



The following are the syllabus copy as per Anna University

Curriculum and experiential learning document

## 1.3.2

# **COURSES THAT INCLUDE EXPERIENTIAL LEARNING THROUGH PROJECT WORK / FIELD WORK/INTERNSHIP DURING 2022-2023**





**1.3.2 AVERAGE PERCENTAGE OF COURSES THAT INCLUDE EXPERIENTIAL LEARNING THROUGH PROJECT WORK/FIELD WORK/INTERSHIP DURING 2022 – 2023**

S.No.	Programme Offering	Name of the Course	Course Code	Project / Field work / Internship	Page No.
1	B.E-Mechanical Engineering	Materials Science	PH3251	Industrial Visit	3
2	B.E-Mechanical Engineering	Basic Electrical, Electronics Engineering	BE3251	Industrial Visit	10
3	B.E-Mechanical Engineering	Engineering Mechanics	ME3351	Industrial Visit	17
4	B.E-Mechanical Engineering	Engineering Thermodynamics	ME3391	In-plant Training	24
5	B.E-Mechanical Engineering	Fluid Mechanics and Machinery	CE3391	In-plant Training	26
6	B.E-Mechanical Engineering	Engineering Materials and Metallurgy	ME3392	Internship	28
7	B.E-Mechanical Engineering	Manufacturing Process	ME3393	In-plant Training	30
8	B.E-Mechanical Engineering	Theory of Machines	ME3491	Internship	32
9	B.E-Mechanical Engineering	Thermal Engineering	ME3451	Internship	34
10	B.E-Mechanical Engineering	Hydraulics and Pneumatics	ME3492	Internship	36
11	B.E-Mechanical Engineering	Manufacturing Technology	ME3493	Internship	38
12	B.E-Mechanical Engineering	Strength of Materials	CE3491	Internship	40
13	B.E-Mechanical Engineering	Environmental and Science sustainability	GE3451	Internship	43
14	B.E-Mechanical Engineering	Thermal Engineering- II	ME8595	Internship	45





15	B.E-Mechanical Engineering	Design of Machine Elements	ME8593	Internship	47
16	B.E-Mechanical Engineering	Metrology and Measurements	ME8501	Internship	49
17	B.E-Mechanical Engineering	Dynamics of Machines	ME8594	In-plant Training	51
18	B.E-Mechanical Engineering	Automotive Systems	OAT551	Internship	53
19	B.E-Mechanical Engineering	Design of Transmission Systems	ME8651	In-plant Training	55
20	B.E-Mechanical Engineering	Computer Aided Design and Manufacturing	ME8691	Project	57
21	B.E-Mechanical Engineering	Heat and Mass Transfer	ME8693	Internship	62
22	B.E-Mechanical Engineering	Finite Element Analysis	ME8692	Internship	64
23	B.E-Mechanical Engineering	Hydraulics and Pneumatics	ME8694	Project work	66
24	B.E-Mechanical Engineering	Welding Technology	PR8592	Project work	71
25	B.E-Mechanical Engineering	Power Plant Engineering	ME8792	In-plant Training	76
26	B.E-Mechanical Engineering	Robotics	OIE751	Project work	78
27	B.E-Mechanical Engineering	Automobile Engineering	ME8091	Project work	82
28	B.E-Mechanical Engineering	Mechatronics	ME8791	Internship	87
29	B.E-Mechanical Engineering	Unconventional Machining Process	ME8073	Project work	89
30	B.E-Mechanical Engineering	Non-Destructive Testing and Evaluation	ME8097	Internship	94
31	B.E-Mechanical Engineering	Process Planning and Cost Estimation	ME8793	Internship	96
32	B.E-Mechanical Engineering	Principles of Management	ME8591	Internship	98
33	B.E-Mechanical Engineering	Production Planning and Control	IE8693	Internship	100
34	B.E-Mechanical Engineering	Project Work	ME8811	Project Work	102





## COURSE OBJECTIVES:

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

## UNIT I CRYSTALLOGRAPHY

9

Crystal structures: BCC, FCC and HCP - directions and planes - linear and planar densities - crystal imperfections- edge and screw dislocations - grain and twin boundaries - Burgers vector and elastic strain energy- Slip systems, **plastic deformation of materials** - Polymorphism - phase changes - nucleation and growth - homogeneous and heterogeneous nucleation.

## UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS

9

Classical free electron theory - Expression for electrical conductivity - **Thermal conductivity**, expression - Quantum free electron theory : Tunneling - degenerate states - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential - Energy bands in solids - tight binding approximation - Electron effective mass - concept of hole. **Magnetic materials**: Dia, para and ferromagnetic effects - paramagnetism in the conduction electrons in metals - exchange interaction and ferromagnetism - quantum interference devices - **GMR devices**.

## UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS

9

Intrinsic Semiconductors - Energy band diagram - direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - extrinsic semiconductors - Carrier concentration in **N-type & P-type semiconductors** - Variation of carrier concentration with temperature - Carrier transport in Semiconductors: Drift, mobility and diffusion - Hall effect and devices - Ohmic contacts - Schottky diode.

## UNIT IV OPTICAL PROPERTIES OF MATERIALS

9

**Classification of optical materials** - Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells - Optoelectronic devices: light detectors and solar cells - **light emitting diode** - laser diode - optical processes in organic semiconductor devices - excitonic state - Electro-optics and nonlinear optics: **Modulators and switching devices** - plasmonics.

## UNIT V NANOELECTRONIC DEVICES

9

Quantum confinement - Quantum structures - quantum wells, wires and dots - Zener-Bloch oscillations - Resonant tunneling - quantum interference effects - mesoscopic structures - Single electron phenomena - Single electron Transistor. Semiconductor photonic structures - 1D, 2D and 3D photonic crystal. Active and passive optoelectronic devices - photo processes - spintronics - carbon nanotubes: Properties and applications.

TOTAL: 45 PERIODS

## COURSE OUTCOMES:

At the end of the course, the students should be able to

- know basics of crystallography and its importance for varied materials properties
- gain knowledge on the electrical and magnetic properties of materials and their applications
- understand clearly of semiconductor physics and functioning of semiconductor devices
- understand the optical properties of materials and working principles of various optical devices
- appreciate the importance of functional nanoelectronic devices.



Dr. J. SUNDARARAJAM,  
M.E., M.Tech, Ph.D.,  
Professor

MRR College of Engineering & Technology  
Nattam, Dindigul District - 625 011



**TEXT BOOKS:**

1. V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.
2. S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.
3. Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.
4. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc-Graw Hill India (2019)
5. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

**REFERENCES:**

1. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2. Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.
3. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006
4. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017
5. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.

**CO's-PO's & PSO's MAPPING**

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	2	1	1	-	-	-	-	-	-	-	-	-
2	3	2	1	1	2	1	1	-	-	-	-	-	-	-	-
3	3	2	2	2	2	1	-	-	-	-	-	-	-	-	-
4	3	2	2	1	2	2	-	-	-	-	-	1	-	-	-
5	3	2	2	1	2	1	-	-	-	-	-	-	-	-	-
AVG	3	2	1.6	1.4	1.8	1.2	1	-	-	-	-	1	-	-	-

1-Low,2-Medium,3-High,"-"-no correlation

Note: the average value of this course to be used for program articulation matrix.



**Dr. J. SUNDARARAJAN,**

B.E., M.Tech., Ph.D.,

Principal

NPR College of Engineering & Technology

Nathan, Dindigul (TN) - 624 401.





## Industrial Visit to VEI Technologies, Chennai

### PERMISSION LETTER

From

Dr. P.S. Satheesh Kumar,  
Head of the Department,  
Department of Science and Humanities,  
NPR College of Engineering & Technology, Natham,  
Dindigul - 624 401.

To

The Administrative Office,  
NPR Group of Institutions,  
Natham,  
Dindigul - 624 401.

