



# MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING

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

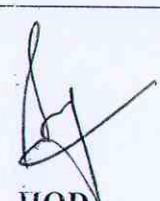


## Department of Mechanical Engineering

### 1.3.2 Average percentage of courses that include experiential learning through project work/field work/internship on AY 2022-23

S. No	Title of the Project	Subject code & Subjects name related to the Project
1	Study of Microstructural and Mechanical properties of AA6351/TiB2 Composites	ME8491 Engineering Metallurgy, ME8513 Metrology and Measurements Laboratory
2	Investigation of microstructural and mechanical behavior of aluminium 6063/Gr polymer composites	ME8491 Engineering Metallurgy, CE8381 Strength of Materials Laboratory
3	Experimental Investigation of Sugarcane bagasse with waste plastic composite material	ME8491 Engineering Metallurgy, CE8381 Strength of Materials Laboratory
4	Dry Sliding Wear Behaviour of AA3651/TiB2 in suit composites	ME8491 Engineering Metallurgy
5	Design and development of Pen Type Pressure Gauge for vehicles	CE8394 Fluid Mechanics and Machinery, ME8381 Computer Aided Machine Drawing
6	A Comparative study of conventional and alternative locking mechanisms for MC4PV connectors	CE8395 Strength of Materials for Mechanical Engineers ME8681 CAD / CAM Laboratory
7	Material Optimization for aircraft interior application by using natural fibers	ME8491 Engineering Metallurgy
8	Experimental Investigation of Glass Banana and areca fiber of hybrid composite material	ME8491 Engineering Metallurgy, CE8381 Strength of Materials Laboratory
9	Design optimization of frame in GO KART	CE8395 Strength of Materials for Mechanical Engineers ME8681 CAD / CAM Laboratory
10	Effect of welding parameter on TIG welding of INCONEL 718 alloy	ME8351 Manufacturing Technology - I ME8361 Manufacturing Technology Laboratory - I
11	Design and Fabrication of semiautomatic load testing machine on screw thread using ac motor with gear box	ME8651 Design of Transmission Systems ME8681 CAD / CAM Laboratory

  
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**HOD**  
Head of the Department  
Department of Mechanical Engineering  
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STUDY OF MICROSTRUCTURAL AND MECHANICAL  
PROPERTIES OF AA6351/TiB<sub>2</sub> COMPOSITES

A PROJECT REPORT

*Submitted by*

J.BALAJI	311819114004
S.MUSHARRAF ALI	311819114018
M.MOHAMMED AASHIK	311819114304

*in partial fulfilment for the award of the degree*

*of*

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

MOHAMED SATHAK A. J. COLLEGE OF ENGINEERING, EGATTUR

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MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "STUDY OF MICROSTRUCTRE AND MECHANICAL PROPERTIES OF AA6351/TiB<sub>2</sub> COMPOSITES" is the bonafide work of "J.BALAJI (311819114004) , M.MUSHARRAF ALI (311819114004) , M.MOHAMED AASHIK (311819114304)" who carried out the project work under my supervision.

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Mr. S.R Mohan M.Tech.,

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Project Viva-Voce held on 18-05-2023

M. V 18/5/23  
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18/5/2023  
EXTERNAL EXAMINER

## ABSTRACT

The present study aims to investigate the microstructure and mechanical properties of AA6351/TiB<sub>2</sub> composite material. The Composite was prepared by casting method and varying weight percentages (0%, 3% ,6% and 9%) of TiB<sub>2</sub> particles were added to the AA6351 matrix. The microstructural analysis was carried out using optical microscopy will reveale a uniform distribution of TiB<sub>2</sub> particles within the matrix. The mechanical properties of the composite material were evaluated using Tensile , Impact and hardness test. The optical microscope revealed a uniform dispersal of TiB<sub>2</sub> Particles in the aluminium matrix. The results obtained indicate that the hardness and tensile strength were increased with an increase in weight percentage of TiB<sub>2</sub> contents , But the impact test have high result in 3% of TiB<sub>2</sub> composite.

**KEYWORDS:** AA6351 alloy , Stir casting , Optical Microscopy , Micro Vickers Hardness test , Tensile test , Impact test.



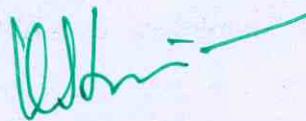
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## CHAPTER 6

### CONCLUSIONS

The Microstructural and Mechanical behaviour of AA6351/TiB<sub>2</sub> Composites were investigated and the following conclusions were obtained.

1. By Using of optical microscope to confirms that TiB<sub>2</sub> and Aluminium are present within the composite.
2. The strong interfacial bonding of TiB<sub>2</sub>, particles with the matrix should enhance the mechanical properties of the composite.
3. The hardness, tensile strength and impact strength are enhanced steadily with the increase in mass fraction of titanium diboride particles upto 9%



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**OBJECTIVE:**

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

**UNIT I ALLOYS AND PHASE DIAGRAMS 9**

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

**UNIT II HEAT TREATMENT 9**

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

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

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

**UNIT IV NON-METALLIC MATERIALS 9**

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

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

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

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

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

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

**TEXT BOOKS:**

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

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ME8513

## METROLOGY AND MEASUREMENTS LABORATORY

L	T	P	C
0	0	4	2

## OBJECTIVE:

- To familiar with different measurement equipments and use of this industry for quality inspection.

## LIST OF EXPERIMENTS

- Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge – using gauge blocks
- Calibration and use of measuring instruments – depth micrometer, bore gauge, telescopic gauge
- Measurement of linear dimensions using Comparators
- Measurement of angles using bevel protractor and sine bar
- Measurement of screw thread parameters – Screw thread Micrometers and Three wire method (floating carriage micrometer)
- Measurement of gear parameters – disc micrometers, gear tooth vernier caliper
- Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)
- Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components
- Non-contact (Optical) measurement using Toolmaker's microscope / Profile projector and Video measurement system
- Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.
- Machine tool metrology – Level tests using precision level; Testing of straightness of a machine tool guide way using Autocollimator, spindle tests.
- Measurement of force, torque and temperature

TOTAL: 60 PERIODS

## OUTCOMES

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

- CO1 Measure the gear tooth dimensions, angle using sine bar, straightness and flatness, thread parameters, temperature using thermocouple, force, displacement, torque and vibration.
- CO2 Calibrate the vernier, micrometer and slip gauges and setting up the comparator for the inspection.

## LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Micrometer	5
2	Vernier Caliper	5
3	Vernier Height Gauge	2
4	Vernier depth Gauge	2
5	Slip Gauge Set	1
6	Gear Tooth Vernier	1
7	Sine Bar	1
8	Floating Carriage Micrometer	1
9	Profile Projector / Tool Makers Microscope	1
10	Parallel / counter flow heat exchanger apparatus	1
11	Mechanical / Electrical / Pneumatic Comparator	1
12	Autocollimator	1
13	Temperature Measuring Setup	1
14	Force Measuring Setup	1
15	Torque Measuring Setup	1

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INVESTIGATION OF MICROSTRUCTURAL AND  
MECHANICAL BEHAVIOR OF ALUMINIUM 6063/Gr  
POLYMER COMPOSITES

A PROJECT REPORT

*Submitted by*

M.GOKUL	(311819114005)
A.SHEIK HUSSAIN	(311819114020)
S.SALAUDEEN BADUSHA	(311819114306)

*In partial fulfilment for the award of the degree*

*of*

**BACHELOR OF ENGINEERING**

*In*

**MECHANICAL ENGINEERING**

**MOHAMED SATHAK A. J. COLLEGE OF ENGINEERING,**

**CHENNAI 603 103**

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**MAY 2023**

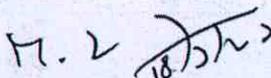
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ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report INVESTIGATION OF MICROSTRUCTURAL AND MECHANICAL BEHAVIOR OF ALUMINIUM 6063/Gr POLYMERCOMPOSITES is the bonafide work of "M.GOKUL (311818114005), A.SHEIK HUSSAIN (311818114020), and S.SALAUDEEN BADUSHA (311818114306), who carried out the project work under my supervision.

  
SIGNATURE

Dr. M.SHUNMUGASUNDARAM Ph.D.,

HEAD OF THE DEPARTMENT

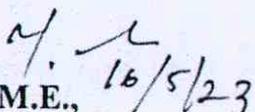
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Mr. M.SURESH, M.E., 16/5/23

SUPERVISOR

Assistant professor

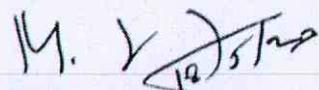
Mohamed Sathak A. J. College of

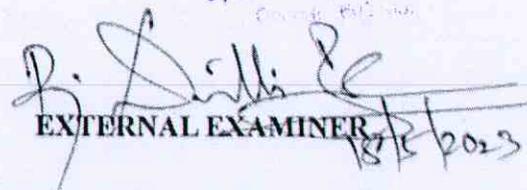
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INTERNAL EXAMINER

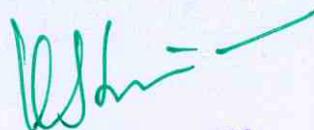
  
EXTERNAL EXAMINER 18/5/2023

## ABSTRACT

In the present day, Aluminium polymer composites are widely used in the field of engineering applications, especially in automobile, aerospace, marine, and processing industries, because of their improved higher specific strength, wear resistance, low density, high strength, and good structural rigidity. Presently hybrid composites play a vital role in engineering applications. In this present work, Aluminium alloy 6063 has been used as the matrix and recycled polymer as the reinforcement. The Aluminium composite is produced by liquid metallurgical route (stir casting). This method is less expensive and very effective. The objective of this work is to predict the tensile strength, compression, impact, and Corrosion behavior of the Composites.

## KEYWORDS

Aluminum 6063, Recycled Polymer, Tensile test, Compression test, Impact test & Microstructure test.

  
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## CHAPTER 6

### CONCLUSION

The conclusions based on the present work on Al6063 – PET (Polyethylene Terephthalate) metal matrix composites are as follows,

- ❖ The Selection of matrix base material.
- ❖ Mould making as per specimen.
- ❖ Composite preparation with Al6063 and PET (Polyethylene Terephthalate)
- ❖ Casting of metal matrix composites by stir casting process by using Al6063 / PET (Polyethylene Terephthalate) as reinforcements.
- ❖ The casting material is obtained and weight percentage of the composite materials is calculated.
- ❖ We have undergone Mechanical testing like Tensile, Impact, Compression and Microstructure.
- ❖ In tensile testing there are totally six specimens (T1, T2, T3, T4, T5, T6) out of the six T2-1 was found to high strength and T1-1 was found to be low strength.
- ❖ In Impact testing there are totally three specimens in which the specimen no.1 was found to be stronger than other two.
- ❖ Also in Compression test there are 3 specimens (C1-1, C1-2,C1-3,C2-1,C2-2,C2-3) out of the two specimens the C2-1 is found to be stronger.



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ME8491

ENGINEERING METALLURGY

L T P C  
3 0 0 3

OBJECTIVE:

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

UNIT I ALLOYS AND PHASE DIAGRAMS 9

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

UNIT II HEAT TREATMENT 9

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

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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.

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

TOTAL: 45 PERIODS

OUTCOMES

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

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

TEXT BOOKS:

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

Principal  
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OBJECTIVES:

- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

STRENGTH OF MATERIALS

30

LIST OF EXPERIMENTS

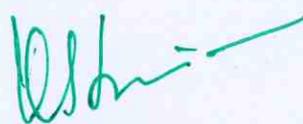
1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical Properties Comparison  
(i) Unhardened specimen (ii) Quenched Specimen and (iii) Quenched and tempered specimen.
11. Microscopic Examination of  
(i) Hardened samples and (ii) Hardened and tempered samples.

OUTCOME:

- Ability to perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1

  
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5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7	Metallurgical Microscopes	3
8	Muffle Furnace (800 C)	1

## FLUID MECHANICS AND MACHINES LABORATORY

30

### LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL: 60 PERIODS

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

- Perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.
- Use the measurement equipments for flow measurement.
- Perform test on different fluid machinery.

### LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty
1	Orifice meter setup	1
2	Venturi meter setup	1
3	Rotameter setup	1
4	Pipe Flow analysis setup	1
5	Centrifugal pump/submergible pump setup	1
6	Reciprocating pump setup	1
7	Gear pump setup	1
8	Pelton wheel setup	1
9	Francis turbine setup	1
10	Kaplan turbine setup	1

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**EXPERIMENTAL INVESTIGATION ON SUGARCANE  
BAGASSE WITH WASTE PLASTIC COMPOSITE  
MATERIAL**

**A PROJECT REPORT**

*Submitted by*

**MANIKANDAN P (311819114303)**  
**RAMKUMAR C (311819114305)**  
**SARATHKUMAR N (311819114311)**

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

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**



*Mohamed Sathak A.J.*

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**MAY 2023**

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "EXPERIMENTAL INVESTIGATION ON SUGARCANE BAGASSE WITH WASTE PLASTIC COMPOSITE MATERIAL" is the bonafide work of "Ram Kumar C (311819114305), Manikandan P (311819114303), Sarath Kumar N (311819114311)" who carried out the project work under my supervision.

