of the accident are taking place due to lack of conciousness in work and because of natural hazardness like wild fire,valcanos,etc... The robot designed in this project shall detect the fire accident and will extinguish with in short time which saves more life in earth. This project is a computer programmed electronic based project which works on the principle of light sensor and proximity sensor .This project is fool proof project ,therefore an unskilled labour and propective of beginners or the master of this field can work.




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# CHAPTER 1

## INTRODUCTION

Fire accident in India is a common unpleasant event that happens unexpectedly and causes damage, injury or even death. Many wealth and lives are fallen in danger. As a developing country we had no modern technology to solve this problem. The main sector of fire brigade has limitation to overcome it. If an automatic fire extinguishing system available, offers greater flexibility. In conventional automatic fire-extinguishing systems utilizing a fire-extinguishing gas, a bomb containing a fire-extinguishing gas, such as halon gas, under pressure is provided at a location. Several gas jetting nozzles are arranged at desired locations within a region when a fire occurs therein. The gas jetting nozzles are connected through a valve and a pipe to the bomb. Fire sensors are arranged at desired locations within the region. In response to a fire signal from the fire sensors, the valve is opened to cause fire-extinguishing gas to jet from the gas jetting nozzles into the region so that automatic extinguishing can be effected therein.

The conventional automatic fire-extinguishing systems require a complicated system of gas pipes from a gas bomb to the gas jetting nozzles, the cost and installation of the pipes is expensive. The gas pipes are fixedly arranged in the walls, ceiling etc., of a room defining a region, it is not easy to remove the gas pipes and to change the arrangement of the gas jetting nozzles. The gas bomb to be used must have a capacity comparable with the space of the region and therefore, gas bombs having different capacities must be prepared for different regions. This is very uneconomical. To eliminate the drawbacks of the above-mentioned conventional fire extinguishing system a Portable automatic fire protection system is disclosed comprising battery powered, independent suppressor units, each including a supply of fire extinguishing fluid and a fire detector. The connection of the individual unit's control circuits provides a control circuit network that automatically initiates an extinguishing fluid discharge from all units in response to fire detection by any single unit.



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The main objective of this project is to provide an automatic fire-extinguishing system which eliminates the above described disadvantages of the prior arts, and to enable easy installation or removal of the system in or from a region wherein automatic fire-extinguishing should be effected and to allow a flexible arrangement of gas jetting nozzles according to the size and shape of the region. The main part of this task is the involvement of a microcontroller which may be considered to be the nucleus of the whole system. We had established a closed loop feedback system with microcontroller which senses the temperature sensor, smoke detector signal and send it to the solenoid valve through some control circuits to maintain the magnitude of temperature to a certain level. The project presented here is based on fire-fighting robot. Robotics has gained popularity due to the advancement of many technologies of computing and nontechnology making humanoid is easier and comfortable. The firefighting robot is design to search for a fire in a small floor plan house of the specific dimension.

Mobile is attached to the head of the robot to provide video from the fire prone area. The robot also has the capability to avoid obstacles and upon detection of fire, it forwards a message to a predefined number. The basic block diagram is as shown in Fig 1.1 The robot moves through a model structure and if fire still exists, it can be extinguished with the help of pump and sprays.