Through Proper Channel

Sub: Requesting permission for Industrial visit - Reg.

Respected Sir,

I am writing to formally request permission for an industrial visit to VEI Technologies for our 1<sup>st</sup> Year students. The visit is scheduled to take place on two days, as outlined below:

I Batch - Departments: CSE A, CSE B, and EEE on 20.06.2023

II Batch - Departments: ECE, AI & DS, MECH and IT on 21.06.2023

We are planning for a total of 270 students from the 1<sup>st</sup> Year, consisting of 180 boys and 90 girls, accompanied by 6 staff members. The staff members accompanying the students are Dr. P.S. Satheesh Kumar, Prof/Physics, Dr. N. Kavitha, ASP/Physics, Dr. P. Rani, ASP/Maths, Dr. P. Shanmuga Priya, ASP/English, Dr. N. Prabakaran, ASP/Chemistry and Mrs. C. Yogitha, AP/Maths.

We assure you that all necessary arrangements regarding transportation, supervision, and safety measures will be diligently taken care of throughout the visit.

We kindly request your approval for this industrial visit, as it will significantly contribute to the academic and professional development of our students. We eagerly await your favorable response.

Natham,  
12.06.2023

Yours Faithfully,

(Dr. P. S. Satheesh Kumar)

**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.

Principal

N.P.R. College of Engineering & Technology  
Natham, Dindigul - 624 401





## Industrial Visit to VEI Technologies, Chennai REQUISITION LETTER

From,  
Dr. P.S. Satheesh Kumar,  
Head of the Department,  
Department of Science and Humanities,  
NPR College of Engineering & Technology, Natham,  
Dindigul - 624 401.

To,  
Dr B Ezhilavan,  
Managing Director,  
VEI Technologies,  
Chennai.

Dear Sir,  
Greetings!

I hope this letter finds you in good health and high spirits. I am writing on behalf of NPR College of Engineering and Technology, situated in Natham, Dindigul district. Our institution is dedicated to the personal and professional development of students from rural backgrounds, offering a range of UG and PG courses.

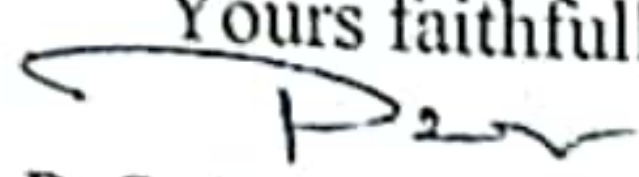
It has been a longstanding practice in our Science and Humanities Department to organize industrial visits for our students every semester, aiming to provide them with practical exposure and industry insights. In line with this, we have planned an industrial visit to VEI Technologies for our 270 first year students and 6 accompanying staff members. The visit is scheduled for two days, with two batches visiting on 20/6/23 and 21/6/23, respectively.

We assure you, sir, that our students will adhere strictly to safety protocols and will not disrupt your regular operations during their visit.

We humbly request your esteemed organization to grant us permission for this industrial visit. We would greatly appreciate if you could confirm the permission through a formal letter or email correspondence.

We look forward to the opportunity for our students to benefit from this valuable learning experience at VEI Technologies.

Natham,  
12.06.23

Yours faithfully,  
  
(Dr. P. S. Satheesh Kumar)





## Industrial Visit to VEI Technologies, Chennai

### CONFIRMATION LETTER FROM INDUSTRY

#### Gmail

Inbox

[info@veitechnologies.com](mailto:info@veitechnologies.com)

Wed, JUNE 14, 2023, 12.28 PM

To:

[hodmathematicsnpccet@gmail.com](mailto:hodmathematicsnpccet@gmail.com)

Dear Sir,

We are happy to give permission for the industrial visit to your wards in VEI Technologies, Chennai. Kindly remind us one day in advance for the visit schedule also send the original letter copy with your hand during the visit.

Thanks and Regards,

Dr B Ezhilavan,  
Managing Director,  
VEI Technologies,  
Chennai.