M. V. 18/5/23  
SIGNATURE

Dr. M. SHUNMUGASUNDARAM,  
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HEAD OF THE DEPARTMENT,  
Associate Professor,  
Department of Mechanical  
Engineering,  
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of Engineering .

Mr. L. Tharani Kumar  
SIGNATURE 18/5/23

Mr. L. THARANI KUMAR, B.E.,  
M.E., (Ph.D.),  
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Assistant Professor,  
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of Engineering .

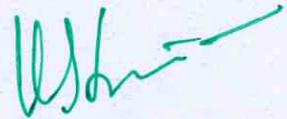
Practical viva-voice held on 18/05/2023

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## ABSTRACT

The main objective of this project is to make composite material by using waste bagasse and waste plastic materials, the entire fibres are made in the form of chopped fibres and the mixture of chopped fibres is mixed with epoxy resin and hardner materials, the mixed material is poured in the mould panel and the composite material is prepared, the prepared composite material is undergone mechanical testings like Tensile, Flexural, Impact, Harness and Water absorption test. The entire experiment can be done in three different ratios of Resin hardner mixer with Sugarcane fibre and waste plastic materials 95-5, 90-10, 85-15 % of weights



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## CHAPTER 6

### CONCLUSION

The experimental investigation on the plastic waste fiber and sugarcane fiber composite material is prepared by using hand layup method of fabrication method with the different composition of 95%, 90%, 85% of resin and 5%, 10%, 15% of fiber materials the results obtained for tensile test, flexural strength, impact strength, hardness and water absorption test of the materials the results values are increased linearly for increase in the weight of fiber materials



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Chennai - 603103.

**OBJECTIVE:**

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

**UNIT I ALLOYS AND PHASE DIAGRAMS 9**

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

**UNIT II HEAT TREATMENT 9**

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

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

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

**UNIT IV NON-METALLIC MATERIALS 9**

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

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

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

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

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

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

**TEXT BOOKS:**

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

  
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**CE8381 STRENGTH OF MATERIALS AND FLUID MECHANICS AND MACHINERY  
LABORATORY**

L T P C

0 0 4 2

**OBJECTIVES:**

- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

**STRENGTH OF MATERIALS**

30

**LIST OF EXPERIMENTS**

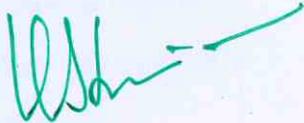
1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical Properties Comparison  
(i) Unhardened specimen (ii) Quenched Specimen and (iii) Quenched and tempered specimen.
11. Microscopic Examination of  
(i) Hardened samples and (ii) Hardened and tempered samples.

**OUTCOME:**

- Ability to perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.

**LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS**

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Universal Tensile Testing machine with double shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1

  
**PRINCIPAL**  
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Sipcot - IT Highway Egattur,  
Chennai - 603103.

**DRY SLIDING WEAR BEHAVIOUR OF AA6351/TiB<sub>2</sub> IN  
SUIT COMPOSITIES**

**A PROJECT REPORT**

Submitted by

**M. MOHAMMED ISMAIL (311819114016)**  
**K. NAJU BUDEEN (311819114019)**  
**V. UMA SHANKAR (311819114309)**

*In partial fulfillment for the award of the degree*

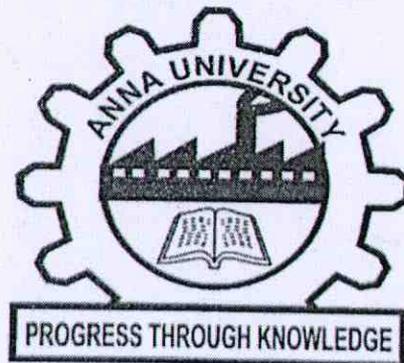
Of

**BACHELOR OF ENGINEERING**

In

**MECHANICAL ENGINEERING**

**MOHAMED SATHAK A J COLLEGE OF ENGINEERING**



*Wsh*

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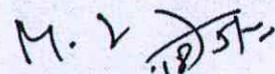
**ANNA UNIVERSITY : CHENNAI 600025**

**MAY 2023**

# ANNA UNIVERSITY : CHENNAI 600 025

## BONAFIDE CERTIFICATE

Certified that this project report "DRY SLIDING WEAR BEHAVIOUROFAA6351/TiB<sub>2</sub> IN SUIT COMPOSITIES" is the bonafide work of " M. MOHAMMED ISMAIL (311819114016), K. NAJU BUDEEN (311819114019) AND V. UMA SHANKAR (311819114309)", who carried out the project work under my supervision.

  
SIGNATURE

  
SIGNATURE

Dr. M. SHUNMUGASUNDARAM, M.E, Ph.D;

MR. MOHAN S.R M.Tech

HEAD OF THE DEPARTMENT

SUPERVISOR

Professor,

Assistant Professor,

Department of Mechanical Engineering

Department of Mechanical Engineering

Mohamed Sathak A J College

Mohamed Sathak A J College

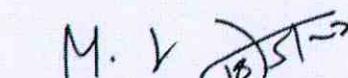
of Engineering

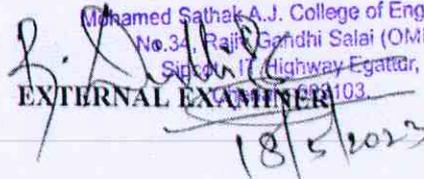
of Engineering

Chennai - 603 103

Chennai - 603 103

Project Viva-Voce held on 18/05/2023

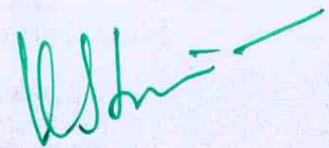
  
INTERNAL EXAMINER

  
**PRINCIPAL**  
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Chennai - 603 103  
  
EXTERNAL EXAMINER  
18/5/2023

## ABSTRACT

The influence of titanium diboride ( $TiB_2$ ) loading on the dry sliding wear characteristics of aluminum 6351 matrix alloy-titanium diboride ( $Al/TiB_2$ ) composite materials has been assessed using a pin-on disc wear tester at different loads. The composites with (0,5,10,15 wt%) of fine  $TiB_2$  particles were fabricated using stir casting technique. For comparison, as-cast of the base alloy were made under the same processing applied for  $Al/TiB_2$  composites. The results indicate that fine  $TiB_2$  particles markedly improved the wear performance of the aluminum 6351 matrix alloy. The coefficient of friction decreases with decrease in the amount of  $TiB_2$ , but this effect was more pronounced in dry sliding. Hardness of composites increased with increasing  $TiB_2$  loading. The wear rates increase with increase in load and dependent upon  $TiB_2$  loading in the base alloy. Among the composites tested,  $Al/TiB_2$  composites containing 9 wt%  $TiB_2$  exhibited superior wear resistance over the base alloy  $Al/TiB_2$  composites. These observations were correlated in terms of the  $TiB_2$  loading in base alloy which resulted in the variations of the hardness.

KeyWord: AA6351,  $TiB_2$ , Stir Casting, Dry Wear Sliding Testing and Optical Microscope Structure Testing.



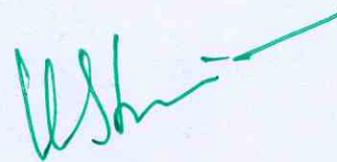
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Chennai - 603103.

## CHAPTER 5

### CONCLUSION

This Microstructural and Dry Sliding Wear Behaviour of AA6351/TiB<sub>2</sub> Composites were investigated and the following Conclusion were obtained.

1. By Using of optical Microscope to confirms that TiB<sub>2</sub> and AA6351 are present within the composite.
2. The strong interfacial bonding of TiB<sub>2</sub>, particles with the matrix should enhance the mechanical properties of composite.
3. Wear rate and co-efficient of friction has been drastically reduced to which increases strength of material and hardness.



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ME8491

ENGINEERING METALLURGY

L T P C  
3 0 0 3

OBJECTIVE:

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

UNIT I ALLOYS AND PHASE DIAGRAMS 9

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

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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.

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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.

PRINCIPAL

TEXT BOOKS:

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

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Chennai - 603105.

**DESIGN AND DEVELOPMENT OF PEN TYPE  
PRESSURE GAUGE FOR VEHICLES**

**A PROJECT REPORT**

*Submitted by*

**ARSATH A (311819114301)**

**SYED SUFFIYAN (311819114308)**

**VIJAY SARATH V (311819114310)**

*In partial fulfillment for the award of the degree*

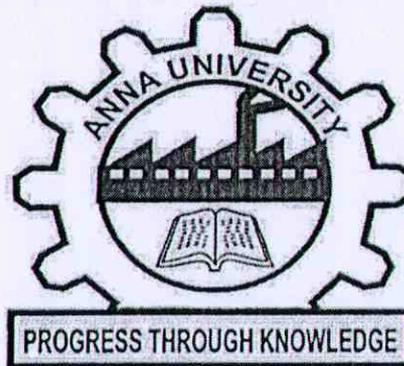
of

**BACHELOR OF ENGINEERING**

IN

**MECHANICAL ENGINEERING**

**MOHAMED SATHAK A J COLLEGE OF ENGINEERING**



**ANNA UNIVERSITY : CHENNAI 600025**

**MAY 2023**

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Chennai - 603103.

ANNA UNIVERSITY : CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "DESIGN AND DEVELOPMENT OF PEN TYPE PRESSURE GAUGE FOR VEHICLES" is the bonafide work of "ARSATH.A (31181114301), SYED SUFFIYAN (311819114308) and VIJAY SARATHI V (311819114310)", who carried out the project work under my supervision.

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Project Viva-Voce held on 18/05/2023.

M. V 18/5/23

INTERNAL EXAMINER

18/5/2023

EXTERNAL EXAMINER

18/5/23

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## ABSTRACT

This abstract describes a new type of pressure gauge designed for measuring pressure in vehicles. The gauge uses a pen-shaped design with a spring mechanism to accurately measure pressure. The spring mechanism is calibrated to provide precise measurements within a specific pressure range, and the pencil design allows for easy handling and storage. To use the gauge, the user simply inserts the pen tip into the pressure source, due to pressure the spring gets compressed and moves scale, visible reading on scale displays pressure. The gauge then provides a reading of the pressure on a printed scale. The design of these gauges typically involves a spring mechanism that is compressed or extended in response to changes in pressure, causing a pointer to move along a scale and indicate the pressure reading. The design and optimization of these gauges often involve finite element analysis and experimental testing to ensure their performance meets the desired requirements. The pen type pressure gauge using a spring mechanism is a compact and portable tool that can be used in a variety of automotive applications. It provides a cost-effective solution for measuring pressure with high accuracy and reliability, making it an essential tool for anyone who needs to measure pressure in a range of settings.

**Key words:** Gauge, Helical, Sensitivity, Accuracy, Valve stem, Reliability



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## CHAPTER 10

### CONCLUSION

We have successfully developed a model which has unique design and low cost compare to other gauges and it does not need any external power source or aid to run. Overall pen-type pressure gauges are reliable and accurate tool for measuring pressure in a variety of applications. Their compact size and handheld design make them particularly useful for consumers. It is not only used to measure pressure but also improves tire efficiency and fuel economy and can be used in any environment which makes it more suitable.

1. Pen gauge is more accurate and has longer lifespan around 15 years
2. All analysis have been done to check proper utilization of gauge
3. Compared to other gauges, pen gauge has satisfied customer needs like low cost, highly portable.

Thus this makes pen gauge a standard tool for measuring pressure in vehicles.



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**OBJECTIVES**

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

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

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

**UNIT II FLOW THROUGH CIRCULAR CONDUITS 12**

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

**UNIT III DIMENSIONAL ANALYSIS 12**

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

**UNIT IV PUMPS 12**

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

**UNIT V TURBINES 12**

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

**TOTAL: 60 PERIODS****OUTCOMES:**

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

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

**TEXT BOOK:**

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



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ME8381

**COMPUTER AIDED MACHINE DRAWING**

L T P C  
0 0 4 2

**OBJECTIVES:**

- To make the students understand and interpret drawings of machine components
- To prepare assembly drawings both manually and using standard CAD packages
- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain practical experience in handling 2D drafting and 3D modeling software systems.