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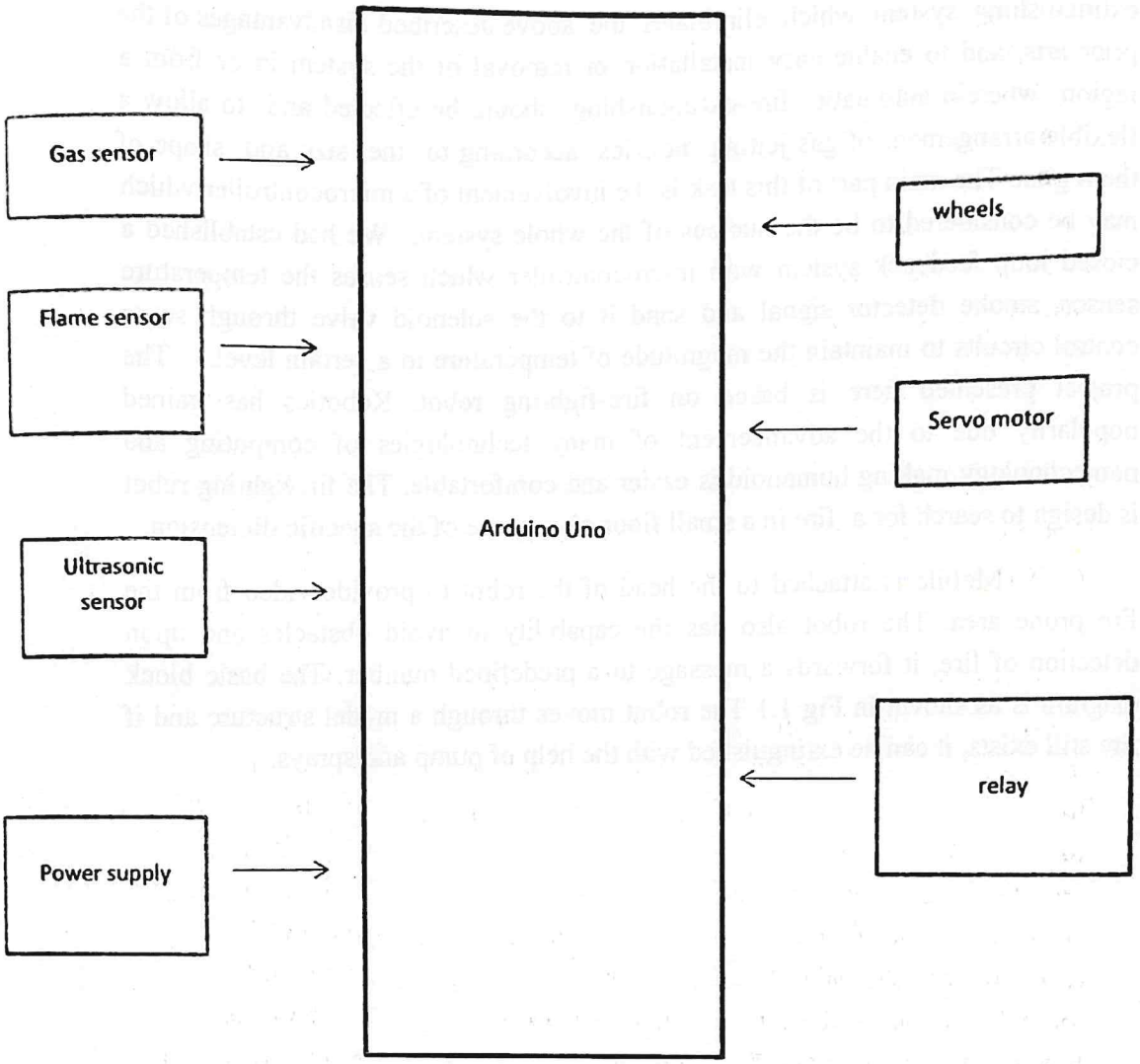



**Fig.1.1 Basic Block Diagram**



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## 1.2.FIRE FIGHTING ROBOTIC SYSTEM

A robot is a machine especially one programmable by a computer capable of carrying out a complex series of actions automatically. Robot is also a mechanical design that is capable of performing human tasks or behave like human manner. Building a robot requires a complex programming. It is about building systems and putting together motors and wires among other important components. A fire fighter robot is one that has a small fire extinguisher . By attaching a small fire extinguisher to the robot, the automation put out the fire by human controlling. This project covers the design and construction of a robot that is able to sense and extinguish fire. The robot turns on an electronic valve releasing stored water on the flame. Fire fighters face risky situations when extinguishing fires and rescuing victims, it is an inescapable part of being a fire fighter. In contrast, a robot can function by itself or controls from a distance, which means that firefighting and rescue activities could be accomplished without putting fire fighters at risk by using robot technology instead.