# NPR

**COLLEGE OF ENGINEERING & TECHNOLOGY  
(AUTONOMOUS)**

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NPR Nagar, Natham - 624 401, Dindigul Dist, Tamil Nadu. Ph: 04544 - 246500, 501, 502.



**DEPARTMENT OF SCIENCE AND HUMANITIES**  
**Industrial Visit to VEI Technologies, Chennai**

S. No.	REGISTER NUMBER	NAME OF THE STUDENT	DEPARTMENT	GENDER
113.	920822114001	Abdul Ajees A	MECH	Male
114.	920822114002	Alaguraja V	MECH	Male
115.	920822114003	Arvinth Nagarathinam B J	MECH	Male
116.	920822114004	Bala K	MECH	Male
117.	920822114005	Bala N	MECH	Male
118.	920822114015	Muthuvel S	MECH	Male
119.	920822114016	Nandhagopal C	MECH	Male
120.	920822114017	Naveen Kumar M	MECH	Male
121.	920822114018	Riswanth S	MECH	Male
122.	920822114019	Sabariganapathy S	MECH	Male

HOD- I Year

(Dr. P. S. Sathyaesh Kumar)

PRINCIPAL

**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal

N.P.R. College of Engineering & Technology  
Natham, Dindigul (Dt) - 624 401.