**UNIT I DRAWING STANDARDS & FITS AND TOLERANCES 12**

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions – Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning & tolerancing.

**UNIT II INTRODUCTION TO 2D DRAFTING 16**

- Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing.
- Bearings - Bush bearing, Plummer block
- Valves – Safety and non-return valves.

**UNIT III 3D GEOMETRIC MODELING AND ASSEMBLY 32**

Sketcher - Datum planes – Protrusion – Holes - Part modeling -- Extrusion – Revolve – Sweep – Loft – Blend – Fillet - Pattern – Chamfer - Round - Mirror – Section - Assembly

- Couplings – Flange, Universal, Oldham's, Muff, Gear couplings
- Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints
- Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch
- Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pump

**TOTAL:60 PERIODS**

**Note:** 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software

**OUTCOMES:**

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

CO1 Follow the drawing standards, Fits and Tolerances

CO2 Re-create part drawings, sectional views and assembly drawings as per standards

**TEXT BOOK:**

1. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013

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**REFERENCES:**

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers, 2013
2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing", published by Tata Mc GrawHill, 2006
4. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

A COMPARATIVE STUDY OF CONVENTIONAL  
AND ALTERNATIVE LOCKING MECHANISMS FOR  
MC4 PV CONNECTORS

A PROJECT REPORT

*Submitted by*

ATEF JAMALUDEEN

(311819114003)

*in partial fulfillment for the award of the degree*

*of*

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

MOHAMMED SATHAK A J COLLEGE OF ENGINEERING



ANNA UNIVERSITY: CHENNAI 600 025

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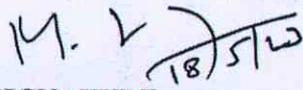
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No.34, Rajiv Gandhi Salai  
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Chennai - 600100.

ANNA UNIVERSITY: CHENNAI 600 025

**BONAFIDE CERTIFICATE**

Certified that this project report “A Comparative Study of Conventional and Alternative Locking Mechanisms for MC4 PV Connectors” is the bonafide work of ATEF JAMALUDEEN (311819114003) who carried out the project work under my supervision.

  
SIGNATURE

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**HEAD OF THE DEPARTMENT**  
Professor,  
Department of Mechanical  
Engineering  
Mohamed Sathak A J College of  
Engineering

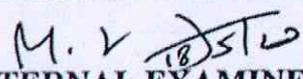
  
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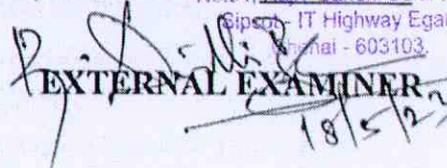
**Mr. D Sakthivel M.E.,**  
**SUPERVISOR**  
Assistant Professor,  
Department of Mechanical  
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Mohamed Sathak A J College of  
Engineering



Submitted for the university practical examination held at **MOHAMED**

**SATHAK A J COLLEGE OF ENGINEERING, CHENNAI** on 18/5/23

  
INTERNAL EXAMINER

  
EXTERNAL EXAMINER  
18/5/23

**PRINCIPAL**

Mohamed Sathak A.J. College of Engineering  
No. 4, Rajiv Gandhi Salai (O.M.R)  
Gipson - IT Highway Egattur,  
Chennai - 603103.

## ABSTRACT

This study presents a comparative study of conventional and alternative locking mechanisms for MC4 photovoltaic (PV) connectors. Currently, MC4 connectors rely on a snap-in design for locking, but alternative locking mechanisms such threaded locks (and Bayonet) have been proposed as potential improvements. In this study, the performance of different locking mechanisms, considering factors such as ease of use, durability, and compatibility with existing PV systems have been studied. The potential for new designs that incorporate elements of these alternative locking mechanisms have also been designed and explored. The results of this study conclude that alternative locking mechanisms, particularly the bayonet lock, offer potential improvements in reliability and ease of use. This report serves as an exploratory study into guiding towards the possibilities of replacing the current mechanism with ones with better reliability and ease of use.



Mohamed Sathak A. S. (Author)  
No. 34, Rajiv Gandhi Salai (Old),  
Sipcot, Highway Egattur,  
Chennai - 603103.

**Keywords:** Solar connector; MC4 photovoltaic connector; Locking mechanism;

Snap-in lock; Threaded lock; Screw-in lock; Bayonet lock; Twist-lock.

## CHAPTER 7

### CONCLUSION

In summary, this study has compared conventional snap-in locking mechanisms for MC4 photovoltaic connectors to alternative locking mechanisms such as screw-in lock and the bayonet lock. Two new designs with alternative locking mechanisms have been designed, the efficiency and performance of which have been analysed using finite element analysis. The results of this study indicate that alternative locking mechanisms offer potential improvements in ease of use, durability, and compatibility with existing PV systems. This study highlights the potential for new designs that incorporate elements of these alternative locking mechanisms to improve the performance of MC4 PV connectors. In addition, the bayonet and screw-in locking mechanisms are found to be more environmentally friendly, as they do not require additional tooling. However, further research is required to fully assess the potential of these alternative locking mechanisms. This report serves as an exploratory study into guiding towards the possibilities of replacing the current mechanism with ones with better reliability and ease of use.



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**CE8395 STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS**

L T P C

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**OBJECTIVES:**

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

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

9

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

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

9

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

**UNIT III TORSION**

9

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

**UNIT IV DEFLECTION OF BEAMS**

9

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

**UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS**

9

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

**TOTAL: 45 PERIODS**

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ME8681

CAD / CAM LABORATORY

L	T	P	C
0	0	4	2

**OBJECTIVES:**

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

**LIST OF EXPERIMENTS**

30 PERIODS

**1. 3D GEOMETRIC MODELLING**

**List of Experiments**

1. Introduction of 3D Modelling software

Creation of 3D assembly model of following machine elements using 3D Modelling software

2. Flange Coupling
3. Plummer Block
4. Screw Jack
5. Lathe Tailstock
6. Universal Joint
7. Machine Vice
8. Stuffing box
9. Crosshead
10. Safety Valves
11. Non-return valves
12. Connecting rod
13. Piston
14. Crankshaft

\* Students may also be trained in manual drawing of some of the above components

30 PERIODS

**2. Manual Part Programming.**

(i) Part Programming - CNC Machining Centre a) Linear Cutting.

b) Circular cutting.

c) Cutter Radius

Compensation. d) Canned

Cycle Operations.

(ii) Part Programming - CNC Turning

Centre a) Straight, Taper and Radius Turning.

b) Thread Cutting.

c) Rough and Finish Turning

Cycle. d) Drilling and Tapping

Cycle.

**3. Computer Aided Part Programming**

e) CL Data and Post process generation using CAM packages.

f) Application of CAPP in Machining and Turning Centre.

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**TOTAL: 60 PERIODS**

**OUTCOMES**

CO1 Draw 3D and Assembly drawing using CAD software

CO2 Demonstrate manual part programming with G and M codes using CAM

**MATERIAL OPTIMIZATION FOR AIRCRAFT  
INTERIOR APPLICATION BY USING NATURAL FIBERS**

**A PROJECT REPORT**

*Submitted by*

**HELAL AHAMED M**

**311819114007**

**LAKSHAN M**

**311819114010**

**MOHAMMED KURSHITH ALI M**

**311819114017**

*In partial fulfilment for the award of the degree*

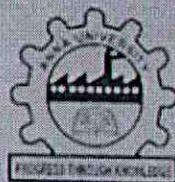
*of*

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**

**MOHAMED SATHAK A J COLLEGE OF ENGINEERING,  
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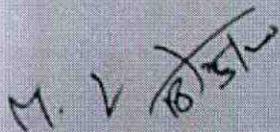
**ANNA UNIVERSITY: CHENNAI 600 025**

**MAY 2023**

ANNA UNIVERSITY : CHENNAI 600 025

BONAFIDE CERTIFICATE

It is certified that this project report titled " MATERIAL OPTIMIZATION FOR AIRCRAFT INTERIOR APPLICATION BY USING NATURAL FIBERS " is bonafide work of " HELAL AHAMED M (311819114007), LAKSHAN M (311819114010), MOHAMMED KURSHITH ALI M (311819114017) " who carried out the research under my supervision



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Department of Mechanical Engineering,  
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T Sipcot, OMR, Siruseri,  
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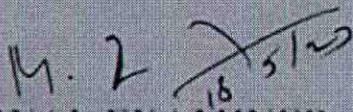
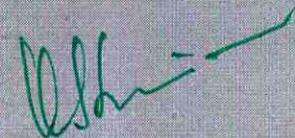


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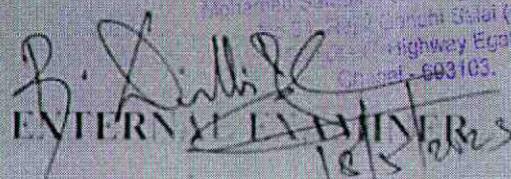
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Practical viva-voice held on 18-05-2023



INTERNAL EXAMINER



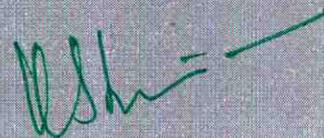
EXTERNAL EXAMINER  
18/5/2023

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## ABSTRACT

Polymers and their composites are one of the most advanced and adaptable engineering materials. The strength of any composite depends upon number of factors such as volume/weight fraction of reinforcement, types of fibers, orientation angles, chemical treatment of reinforcement and many others. The present work focuses on the analysis of mechanical properties (**Tensile and Flexural**) of synthetic and natural fiber (**SISAL Fiber & BANANA Fiber**) reinforced with epoxy composites. An attempt is made to reduce the usage of synthetic glass fibers by incorporating natural banana fibers such that the resultant hybrid composite shows increased strength when compared with single synthetic fibers (**GLASS Fiber**). The test specimens were prepared and tested according to standards. Experimental results revealed that reinforcement of natural fibers up to some extent increases the mechanical properties and reduces the overall cost of fabrication of composites.

**KEYWORDS** Banana Fiber, Glass Fiber, Sisal Fiber, Epoxy



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## CHAPTER II

### CONCLUSION

The mechanical properties of the natural fibre composites using glass, banana and sisal fibre reinforced epoxy resin composites were studied in this work. The composites were fabricated by hand layup technique and tested according to standard. From the experiment the following conclusions have been drawn. It has been observed that the various properties of the composites are greatly influenced by the fibre loading and fibre length. From the mechanical property tests of tensile, Flexural, shore hardness "D" can be observed from composites in the strength properties. The hardness value and ultimate tensile strength in natural fibre composites compared with Glass fibre enhanced value are More or less equivalent to glass fibre.



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**ME8491****ENGINEERING METALLURGY**

L	T	P	C
3	0	0	3

**OBJECTIVE:**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**TEXT BOOKS:**

- Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1967
- Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2014

**PRINCIPAL**  
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 Sipcot - IT Highway Egattur,  
 Chennai - 603103.

OBJECTIVES:

- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

STRENGTH OF MATERIALS

30

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod

2. Double shear test on Mild steel and Aluminium rods
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  10. Tempering- Improvement Mechanical Properties Comparison
- (i) Unhardened specimen (ii) Quenched Specimen and (iii) Quenched and tempered specimen.

11. Microscopic Examination of

- (i) Hardened samples and (ii) Hardened and tempered samples.

OUTCOME:

- Ability to perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1

**EXPERIMENTAL INVESTIGATION OF GLASS,  
BANANA AND ARECA FIBER OF HYBRID  
COMPOSITE MATERIAL**

**A PROJECT REPORT**

*Submitted by*

**ABDULLAH B (311819114002)**

**GUNAL S (311819114006)**

**MOHAMED TOWFIC A (311819114014)**

*In partial fulfilment for the award of the degree*

*of*

**BACHELOR OF ENGINEERING**

*in*

**MECHANICAL ENGINEERING**

**MOHAMED SATHAK A J COLLEGE OF ENGINEERING,**

**CHENNAI 603 103**



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Sipcot - IT Highway Egattur,  
Chennai - 603103.

**MAY 2023**

ANNA UNIVERSITY: CHENNAI 600 025

**BONAFIDE CERTIFICATE**

Certified that this project report "EXPEERIMENTAL INVESTIGATION OF GLASS, BANANA AND ARECA FIBER OF HYBRID COMPOSITE MATERIAL" is the bonafide work of "ABDULLAH B(311819114002), GUNAL S(311819114006),MOHAMED TOWFIC A(311819114014) who carried out the project work under my supervision.

M. V. [Signature] 18/5/23

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**HEAD OF THE DEPARTMENT,**

Mechanical Engineering,

MSAJCE,

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SIGNATURE

Mr.D.Sakthivel M.E.,

**SUPERVISOR,**

Assistant Professor,

Mechanical Engineering,

MSAJCE,

Chennai 603 103.