The robots decrease the need for fire fighters to get into dangerous circumstances. This robot uses dc motors, castor wheel, microcontroller, sensors, pump and sprinkler. Microcontroller is the heart of the proposed project. Microcontroller and module controls all the parts of the robot by using of programming. In this paper, a firefighting robot is proposed. The main function of this robot is to become an unmanned support vehicle, developed to search and extinguish fire. There are several existing types of vehicles for firefighting at home and extinguish forest fires. Our proposed robot is designed to be able to work on its own or be controlled remotely. In other words, robots can reduce the need for fire fighters to get into dangerous situations. Additionally, having a compact size and automatic control also allows the robot to be used when fire occurs in small and narrow spaces with hazardous environments.



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## 1.3.BLOCK DIAGRAM DISCRIPTION

The Figure shows the working of the circuit . The ultra-sonic sensors used mainly focus on the obstacle detection and the IR are connected in voltage divider configuration with the analog input pins of the controller. When the flames signal falls on ultrasonic sensor the resistance of the sensor. This change in resistance of the IR receiver results the analog voltage to vary between ground to VCC. The voltage is read from the analog input pin of the controller and converted to a digitized reading using inbuilt ADC channel. The Arduino UNO microcontroller has 10-bit ADC channels, so the digitized reading ranges from 0 to 1023.The sensors are calibrated to detected fire from a distance of 1 Meter. The output obtained corresponding to the calibration point is set as the threshold in the program code. The same computation is done for all the three sensors.

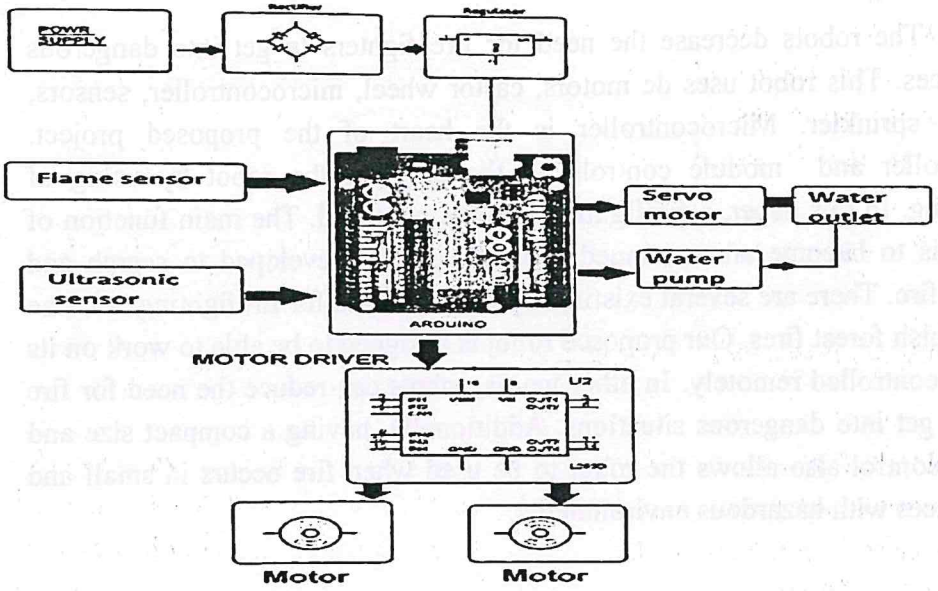



**Fig.1.2 Block Diagram**



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# CHAPTER 8

# CONCLUSION

A Fire Fighting Autonomous Robotic system equipped with sensitive sensors for fire alarm and detection, avoidance behaviour mechanism and SMS Messaging Capability have been designed and fabricated. Complete extinguishing of smoke and fire was efficiently performed. Significant response of ultrasonic sensor installed in the robotic system was successfully recognized by the microcontroller which was manifested in the avoidance of the robotic system from the obstacle.

The alarm as well as the SMS message capability was successfully activated upon the detection of flame and smoke. The owner's mobile phone received a short text message warning them that fire has been detected. This simply suggests that the fabricated fire-fighting autonomous robotic system was functioning effectively and efficiently. With the achievement of the objectives of this research, it concluded that the designed system is reliable and cost effective which should be employed in fire-fighting .



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