Submitted for Viva-Voice examination held on....18/05/2023

[Signature]

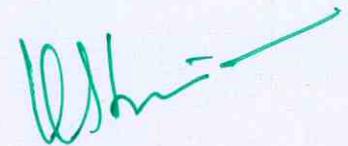
M. V. [Signature] 18/5/23  
INTERNAL EXAMINER

[Signature]  
PRINCIPAL  
Mohamed Sathik A. College of Engineering  
Sai Sai (OMR)  
EXTERNAL EXAMINER  
18/5/23

## ABSTRACT

The composites are one of the advanced engineering materials which are commonly used in this decade in day today life. The natural fibers are used for the reinforcement in order to get higher strength, reduced density, lower weight for several applications. In this work, an attempt is made to hybridize using Glass (synthetic) fiber ,Banana (natural) fiber and areca fiber with Epoxy resin as the matrix material.The composites are fabricated using the Hand Lay-Up method for the different weight percentages of the reinforcements. The mechanical properties are evaluated by conducting tests such as Tensile test, Flexural test, Impact test,Hardness test, Water absorption test .

**KEYWORDS:** Glass Fiber, Banana Fiber, Areca Fiber, Tensile Test, ImpactTest, Barcol Hardness Test, Flextural Test, Water Adsorbtion Test.

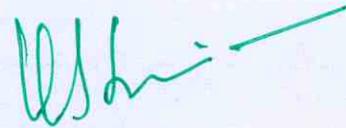


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Chennai - 603 103.

## CHAPTER 7

### CONCLUSION

The hybrid composite material GFRP, Areca fiber and Banana fiber is prepared by using hand layup method of fabrication process, in this method 300mm x 300mm size of the plate is prepared for the material testing's. Flexural strength of 72.20MPa, Tensile Strength of 37.57 MPa, Barcol Hardness value 48, Impact strength value of 7.2 and water absorption value is 0.02% is improved in this composite material



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ME8491

**ENGINEERING METALLURGY**

L T P C  
3 0 0 3

**OBJECTIVE:**

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

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**TOTAL: 45 PERIODS**

**OUTCOMES**

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**TEXT BOOKS:**

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- Williams D Callister, "Material Science and Engineering" Wiley India Pvt. Ltd. Revised Indian Edition 2014

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Sipcot - IT Highway Egattur,  
Chennai - 603103.

OBJECTIVES:

- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

STRENGTH OF MATERIALS

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Chennai - 603103.

**DESIGN OPTIMIZATION OF FRAME IN GO KART**

**A PROJECT REPORT**

*Submitted by*

<b>JAHETH SALMAN .B</b>	<b>311819114008</b>
<b>MOHAMED ARSATH .M</b>	<b>311819114011</b>
<b>MOHAMMED IRFAAN .P</b>	<b>311819114015</b>

*In partial fulfilment for the award of the degree*

*of*

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**

**MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING**



**ANNA UNIVERSITY: CHENNAI 600 025**

**MAY 2023**

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Chennai - 603103.

ANNA UNIVERSITY: CHENNAI 600 025

**BONAFIDE CERTIFICATE**

Certified that this project report "DESIGN OPTIMIZATION OF FRAME IN GO KART "is the bonafide work of "JAHETH SALMAN B (311819114008), MOHAMED ARSATH M (311819114011) and MOHAMMED IRFAAN P (311819114015) ", who carried out the project work under my supervision.

M. V. JST  
18/5/23  
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Submitted for the university practical examination held on 18/05/2023

M. V. JST  
18/5/23  
INTERNAL EXAMINER

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18/5/2023

## ABSTRACT

This project aims to optimize the design of a go-kart chassis to increase its cornering stability by improving its torsional stiffness. Due to the absence of a differential gear and suspension system, the chassis must be responsible for offering proper rigidity and torsional stiffness to the kart and producing load transfers during cornering. The Chassis presented by Solazzi is adopted to be the parent model, The design concept performed in this project is the arrangement of extra members at suitable positions on the chassis frame. SolidWorks software is utilized for the design and analysis of the chassis. The project involves the use of computer-aided engineering tools to determine the stress and deformation levels in the chassis, this project also emphasizes the safety of the drivers by improving the cornering stability of the chassis.

The optimized design is intended to ensure that the go-kart remains structurally stable during high-speed cornering, reducing the risk of accidents and enhancing the safety of the drivers. The results are then used to optimize the design and increase the torsional stiffness of the chassis, which can be used to improve the cornering performance of go-karts and safety of the drivers.



**PRINCIPAL**  
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No.34, Rajiv Gandhi  
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## CHAPTER 7

### CONCLUSION

In conclusion, the design optimization of a go-kart frame is a complex process that involves the consideration of multiple performance criteria and constraints. Through the use of simulation models and optimization techniques, the design can be refined to meet the desired performance metrics.

The results of the optimization process can lead to improved performance, safety, and sustainability, with implications for the motorsport industry and beyond. However, there are limitations to the current study, such as the simplified assumptions made in the simulation models, and opportunities for future work, such as exploring new materials and incorporating machine learning algorithms.

Overall, this project aims to improve the cornering stability of kart frame by improving its torsional stiffness. Chassis frame has been modelled using SolidWorks and analysis were carried out using the same, results are discussed to choose the optimum design which satisfies the objective of this project.



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**CE8395 STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS**

L T P C

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**OBJECTIVES:**

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

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

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

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

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

**UNIT III TORSION 9**

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

**UNIT IV DEFLECTION OF BEAMS 9**

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

**UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9**

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

**TOTAL: 45 PERIODS**

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**CAD / CAM LABORATORY**

L	T	P	C
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**OBJECTIVES:**

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

**LIST OF EXPERIMENTS**

**1. 3D GEOMETRIC MODELLING**

**30 PERIODS**

**List of Experiments**

**1. Introduction of 3D Modelling software**

**Creation of 3D assembly model of following machine elements using 3D Modelling software**

2. Flange Coupling
3. Plummer Block
4. Screw Jack
5. Lathe Tailstock
6. Universal Joint
7. Machine Vice
8. Stuffing box
9. Crosshead
10. Safety Valves
11. Non-return valves
12. Connecting rod
13. Piston
14. Crankshaft

\* Students may also be trained in manual drawing of some of the above components

**2. Manual Part Programming.**

**30 PERIODS**

- (i) Part Programming - CNC Machining Centre  
a) Linear Cutting.  
b) Circular cutting.  
c) Cutter Radius Compensation. d) Canned Cycle Operations.
- (ii) Part Programming - CNC Turning Centre  
a) Straight, Taper and Radius Turning.  
b) Thread Cutting.  
c) Rough and Finish Turning Cycle. d) Drilling and Tapping Cycle.

**3. Computer Aided Part Programming**

- e) CL Data and Post process generation using CAM packages.
- f) Application of CAPP in Machining and Turning Centre.

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**TOTAL: 60 PERIODS**

**OUTCOMES**

- CO1 Draw 3D and Assembly drawing using CAD software
- CO2 Demonstrate manual part programming with G and M codes using CAM

EFFECT OF WELDING PARAMETER ON TIG  
WELDING OF INCONEL 718 ALLOY

A PROJECT REPORT

*Submitted by*

AA YATHUL MUFARAK A (311819114001)

MOHAMED SHAJITH M (311819114013)

UMAR MUBARAK M (311819114021)

*In partial fulfilment for the award of the degree*

*of*

BACHELOR OF ENGINEERING

In

MECHANICAL ENGINEERING

MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING,

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*WSh*

ANNA UNIVERSITY: CHENNAI 600 025

APRIL 2023

Mohamed Sathak A.J. College of Engineering  
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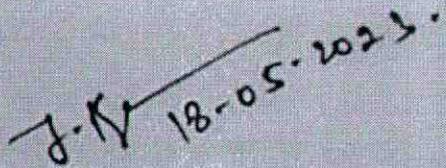
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BONAFIDE CERTIFICATE

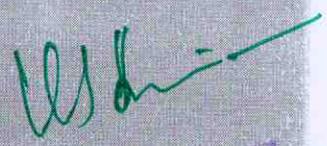
Certified that this project report "EFFECT OF WELDING PARAMETER ON TIG WELDING OF INCONEL 718 ALLOY" is the bonafide work of "AAYATHUL MUFARAK A(311819114001), MOHAMED SHAJITH M(311819114013) and UMAR MUBARAK M(311819114021) who carried out the project work under my supervision.

  
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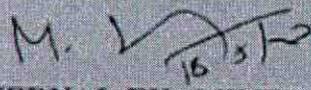
  
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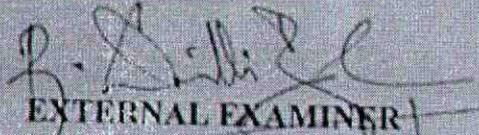
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Submitted for Viva-Voce examination held on... 18-05-2023

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(MSAJCE)

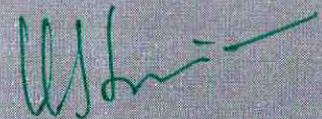
  
INTERNAL EXAMINER

  
EXTERNAL EXAMINER  
18/5/2023

## ABSTRACT

Inconel 718, since its invention, has been a material of choice for industries where components in service conditions are exposed to extremely high temperatures, corrosion, and oxidation environments. As per the American welding society for butt-joining such alloys non-traditional techniques are the best means for producing permanent joints. These techniques require high-cost setup and high maintenance costs which are only economical for high-volume assembly line fabrication in mass-production facilities. Therefore, Tungsten Inert Gas (TIG) welding is highly suitable for producing defect-free autogenous weldments in high-strength alloy. This work focuses on the experimental investigation on welding current in TIG welded Inconel 718 alloy. The microstructure and microhardness properties are studied. Current is varied from 40A to 70A with a voltage of 12V. Combinations of welding current shows the variations in microhardness and microstructure in the weldments are investigated. The main objective of the study is to find the feasible welding current for achieving the higher microhardness in the welded Inconel 718 alloy.

Keywords: Tungsten inert gas (TIG) welding, Inconel 718, Welding current, Voltage



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## CHAPTER 5

### CONCLUSION

Based on the result obtained from the experiments conducted to study the properties of Inconel 718 alloy using TIG welding for the different welding current the following conclusions were made,

- It can be noted that the maximum microhardness of 272 HV was observed under the base current of 40 A in sample 4 and the minimum microhardness of 247 HV was observed at the welding current of 65A for sample 2.
- In weld zone, fine acicular grains influence the microhardness value i.e., grain size decreases with increase in microhardness value.
- In HAZ, presence of acicular grains influence the microhardness value i.e., grain size decreases with increase in microhardness value.

In general, lower welding currents result in higher microhardness values and vice versa.



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**OBJECTIVE:**

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

**UNIT I METAL CASTING PROCESSES 9**

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing –Cores T-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 s–pecial 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:**

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

**OBJECTIVE:**

- To Study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.

**LIST OF EXPERIMENTS**

Machining and Machining time estimations for:

- Taper Turning
- External Thread cutting
- Internal Thread Cutting
- Eccentric Turning
- Knurling
- Square Head Shaping
- Hexagonal Head Shaping
- Fabrication of simple structural shapes using Gas Metal Arc Welding
- Joining of plates and pipes using Gas Metal Arc Welding/ Arc Welding /Submerged arc welding
- Preparation of green sand moulds
- Manufacturing of simple sheet metal components using shearing and bending operations.
- Manufacturing of sheet metal components using metal spinning on a lathe

**TOTAL: 60 PERIODS****OUTCOMES:**

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

- CO1 Demonstrate the safety precautions exercised in the mechanical workshop.  
 CO2 Make the workpiece as per given shape and size using Lathe.  
 CO3 Join two metals using arc welding.  
 CO4 Use sheet metal fabrication tools and make simple tray and funnel.  
 CO5 Use different moulding tools, patterns and prepare sand moulds.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S. NO.	NAME OF THE EQUIPMENT	Qty.
1	Centre Lathes	7 Nos.
2	Horizontal Milling Machine	1 No
3	Vertical Milling Machine	1 No
4	Shaper	1 No.
5	Arc welding transformer with cables and holders	2 Nos
6	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit	1 No
7	Moulding table, Moulding equipments	2 Nos
8	Sheet metal forming tools and equipments	2 Nos.


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**DESIGN AND FABRICATION OF SEMIAUTOMATIC  
LOAD TESTING MACHINE ON SCREW THREAD  
USING AC MOTOR WITH GEAR BOX**

**A PROJECT REPORT**

*Submitted by*

**KABIR MOHAMED A**

**(311819114009)**

*in partial fulfillment for the award of the degree*

*of*

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**

**MOHAMMED SATHAK A. J. COLLEGE OF ENGINEERING**



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**ANNA UNIVERSITY : CHENNAI 600025**

**APRIL 2023**

ANNA UNIVERSTY : CHENNAI 600 025

**BONAFIDE CERTIFICATE**

Certified that this project report “DESIGN AND FABRICATION OF SEMIAUTOMATIC LOAD TESTING MACHINE ON SCREW THREAD USING AC MOTOR WITH GEAR BOX” is the bonafide work of KABIR MOHAMED A (311819114009), who carried out the project work under my supervision.

*M. V. J*  
*18/5/23*  
SIGNATURE

Dr.M.Shunmugasundaram M.E., Ph.D.,  
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Mechanical Engineering,  
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*J. K. V*  
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MSAJCE,  
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Submitted for the viva-voce examination held on 18-05-2023  
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*M. V. J*  
*18/5/23*  
INTERNAL EXAMINER

*R. S. S*  
*18/5/23*  
EXTERNAL EXAMINER

## ABSTRACT

Load testing is an essential procedure for evaluating the strength and performance of screw threads. Screw threads are widely used in various applications, such as fastening, power transmission, and precision mechanics. Load testing involves applying an external force or load on the screw thread and measuring its response to determine its durability and resistance to deformation or failure. The load testing process for screw threads typically involves subjecting the screw to an axial or torsional load, or a combination of both. The load is gradually increased until the screw thread reaches its maximum load capacity or fails. The load capacity of a screw thread depends on various factors, such as its geometry, material properties, and surface finish. Load testing on screw threads can help identify design flaws, manufacturing defects, and material deficiencies. The test results can be used to optimize the screw thread design and manufacturing process to improve its performance and durability. Load testing is also critical for ensuring the safety and reliability of screws used in critical applications, such as aerospace, automotive, and medical devices. Load testing is an essential procedure for evaluating the performance and strength of screw threads. It can provide valuable insights into the design, manufacturing, and performance optimization of screws used in various applications.



Keywords: Load Testing, Axial Load, Safety and Reliability of screws

Optimization of Screws.

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## CHAPTER 5

### CONCLUSION

There are so many ways are available to change the testing machine into the automation. But we choose the best and simplest method and also more economical method of changing automation. This type of testing machine more easy to handle and operate. Checking the quality of the component is more vital, so this testing machine is more helpful and reliable. In conclusion, load testing is a crucial process for evaluating the performance and reliability of screw threads. It helps determine the maximum load that a screw thread can withstand before it fails, and identifies potential weaknesses and defects in the thread. In this machine load testing i.e., tensile testing and torque testing, and some specialized equipments is required for conducting these tests. Following proper safety protocols is crucial when performing load testing to avoid injury or damage to equipment. By performing load testing on screw threads, manufacturers can ensure that their products meet safety and quality standards, and provide customers with reliable and high-quality mechanical components.



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**OBJECTIVES:**

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

**UNIT I DESIGN OF FLEXIBLE ELEMENTS 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 a–xial 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", 4<sup>th</sup> Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8<sup>th</sup> Edition, Tata McGraw-Hill, 2008.

  
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CAD / CAM LABORATORY

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**OBJECTIVES:**

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
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**30 PERIODS**

**List of Experiments**

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\* Students may also be trained in manual drawing of some of the above components

**2. Manual Part Programming.**

**30 PERIODS**

- (i) Part Programming - CNC Machining Centre  
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c) Cutter Radius Compensation.  
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a) Straight, Taper and Radius Turning.  
b) Thread Cutting.  
c) Rough and Finish Turning Cycle.  
d) Drilling and Tapping Cycle.

**3. Computer Aided Part Programming**

- e) CL Data and Post process generation using CAM packages
- f) Application of CAPP in Machining and Turning Centre.

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**TOTAL: 60 PERIODS**

**OUTCOMES**

- CO1 Draw 3D and Assembly drawing using CAD software  
CO2 Demonstrate manual part programming with G and M codes using CAM

CONSOLIDATED INTERNSHIP DETAILS FOR THE PERIOD OF EVEN SEM 2022 - 2023

Department : Mech					Academic Year: 2022-2023	
S.No	Name of the student	Sem/Year	Name of the Industry	Contact Person Details	Period	#Type of Training
1	Syed Mohammed (311821114307)	4th/2nd	Vignesh Engineering Industries	Mr. Hari (MD) / 9677014047	1 Month	Tools
2	Dhanush Aditya (311821114003)	4th/2nd	National Institute of Wind Energy	Mr. S. Paramasivan / 8052515645	1 Month	Product
3	Shaik Irfan K (311821114014)	4th/2nd	NLC	Mr. M. Srinivasan / 6371175935	26 Days	Product
4	Hari M (311821114006)	4th/2nd	NLC	Mr. M. Srinivasan / 8372166931	26 Days	Product
5	Chandru P (311821114018)	4th/2nd	Pantech e learning pvt. Ltd.	Ms. Swetha (HR) / 9841683932	1 Month	Product
6	Shameer Ahmed A (311821114021)	4th/2nd	Vignesh Engineering	Mr. Hari (MD) / 9677014047	1 Month	Tools
7	Abdur Rahman J (311821114017)	4th/2nd	Vignesh Engineering	Mr. Hari (MD) / 9677014047	1 Month	Tools
8	J.Abdul Kaffar (311821114002)	4th/2nd	JASS Metal Works LLC	Mr. Arul (HR) / 9940844851	1 Month	Tools

Supporting Documets Required : 1. Communication letters/Mail

2. Copy of Certificate issued by Industry

#Type of Training: Service/Product/Software/Tools/Management Based

Faculty Coordinator

*[Signature]*  
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Esto - 2001

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Rev. Date: 04.01.21

CONSOLIDATED INTERNSHIP DETAILS FOR THE PERIOD OF ODD / EVEN SEM 2022 / 2023

Department : Mechanical Engineering

Academic Year: 2022-23

S.No	Name of the student	Sem/Year	Name of the Industry	Contact Person Details	Period	#Type of Training
1	ABUTHAGIR. J	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
2	ARUN. T	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
3	DINESH. M	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
4	IMTHIYAS. A	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
5	MANIKANDAN. K	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
6	MOHAMED AFROSE	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
7	MOHAMED AJMAL A.R	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
8	MOHAMED GHOUSE NAGUTH	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
9	MOHAMED IJAZ. M	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
10	MOHAMED ILIYAS.S	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
11	MOHAMED ISMAIL. A	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
12	MOHAMED SATHAKATHULL	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product
13	MOHAMMED MANSOOR. S	V/III	SRI KVS INDUSTRIES CHENNAI	Dr. VSVVerchezhiyan MD 9710939322	23/01/2023 TO 04/02/2023	Product

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CONSOLIDATED INTERNSHIP DETAILS FOR THE PERIOD OF ODD / EVEN SEM 2022 / 2023

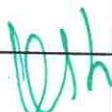
Department : Mechanical Engineering

Academic Year: 2022-23

S.No	Name of the student	Sem/Year	Name of the Industry	Contact Person Details	Period	#Type of Training
1	AADIL T (H)	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director 8608633333	07.07.2023 to 27.07.2023	Service
2	ABDUL KAFFAR (H)	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
3	DHANUSH ADITHYA S	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
4	HARI. M	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
5	JASWIN KUMAR B (H)	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
6	MOHAMED ANSARI N	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
7	SANDEEP . S (H)	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
8	SEYED AHAMED S .T (H)	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
9	SHAIK IRFAN	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
10	UDHAYAKUMAR.G	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
11	ABDUR RAHMAN J	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
12	CHANDRU	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
13	SHAMMER AHAMED	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service

PRINCIPAL  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (O.M.R)  
Sipcot - IT Highway Egattur  
Chennai - 603103

14	SYED MOHAMMED	III/II	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
15	HASAN HAFFIL	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
16	IMTHIYAS. A	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
17	KISHORE P	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
18	MOHAMED ANAS.M	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
19	MOHAMED ANSAR ALI .N	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
20	MOHAMED ASIF M	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
21	MOHAMED MUFEED	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
22	SYED MOHAMED SUFIYAN. S	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
23	MOHAMED YAZIR	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
24	MOHAMED THAISEER S	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
25	MOHAMED YUSUF A	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
26	MOHANRAJ.R	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
27	MOHAMED AGIL ZUBIER	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
28	PRABHU	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
29	SAHUBAR SATHIK N	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
30	SRIRAM.N	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
31	VASANTHA KUMAR. N	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service

  
**PRINCIPAL**  
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 No.34, Rajiv Gandhi Salai (OMR)  
 Sipcot - IT Highway Egattur,  
 Chennai - 600103.

32	VIJAY S	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
33	YUVAN SAI V N	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
34	TAHA MAFAAZ AHMED	V/III	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
35	GOKUL M	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
36	GUNAL	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
37	HELAL AHAMED M	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
38	MOHAMED TOWFIC A	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
39	ARSATH A	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
40	P MANIKANDAN	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
41	MOHAMMED AASHIK M	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
42	SALAUDEEN BADUSHA	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
43	SANJAY KUMAR.C	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
44	SYED SUFFIYAN	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service
45	UMASHANKAR. V	VII/IV	Green Valleys Shelters Pvt. Ltd	Er.K.R.Thirumurugan Managing Director	07.07.2023 to 27.07.2023	Service

Supporting Documets Required :

1. Copy of Communication letters/Mail
2. Copy of Certificate issued by Industry

#Type of Training: Service/Product/Software/Tools/Management Based

Faculty Coordinator

Sign of the HoD with date

Format No : PLA 10

Rev.No.: 1.0

Rev. Date: 04.01.21

PRINCIPAL  
Mohamed Sathak A.J. Centre of Engineering  
155-34, Rajiv Gandhi Salai (K. J. Somaiya)  
Chennai - 603103.

M. 27  
29/7/23

TIN NO: 33361667275  
SI NO: 3300311-09703-F  
EC NO: 0411015982  
IST IN: 33AAJPR3046C1Z0

Cell: 98401 11167  
98840 39549  
96770 14047

# VIGNESH ENGINEERING INDUSTRIES



No. 4/430, Lakshmi Avenue, Sivankoil Street, Periyakalanthan Cheiry,  
Iyyappanthangal, Chennai – 600 056 E-mail: vigneshengg91@yahoo.com

Reg No: 119

Date: 20.07.23

## TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. SYED MOHAMMED, Reg No: 311821114307, B.E Mechanical from Mohamed Sathak A J College of Engineering, Chennai – 603103 has undergone Internship from 20.06.2023 to 20.07.2023 at our VIGNESH ENGINEERING INDUSTRIES.



**FOR VIGNESH ENGINEERING INDUSTRIES**

*[Handwritten Signature]*

**Proprietor**

**FOR VIGNESH INDUSTRIES**

*[Handwritten Signature]*

**PRINCIPAL**

Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.



नीवे NIWE  
(ISO 9001 Certified)

# राष्ट्रीय पवन ऊर्जा संस्थान NATIONAL INSTITUTE OF WIND ENERGY

(पूर्व में "पवन ऊर्जा प्रौद्योगिकी केन्द्र" Formerly "Centre for Wind Energy Technology")  
(नवीन और नवीकरणीय ऊर्जा मंत्रालय, भारत सरकार Ministry of New and Renewable Energy, Government of India)

नीवे/अनुसंधान एवं विकास/ इंटरनशिप / 2023-24  
NIWE / R & D / Internship -43/ 2023-24

दिनांक : 31 जुलाई 2023  
Date: 31.07.2023

## सभी संबंधितों को TO WHOMSOEVER IT MAY CONCERN

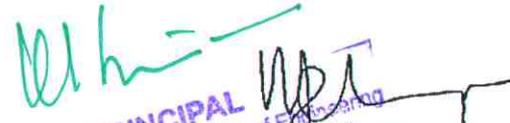
यह प्रमाणित किया जाता है कि श्री/सुश्री/श्रीमती धनुष आदित्य.एस, बी.ई. (मैकेनिकल इंजीनियरिंग) (पंजीकरण सं 311821114003), मोहम्मद साथक ए.जे कॉलेज का इंजीनियरिंग, चेन्नई, ने राष्ट्रीय पवन ऊर्जा संस्थान में 30 जून 2023 से 31 जुलाई 2023 की अवधि में इंटरनशिप कार्यक्रम पूर्ण किया है तथा "पवन टरबाइन रोटर ब्लेड डिजाइन और विश्लेषण" विषय पर रिपोर्ट प्रस्तुत किया है

This is to Certify that Shri / Ms. DHANUSH ADITHYA. S, B.E (Mechanical Engineering) (Reg.No: 311821114003) Mohamed Sathak A.J. College of Engineering, Chennai, has completed an internship at National Institute of Wind Energy, Chennai from 30 June 2023 to 31 July 2023 and submitted a report on "WIND TURBINE ROTOR BLADE DESIGN AND ANALYSIS".

इंटरनशिप की अवधि में उन्होंने आवश्यक अनुशासन, सावधानी निरूपित किया है तथा इंटरनशिप पूर्ण करने हेतु आवश्यक कौशल में विशेषज्ञता प्रदर्शित की है।

During the course of internship, he demonstrated the required discipline, rigour and expertise over the skills required for the completion of this internship.



  
PRINCIPAL  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (Old ECR)  
Sipcot - 605 004  
Chennai - 605 004  
एम.सी. लावण्या  
M.C. LAVANYA  
उप निदेशक (तकनीकी) एवं प्रकोष्ठ प्रमुख,  
अनुसंधान एवं विकास  
Deputy Director (Technical) &  
Unit Chief, R & D

वेलाचेरी - ताम्बरम मुख्य मार्ग, पल्लिकरणई, चेन्नई - 600 100. तमिल नाडु, भारत  
Velachery - Tambaram Main Road, Pallikaranal, Chennai - 600 100. Tamil Nadu, INDIA  
दूरभाष/Tel No.: +91 - 44 - 2246 3982 / 83 / 84, +91 - 44 - 2900 1162 / 1167 / 1195  
फैक्स/Fax No.: +91 - 44 - 2246 3980 / 2246 3990  
ई-मेल/E-mail : Info@niwe.res.in वेबसाइट/Website : http://niwe.res.in



CREATING WEALTH  
FOR WELLBEING

NLC INDIA LIMITED  
("NAVRATNA") – A GOVERNMENT OF INDIA ENTERPRISE  
NEYVELI – 607 802, TAMIL NADU

**CERTIFICATE**

This is to certify that  
**SHAIK IRFAN K**

Studying BACHELOR OF ENGINEERING in  
MECHANICAL ENGINEERING at

**MOHAMED SATHAK A J COLLEGE OF ENGINEERING,  
SIRUSERI, CHENNAI**

Has undergone Internship Training on  
"WATER CONSERVATION IN LIGNITE FIRED POWER PLANTS".

During the period from 03.07.2023 to 29.07.2023 at

**NEYVELI NEW THERMAL POWER STATION (NNTPS)  
NLC INDIA LIMITED, NEYVELI**

DATE: 29.07.2023  
PLACE: NEYVELI

**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.

**CHIEF MANAGER**  
LEARNING AND DEVELOPMENT CENTRE  
NLC INDIA LIMITED,

Chief Manager  
Learning & Development Centre  
NLC India Limited, Neyveli-3.

*Training adding Value to life*

MOHAMED SATHAK A J COLLEGE OF ENGINEERING, Chennai - 603103

STUDENT FEEDBACK ON INTERNSHIP/INPLANT TRAINING

Name of the Student	K. Shaik Afan,
Year/Sem	<u>IV</u> / <u>V</u>
Name of the Industry/R&D Organization	NLC India Limited,
Period of Internship/Inplant Training	July - 2021
Was the Internship /Inplant Training Useful?	Yes.
Whether the internship was related to subject? If yes mention the subject	Yes, Thermal Engineering.
Whether any project completed? If yes mention the project title	GWFL - Getting water from coal
Brief Summary/Report of the topic	Non-conventional and highly recommended, for water conservation
General Remarks	Highly useful,

  
Signature of the Student

Format No: FB 10

Rev. No : 1.0

Rev. Date : 04.01.21

  
**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.



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**NLC INDIA LIMITED**  
("NAV RATNA" – A GOVERNMENT OF INDIA ENTERPRISE)  
NEYVELI – 607 802, TAMIL NADU.

**CERTIFICATE**

This is to certify that  
**HARI M**

Studying BACHELOR OF ENGINEERING in  
**MECHANICAL ENGINEERING** at

**MOHAMED SATHAK A J COLLEGE OF ENGINEERING,  
SIRUSERI, CHENNAI**

Has undergone Internship Training on  
"WATER CONSERVATION IN LIGNITE FIRED POWER PLANTS",

During the period from 03.07.2023 to 29.07.2023 at

**NEYVELI NEW THERMAL POWER STATION (NNTPS)  
NLC INDIA LIMITED, NEYVELI**

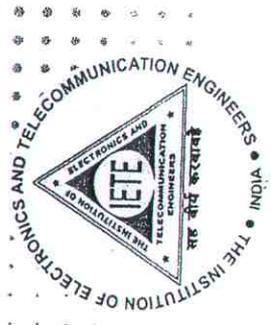
DATE: 29.07.2023  
PLACE: NEYVELI

**PRINCIPAL** LEARNING AND DEVELOPMENT CENTRE  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.

**CHIEF MANAGER**  
NLC INDIA LIMITED,  
Chief Manager  
Learning & Development Centre  
NLC India Limited, Neyveli-3.

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# CERTIFICATE OF INTERNSHIP



This is to Certify that

**CHANDRU P**

**MECHANICAL ENGINEERING**

**MOHAMMED SATHAK AJ COLLEGE OF ENGINEERING**

has Successfully Completed the **1 Month** Internship on

**Renewable energy**

at Pantech e learning Pvt. Ltd.

Duration: From **26th June 2023** to **26th July 2023**

**PEL-SI-2023-1024**

CERTIFICATE NO

DIRECTOR, PANTECH E LEARNING  
WWW.PANTECHELEARNING.COM

**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.



To Whom It May Concern

This is certify that Mr.Abdul Kaffar of BE Mechanical Engineering at Mohamed Sathak A J College of Engineering, Shollinganallur, Chennai, worked under my supervision , During his internship period ( 27/June/23-28/July/23) and he works as a "Design Intern"

During the period of his intenship programme with us he was found punctual , hardworking and inquisitive.

We wish him every success in life.

*Ush...*

PRINCIPAL  
Mohamed Sathak A J College of Engineering  
No.34, P. O. Gandhi Street,  
Sipoot - IT Hub, Chennai - 603103.  
DUBAI - U.A.E.  
JASS METAL WORKS LLC

**INTERNSHIP CERTIFICATE:**

TIN NO: 33361667275  
SI NO: 3300311-09703-B  
EC NO: 0411015982  
ISTIN: 33AAJPR3046C1Z0

Cell: 98401 11167  
98840 39549  
96770 14047

**VIGNESH ENGINEERING INDUSTRIES**

No. 4/430, Lakshmi Avenue, Sivankoil Street, Periyakalanthan Cheiry,  
Iyyappanthangal, Chennai - 600 036 E-mail: vigneshengg91@yahoo.com

Reg No: // 8

Date 20.07.23

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. ABDUR RAHMAN J, Reg No: 311821114301, B E Mechanical from Mohamed Sathak A J College of Engineering, Chennai - 603103 has undergone Internship from 20.06.2023 to 20.07.2023 at our VIGNESH ENGINEERING INDUSTRIES.

*Handwritten signature in green ink.*



Mohamed Sathak  
No.34, Raju Gandhi Street,  
Sipca, IT Highway Location,  
Chennai - 603103

FOR VIGNESH ENGINEERING INDUSTRIES  
*Handwritten signature*  
Proprietor  
FOR VIGNESH INDUSTRIES

[Type here]

# VERZEO

## Certificate of Internship

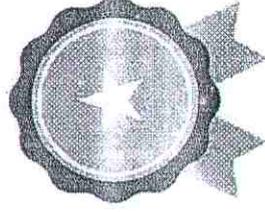
### Shaik Irfan K

has successfully completed an Internship Program Hybrid and Electric Vehicles  
from 01-09-2022 to 31-10-2022.

During the internship, the student was found to be dedicated, hardworking and intelligent.

T.Nikhil

Academic head



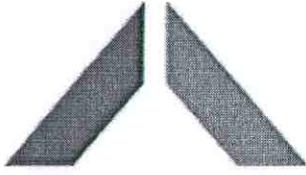


**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (Old IIT)  
Sipcot - IT Highway Egattur,  
Chennai - 600103.



Certificate ID: 683022334  
Date: 24-02-2023

Our internship completion certificates are verified and are recognized  
by eminent industries and universities all over the world.



# GREEN VALLEYS SHELTERS (P) LTD.,

6, Venus Colony 2nd St, Venus Colony, Alwarpet, Chennai, Tamil Nadu 600018

27.07.2023

This is to certify that Mr. AADIL T, student of II Year BE- Mechanical Engineering at Mohamed Sathak AJ College of Engineering, Chennai was successfully completed the internship Training Programme in Green Valleys Shelter Pvt Ltd during the period 07.07.2023 to 27.07.2023 at office in Design section (2D and 3D Modelling).

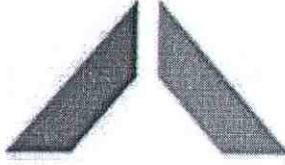
He has wide knowledge in design area and having good knowledge in designing concept. During his work period, we found him a sincere, honest, hardworking and dedicated employee with a professional attitude and very good job knowledge. We wish him all success in his future.

  
**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.

For Green Valleys Shelter Pvt. Ltd



Authorised Signatory



# GREEN VALLEYS SHELTERS (P) LTD.,

6, Venus Colony 2nd St, Venus Colony, Alwarpet, Chennai, Tamil Nadu 600018

27.07.2023

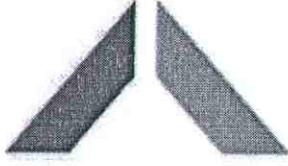
This is to certify that Mr. ABDUL KAFFAR, student of II Year BE-Mechanical Engineering at Mohamed Sathak AJ College of Engineering, Chennai was successfully completed the internship Training Programme in Green Valleys Shelter Pvt Ltd during the period 07.07.2023 to 27.07.2023 at office in Design section (2D and 3D Modelling).

He has wide knowledge in design area and having good knowledge in designing concept. During his work period, we found him a sincere, honest, hardworking and dedicated employee with a professional attitude and very good job knowledge. We wish him all success in his future.

**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.

For Green Valleys Shelter Pvt. Ltd

Authorised Signatory



# GREEN VALLEYS SHELTERS (P) LTD.,

6, Venus Colony 2nd St, Venus Colony, Alwarpet, Chennai, Tamil Nadu 600018

27.07.2023

This is to certify that Mr. DHANUSH ADITHYA S, student of II Year BE- Mechanical Engineering at Mohamed Sathak AJ College of Engineering, Chennai was successfully completed the internship Training Programme in Green Valleys Shelter Pvt Ltd during the period 07.07.2023 to 27.07.2023 at office in Design section (2D and 3D Modelling).

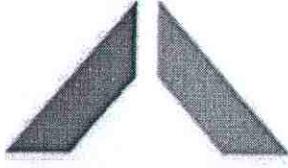
He has wide knowledge in design area and having good knowledge in designing concept. During his work period, we found him a sincere, honest, hardworking and dedicated employee with a professional attitude and very good job knowledge. We wish him all success in his future.

  
**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.

**For Green Valleys Shelter Pvt. Ltd**



**Authorised Signatory**



# GREEN VALLEYS SHELTERS (P) LTD.,

6, Venus Colony 2nd St, Venus Colony, Abwarpet, Chennai, Tamil Nadu 600018

27.07.2023

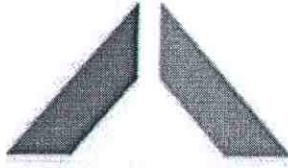
This is to certify that Mr. HARI. M, student of II Year BE-Mechanical Engineering at Mohamed Sathak AJ College of Engineering, Chennai was successfully completed the internship Training Programme in Green Valleys Shelter Pvt Ltd during the period 07.07.2023 to 27.07.2023 at office in Design section (2D and 3D Modelling).

He has wide knowledge in design area and having good knowledge in designing concept. During his work period, we found him a sincere, honest, hardworking and dedicated employee with a professional attitude and very good job knowledge. We wish him all success in his future.

**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.

For Green Valleys Shelter Pvt. Ltd

Authorised Signatory



# GREEN VALLEYS SHELTERS (P) LTD.,

6, Venus Colony 2nd St, Venus Colony, Alwarpet, Chennai, Tamil Nadu 600018

27.07.2023

This is to certify that Mr. JASWIN KUMAR B, student of II Year BE- Mechanical Engineering at Mohamed Sathak AJ College of Engineering, Chennai was successfully completed the internship Training Programme in Green Valleys Shelter Pvt Ltd during the period 07.07.2023 to 27.07.2023 at office in Design section (2D and 3D Modelling).

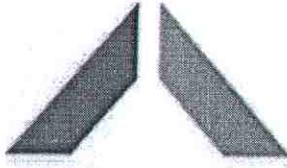
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For Green Valleys Shelter Pvt. Ltd

  
**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.



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27.07.2023

This is to certify that Mr. MOHAMED ANSARI N, student of II Year BE- Mechanical Engineering at Mohamed Sathak AJ College of Engineering, Chennai was successfully completed the internship Training Programme in Green Valleys Shelter Pvt Ltd during the period 07.07.2023 to 27.07.2023 at office in Design section (2D and 3D Modelling).

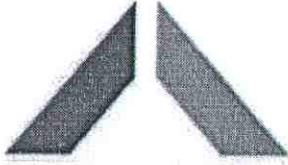
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**For Green Valleys Shelter Pvt. Ltd**

**PRINCIPAL**

Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
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Chennai - 603103.

**Authorised Signatory**



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6, Venus Colony 2nd St, Venus Colony, Alwarpet, Chennai, Tamil Nadu 600018

27.07.2023

This is to certify that Mr. SANDEEP .S, student of II Year BE- Mechanical Engineering at Mohamed Sathak AJ College of Engineering, Chennai was successfully completed the internship Training Programme in Green Valleys Shelter Pvt Ltd during the period 07.07.2023 to 27.07.2023 at office in Design section (2D and 3D Modelling).

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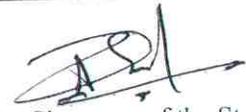
  
**PRINCIPAL**  
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No.34, Rajiv Gandhi Salai (O.M.R)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.



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STUDENT FEEDBACK ON INTERNSHIP/INPLANT TRAINING

Name of the Student	Abdul Kaffan j
Year/Sem	III / IV
Name of the Industry/R&D Organization	Green valleys
Period of Internship/Inplant Training	1 month.
Was the Internship /Inplant Training Useful?	yes
Whether the internship was related to subject ? If yes mention the subject	Yes, it used for CAD,
Whether any project completed? If yes mention the project title	NO
Brief Summary/Report of the topic	it is used for learning about the autocad, Solidworks designing & 2D and 3D modelling
General Remarks	It was very useful



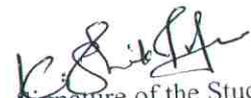
Signature of the Student



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 No.34, Rajiv Gandhi Salai (OMR)  
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 Chennai - 603103.

STUDENT FEEDBACK ON INTERNSHIP/INPLANT TRAINING

Name of the Student	K. Shaik Afa
Year/Sem	III / V
Name of the Industry/R&D Organization	Green Valley .
Period of Internship/Inplant Training	15 days .
Was the Internship /Inplant Training Useful?	Yes .
Whether the internship was related to subject ? If yes mention the subject	Yes , CAD .
Whether any project completed? If yes mention the project title	No .
Brief Summary/Report of the topic	It was vosey useful to learn <sup>about</sup> the design of (2D & 3D modelling)
General Remarks	Good Experience and Gained good knowledge .

  
Signature of the Student

Format No: FB 10

Rev. No : 1.0

Rev. Date : 04.01.21



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No.34, Rajiv Gandhi Salai (Old)  
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Chennai - 603103.



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



## Department of Mechanical Engineering

**Initiative related to industry  
internship/summer training**

**PRINCIPAL**  
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Chennai - 603103.



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**05.08.2023**

**CERTIFICATE OF IN-PLANT TRAINING**

This is to certify the Mr. ARUN. T, Student of Mohamed Sathak AJ College of Engineering has undergone internship Production Line for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

For Sri KVS Industries,

**Authorised Signatory**

**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
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This is to certify the Mr. DINESH. M, Student of Mohamed Sathak AJ College of Engineering has undergone internship Production Line for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

For Sri KVS Industries,

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This is to certify the Mr. IMTHIYAS. A, Student of Mohamed Sathak AJ College of Engineering has undergone internship Production Line for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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This is to certify the Mr. MANIKANDAN. K, Student of Mohamed Sathak AJ College of Engineering has undergone internship Production Line for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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This is to certify the Mr. MOHAMED AFROSE, Student of Mohamed Sathak AJ College of Engineering has undergone internship Production Line for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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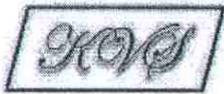
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This is to certify the Mr. MOHAMED AJMAL A.R, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Production Line for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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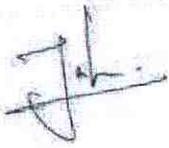
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This is to certify the Mr. MOHAMED ISMAIL. A, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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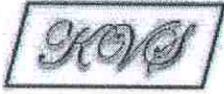
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This is to certify the Mr. MOHAMED SATHAKATHULLA. M, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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This is to certify the Mr. MOHAMMED MANSOOR. S, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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This is to certify the Mr. SADHAM HUSSAIN, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

For Sri KVS Industries,

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**This is to certify the Mr. SALMAN. S, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.**

**For Sri KVS Industries,**

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**PRINCIPAL**

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This is to certify the Mr. SHAIK YASOOF. B, Student of Mohamed Sathak A.J. College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

For Sri KVS Industries,

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This is to certify the Mr. SYED MOHAMED SUFIYAN. S, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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This is to certify the Mr. UMAR JAFFAR ALI, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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This is to certify the Mr. FATHEEN AHMED.M, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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This is to certify the Mr. HARIHARAN, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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**This is to certify the Mr. GOKULNATH.D, Student of Mohamed Sathak AJ  
College of Engineering has undergone internship in Quality Control operations  
for the period from 03/07/2023 TO 05/08/2023. During this period of training, he  
was professional and discipline at his work. We appreciate his behaviour.**

**For Sri KVS Industries,**

**Authorised Signatory**

**PRINCIPAL**  
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**This is to certify the Mr HAJI PUTHU MYDEEN . S, Student of Mohamed Sathak  
AJ College of Engineering has undergone internship in Quality Control operations  
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**PRINCIPAL**

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This is to certify the Mr. MOHAMED FAZID S, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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This is to certify the Mr. MOHAMED ANWAR TA, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

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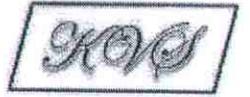
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**No: 351, Sidco Industrial Estate, Ambattur, Chennai - 600098**

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**SRI K.V.S INDUSTRIES**



**Mfrs. of Precision CNC Turned & Machined  
Automobile Components & Forged Products**

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**05.08.2023**

**CERTIFICATE OF IN-PLANT TRAINING**

This is to certify the Mr. RASOOL MOHAMED, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

For Sri KVS Industries,

Authorised Signatory

**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.

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**No: 351, Sidco Industrial Estate, Ambattur, Chennai - 600098**

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**SRI K.V.S INDUSTRIES**



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Automobile Components & Forged Products**

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**05.08.2023**

**CERTIFICATE OF IN-PLANT TRAINING**

This is to certify the Mr. SWARUPAMALVAN, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

For Sri KVS Industries,

Authorised Signatory

**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
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**05.08.2023**

**CERTIFICATE OF IN-PLANT TRAINING**

**This is to certify the Mr. MOHAMED SAMEEM P, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.**

**For Sri KVS Industries,**

**Authorised Signatory**

**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.



**SRI K.V.S INDUSTRIES**



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**05.08.2023**

**CERTIFICATE OF IN-PLANT TRAINING**

**This is to certify the Mr. MOHAMMED SAFREES, Student of Mohamed Sathak  
AJ College of Engineering has undergone internship in Quality Control operations  
for the period from 03/07/2023 TO 05/08/2023. During this period of training, he  
was professional and discipline at his work. We appreciate his behaviour.**

**For Sri KVS Industries,**

**Authorised Signatory**

**PRINCIPAL**

**Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
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Chennai - 603103.**

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**05.08.2023**

**CERTIFICATE OF IN-PLANT TRAINING**

This is to certify the Mr. NARESH.P, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

For Sri KVS Industries,

Authorised Signatory

**PRINCIPAL**  
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No. 34, Rajiv Gandhi Salai (OMR)  
SIPCOT IT Highway Egattur,  
Chennai - 603103.

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**No: 351, Sidco Industrial Estate, Ambattur, Chennai - 600098**

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**SRI K.V.S INDUSTRIES**



**Mfrs. of Precision CNC Turned & Machined  
Automobile Components & Forged Products**

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**05.08.2023**

**CERTIFICATE OF IN-PLANT TRAINING**

This is to certify the Mr. MOHAMED GHOUSE NAGUTHA. M, Student of Mohamed Sathak AJ College of Engineering has undergone internship in Quality Control operations for the period from 03/07/2023 TO 05/08/2023. During this period of training, he was professional and discipline at his work. We appreciate his behaviour.

For Sri KVS Industries,

Authorised Signatory

**PRINCIPAL**  
Mohamed Sathak A.J. College of Engineering  
No.34, Rajiv Gandhi Salai (OMR)  
Sipcot - IT Highway Egattur,  
Chennai - 603103.

---

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**COURSE OBJECTIVES:**

- 1 To study the concepts and basic mechanics of metal cutting and the factors affecting machinability
- 2 To learn working of basic and advanced turning machines.
- 3 To teach the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes.
- 4 To study the basic concepts of CNC of machine tools and constructional features of CNC.
- 5 To learn the basics of CNC programming concepts to develop the part programme for Machine centre and turning centre

**UNIT-I MECHANICS OF METAL CUTTING**

9

Mechanics of chip formation, forces in machining, Types of chip, cutting tools –single point cutting tool nomenclature, orthogonal and oblique 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, surface roughness in turning, machining time and power estimation. Special lathes-Capstan and turret lathes- tool layout –automatic lathes: semi-automatic –single spindle: Swiss type, automatic screw type-multispindle

**UNIT-III RECIPROCATING MACHINE TOOLS**

9

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters- machining time calculation –Gear cutting, gear hobbing and gear shaping –gear finishing methods Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding-microfinishing methods

**UNIT-IV CNC MACHINES**

9

Computer Numerical Control (CNC) machine tools, constructional details, special features–Drives, Recirculating ball screws, tool changers; CNC Control systems - Open/closed, point-to-point/continuous - Turning and machining centres-Workholding methods in Turning and machining centres, Coolant systems, Safety features.

**UNIT-V PROGRAMMING OF CNC MACHINE TOOLS**

9

Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers –Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.

**TOTAL 45 PERIODS****OUTCOMES:** At the end of the course the students would be able to

1. Apply the mechanism of metal removal process and to identify the factors involved in improving machinability.
2. Describe the constructional and operational features of centre lathe and other special purpose lathes.
3. Describe the constructional and operational features of reciprocating machine tools.
4. Apply the constructional features and working principles of CNC machine tools.
5. Demonstrate the Program CNC machine tool through planning, writing codes and setting up CNC machine tools to manufacture a given component.

**TEXTBOOKS:**

1. Kalpakjian, S, "Manufacturing Engineering and Technology", Pearson Education India, 7<sup>th</sup> Edition, 2018.
2. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 4<sup>th</sup> edition, 2018.

**REFERENCES:**

1. Roy, A. Lindberg, Processes and materials of manufacture, PHI/Pearson education, 2006.
2. Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984.
3. Rao, P. N. "Manufacturing Technology," Metal Cutting and Machine Tools, Tata McGraw-Hill, New Delhi, 2009.

ME3451

THERMAL ENGINEERING

L T P C  
4 0 0 4

**COURSE OBJECTIVES:**

- 1 To learn the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles and performance of Internal Combustion (IC) engines and Gas Turbines.
- 2 To analyzing the performance of steam nozzle, calculate critical pressure ratio
- 3 To Evaluating the performance of steam turbines through velocity triangles, understand the need for governing and compounding of turbines
- 4 To analyzing the working of IC Engines and various auxiliary systems present in IC Engines
- 5 To evaluating the various performance parameters of IC Engines

**UNIT I THERMODYNAMIC CYCLES 12**

Air Standard Cycles – Carnot, Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison, Basic Rankine Cycle, modified, reheat and regenerative cycles.

**UNIT II STEAM NOZZLES AND INJECTOR 12**

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 III STEAM AND GAS TURBINES 12**

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing. Gas turbine cycle analysis - open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination.

**UNIT IV INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION 12**

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 V INTERNAL COMBUSTION ENGINE PERFORMANCE AND AUXILIARY SYSTEMS 12**

Performance and Emission Testing, 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

**TOTAL: 60 PERIODS**

**OUTCOMES:** At the end of the course the students would be able to

1. Apply thermodynamic concepts to different air standard cycles and solve problems.
2. To solve problems in steam nozzle and calculate critical pressure ratio.
3. Explain the flow in steam turbines, draw velocity diagrams, flow in Gas turbines and solve problems.
4. Explain the functioning and features of IC Engine, components and auxiliaries.
5. Calculate the various performance parameters of IC Engines

**TEXTBOOKS:**

1. Mahesh.M.Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2. Ganesan.V, "Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.

**REFERENCES:**

1. Ballaney.P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017.
2. Domkundwar, Kothandaraman, & Domkundwar, "A Course in Thermal Engineering", 6th Edition, Dhanpat Rai & Sons, 2011.
3. Gupta H.N, "Fundamentals of Internal Combustion Engines", 2nd Edition Prentice Hall of India, 2013.
4. Mathur M.L and Mehta F.S., "Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
5. Soman.K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 2011.

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Chennai - 600 030.

**COURSE OBJECTIVES:**

- 1 To study the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions.
- 2 To study the basic concepts of toothed gearing and kinematics of gear trains
- 3 To Analyzing the effects of friction in machine elements
- 4 To Analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms.
- 5 To Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

**UNIT-I KINEMATICS OF MECHANISMS**

9

Mechanisms-Terminology and definitions-kinematics inversions of 4 bar and slide crank chain-kinematics analysis in simple mechanisms-velocity and acceleration polygons-Analytical methods-computer approach-cams-classifications-displacement diagrams-layout of plate cam profiles-derivatives of followers motion - circular arc and tangent cams.

**UNIT-II GEARS AND GEAR TRAINS**

9

Spur gear - law of toothed gearing - involute gearing - Interchangeable gears - Gear tooth action interference and undercutting-non standard teeth-gear trains-parallel axis gear trains-epicyclic gear trains-automotive transmission gear trains.

**UNIT-III 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 aspects in brakes-Friction in vehicle propulsion and braking.

**UNIT-IV FORCE ANALYSIS**

9

Applied and Constrained Forces - Free body diagrams - static Equilibrium conditions - Two, Three and four members - Static Force analysis in simple machine members - Dynamic Force Analysis - Inertia Forces and Inertia Torque - D'Alembert's principle - superposition principle - dynamic Force Analysis in simple machine members

**UNIT-V BALANCING AND VIBRATION**

9

Static and Dynamic balancing - Balancing of revolving and reciprocating masses - Balancing machines - free vibrations - Equations of motion - natural Frequency - Damped Vibration - bending critical speed of simple shaft - Torsional vibration - Forced vibration - harmonic Forcing - Vibration isolation. (Gyroscopic principles)

**TOTAL:45 PERIODS****OUTCOMES:** At the end of the course the students would be able to

1. Discuss the basics of mechanism.
2. Solve problems on gears and gear trains.
3. Examine friction in machine elements.
4. Calculate static and dynamic forces of mechanisms.
5. Calculate the balancing masses and their locations of reciprocating and rotating masses. Computing the frequency of free vibration, forced vibration and damping coefficient.

**TEXTBOOKS:**

1. Uicker, J.J., Pennock G. R. and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
2. Ramamurthi. V., "Mechanics of Machines", Narosa Publishing House, 3<sup>rd</sup> edition 2019.

**REFERENCES:**

1. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., 1988.
2. Rao. J.S. and Dukkupati. R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2<sup>nd</sup> edition, 2014.

**COURSE OBJECTIVES**

- 1 To study the coal based thermal power plants.
- 2 To study the diesel, gas turbine and combined cycle power plants.
- 3 To learn the basic of nuclear engineering and power plants.
- 4 To learn the power from renewable energy
- 5 To study energy, economic and environmental issues of power plants

**UNIT-I COAL BASED THERMAL POWER PLANTS**

9

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

**UNIT-II DIESEL, GAS TURBINE AND COMBINED CYCLE POWERPLANTS**

9

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

**UNIT-III NUCLEAR POWER PLANTS**

9

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

**UNIT-IV POWER FROM RENEWABLE ENERGY**

9

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

**UNIT-V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS**

9

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

**TOTAL: 45 PERIODS**

**OUTCOMES:** At the end of the course the students would be able to

1. Explain the layout, construction and working of the components inside a thermal power plant.
2. Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
3. Explain the layout, construction and working of the components inside nuclear power plants.
4. Explain the layout, construction and working of the components inside Renewable energy power plants
5. Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

**TEXTBOOKS:**

1. Nag, P.K., "Power Plant Engineering", Third Edition, Tata McGraw-Hill Publishing Company Ltd., 2008.
2. A Textbook of Power Plant Engineering by R.K. Rajput, 1 January 2016

**REFERENCES:**

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

**PRINCIPAL**  
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Sipcot - IT Highway Egattur,  
Chennai - 603103.

CME365

RENEWABLE ENERGY TECHNOLOGIES

L T P C  
3 0 0 3

COURSE OBJECTIVES

- 1 To know the Indian and global energy scenario
- 2 To learn the various solar energy technologies and its applications.
- 3 To educate the various wind energy technologies.
- 4 To explore the various bio-energy technologies.
- 5 To study the ocean and geothermal technologies.

UNIT – I ENERGY SCENARIO

9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status- Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT – II SOLAR ENERGY

9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT – III WIND ENERGY

9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT – IV BIO-ENERGY

9

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion- mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration – Carbonisation – Pyrolysis - Biogas plants – Digesters – Biodiesel production – Ethanol production - Applications.

UNIT – V OCEAN AND GEOTHERMAL ENERGY

9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss the Indian and global energy scenario.
2. Describe the various solar energy technologies and its applications.
3. Explain the various wind energy technologies.
4. Explore the various bio-energy technologies.
5. Discuss the ocean and geothermal technologies.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.

**COURSE OBJECTIVES:**

1. To illustrate the working principles of various metal casting processes.
2. To learn and apply the working principles of various metal joining processes.
3. To analyse the working principles of bulk deformation of metals.
4. To learn the working principles of sheet metal forming process.
5. To study and practice the working principles of plastics molding.

**UNIT-I METAL CASTING PROCESSES**

9

Sand Casting - Sand Mould - Type of patterns - Pattern allowances - Moldings and Properties and testing - Cores - Types and applications - Molding machines - Types and applications - Melting furnaces - Principle of special casting processes - Shell, investment - Ceramic mould - Pressure die casting - low pressure, gravity - Tilt pouring, high pressure die casting - Centrifugal Casting - CO<sub>2</sub> casting - Defects in Sand casting process - remedies

**UNIT II METAL JOINING PROCESSES**

9

Fusion welding processes - Oxy fuel welding - Filler and Flux materials - Arc welding, Electrodes, Coating and specifications - Gas Tungsten arc welding - Gas metal arc welding - Submerged arc welding - Electro slag welding - Plasma arc welding - Resistance welding Processes - Electron beam welding - Laser beam Welding - Friction welding - Friction stir welding - Diffusion welding - Thermit Welding, Weld defects - inspection & remedies - Brazing - soldering - Adhesive bonding.

**UNIT III BULK DEFORMATION PROCESSES**

9

Hot working and cold working of metals - Forging processes - Open, impression and closed die forging - cold forging - Characteristics of the processes - Typical 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. Introduction to shaping operations.

**UNIT IV SHEET METAL PROCESSES**

9

Sheet metal characteristics - Typical 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 - Incremental forming.

**UNIT V MANUFACTURE OF PLASTIC COMPONENTS**

9

Types and characteristics of plastics - Molding of thermoplastics & Thermosetting polymers - working principles and typical applications - injection molding - Plunger and screw machines - Compression molding, Transfer Molding - Typical industrial applications - introduction to blow molding - Rotational molding - Film blowing - Extrusion - Thermoforming - Bonding of Thermoplastics - duff moulding.

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

At the end of the course the students would be able to

1. Explain the principle of different metal casting processes.
2. Describe the various metal joining processes.
3. Illustrate the different bulk deformation processes.
4. Apply the various sheet metal forming process.
5. Apply suitable molding technique for manufacturing of plastic components.

  
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 Chennai - 603103.

**TEXTBOOKS:**

1. Kalpakjian, S., "Manufacturing Engineering and Technology", Pearson Education India, 4<sup>th</sup> Edition, 2013
2. P.N. Rao Manufacturing Technology Volume 1 McGrawhill Education 5<sup>th</sup> edition, 2018.

**COURSE OBJECTIVES:**

- 1 To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.
- 2 To learnselectingandapplyingvariousheattreatmentprocessesanditsmicrostructure formation.
- 3 To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.
- 4 Toillustratethedifferentpolymer,ceramicsandcompositesandtheirusesinengineeringfield.
- 5 Tolearnthevarioustestingproceduresandfailuremechanisminengineeringfield.

**UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS**

9

Constitutionofalloys–Solid solutions, substitutional and interstitial–phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron–Iron carbide 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 -normalizing, hardening and temperingofsteel.Isothermal transformationdiagramsc-coolingcurves superimposedon I.T.diagram - continuous cooling Transformation (CCT) diagram - Austempering, Martempering - Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding - Flame and Induction hardening - Vacuum and Plasma hardening - Thermo-mechanical treatments- elementary ideasonssintering.

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

9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V,Ti& W) - stainless and tool steels - HSLA - Maraging steels - Grey, white, malleable, spheroidal - alloy cast irons, Copper and its alloys - Brass, Bronze and Cupronickel - Aluminium and its alloys; Al-Cu - precipitation strengthening treatment - Titanium alloys, Mg-alloys, Ni-based super alloys - shape memory alloys- Properties and Applications- Overview of materials standards

**UNIT IV NON-METALLIC MATERIALS**

9

Polymers - types of polymers, commodity and engineering polymers - Properties and applications ofPE,PP,PS,PVC,PMMA,PET,PC,PA,ABS,PAI,PPO,PPS,PEEK,PTFE,Thermosetpolymers-Urea and Phenol formaldehydes -Nylon, Engineering Ceramics - Properties and applications of Al<sub>2</sub>O<sub>3</sub>, SiC, Si<sub>3</sub>N<sub>4</sub>, PSZ and SiALON–intermetallics- Composites- Matrix and reinforcement Materials-applicationsofComposites-Nanocomposites.

**UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS**

9

Mechanisms of plastic deformation, slip and twinning - Types of fracture - fracture mechanics- Griffith's theory-Testing of materials under tension, compression and shear loads–Hardness tests (Brinell, Vickers and Rockwell), Micro and nano-hardness tests, Impact test Izod and charpy, fatigue and creep failure mechanisms.

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

Attheendofthecoursethestudentswouldbeableto

1. Explainalloysandphasediagram,Iron-Ironcarbondiagramandsteelclassification.
2. Explainisothermaltransformation,continuouscoolingdiagramsanddifferentheat treatment processes.
3. Clarifytheeffectofalloyingelementsonferrousandnon-ferrousmetals.
4. Summarizethepropertiesandapplicationsofnon-metallicmaterials.
5. Explainthetestingofmechanicalproperties.

**PRINCIPAL**

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Sipcot - IT Highway Egattur,  
Chennai - 603103.

**TEXTBOOKS:**

1. KennethG.BudinskiandMichaelK.Budinski,“EngineeringMaterials”,PrenticeHallofIndia Private Limited, 9<sup>th</sup> edition ,2018.
2. SydneyH.Avner,“IntroductiontoPhysicalMetallurgy”,McGrawHillBookCompany, 1994

ME3391

ENGINEERING THERMODYNAMICS

L T P C  
3 0 0 3

COURSE OBJECTIVES:

- 1 Impart knowledge on the basics and application of zeroth and first law of thermodynamics.
- 2 Impart knowledge on the second law of thermodynamics in analysing the performance of thermal devices.
- 3 Impart knowledge on availability and applications of second law of thermodynamics
- 4 Teach the various properties of steam through steam tables and Mollier chart.
- 5 Impart knowledge on the macroscopic properties of ideal and real gases.

UNIT I BASICS, ZEROth AND FIRST LAW

9

Review of Basics–Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law–Concept of temperature and Temperature Scales. First law–application to closed and open systems–steady and unsteady flow processes.

UNIT II SECOND LAW AND ENTROPY

9

Heat Engine–Refrigerator-Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance.

UNIT III AVAILABILITY AND APPLICATIONS OF II LAW

9

Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High- and low-grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency

UNIT IV PROPERTIES OF PURE SUBSTANCES

9

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT V GAS MIXTURES AND THERMODYNAMIC RELATIONS

9

Properties of Ideal gas, real gas-comparison. Equations of state for ideal and real gases. vander Waal's relation- Reduced properties-Compressibility factor-Principle of Corresponding states-Generalized Compressibility Chart. Maxwell relations-Tds Equations-heat capacities relations-Energy equation, Joule-Thomson experiment - Clausius-Clapeyron equation.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1. Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
2. Apply the second law of thermodynamics in analysing the performance of thermal devices through energy and entropy calculations.
3. Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart
4. Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
5. Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

TEXTBOOKS:

1. Nag.P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
2. Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014), Anuragam Publications, Chennai.

  
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