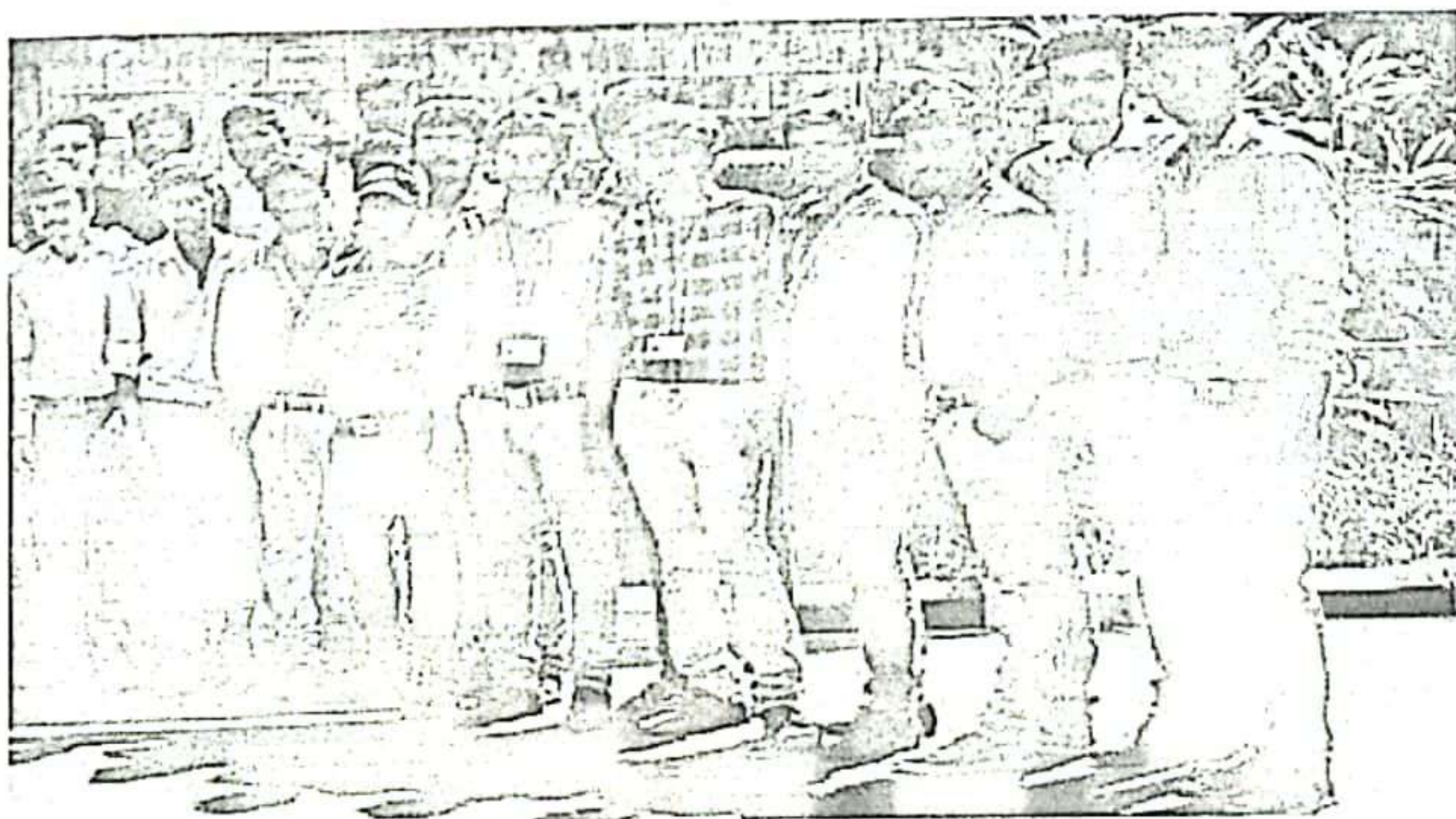


**DEPARTMENT OF SCIENCE AND HUMANITIES**

**Industrial Visit to VEI Technologies, Chennai**

**PHOTO GALLERY**

Date: 20/6/23 & Date: 21/6/23



I Year students are standing in front of VEI Technologies





## DEPARTMENT OF SCIENCE AND HUMANITIES

### Industrial Visit to VEI Technologies, Chennai

### Summary Report

**Date:** June 20<sup>th</sup>, 2023 (I Batch) and June 21<sup>st</sup>, 2023 (II Batch)

**Venue:** VEI Technologies, Poonamallee, Chennai

**Purpose:** The industrial visit to VEI Technologies aimed to offer students from NPRCET a practical insight into industry operations and various departments. It provided an opportunity for 270 first-year students (90 girls and 180 boys) in two batches, accompanied by six staff members, to gain valuable knowledge about the functioning of an R&D company specializing in web development and software solutions.

#### Schedule:

- **Departure:** Students were picked up from NPRCET on 20.6.23(I Batch) and on 21.6.23(II Batch) at 9:30 pm and traveled by bus to Chennai.
- **Arrival:** The group reached Chennai at 6:00 am the following day.
- **Visit to VEI Technologies:** From 9:00 am to 12:00 pm, students toured the facility, gaining insights into the company's various departments and operations.
- **Meeting with Director:** Students had the opportunity to meet Mr. Babu Ezhilavan, the Director of VEI Technologies, who provided information about the company's services, including web application development, website designing, e-commerce solutions, and more. They also learned about value-added courses offered by the company in areas such as IoT, Java and Python.
- **Leisure Activities:** After lunch at a nearby restaurant from 12:00 p.m to 1:00 p.m, students visited the planetarium from 1:00 p.m to 3:00 p.m, followed by a visit to the zoo from 3:00 p.m to 5:00 p.m, and a trip to the beach from 5:00 p.m to 6:30 p.m.
- **Return:** The students began their return journey at 8:00 p.m and reached NPRCET on 20.6.23(I Batch) and on 21.6.23(II Batch) at 5:00 a.m the next day.

**Outcome:** The industrial visit provided students with a practical understanding of industry operations and exposed them to various aspects of web development and software solutions. The interaction with staff and the Director of VEI Technologies enhanced the students' knowledge about the industry and its potential career paths. Additionally, the inclusion of leisure activities ensured a well-rounded experience for the students.

**Conclusion:** The visit to VEI Technologies was a valuable learning experience for the students, allowing them to bridge the gap between theoretical knowledge and practical application in the industry. The well-organized itinerary balanced educational insights with recreational activities, making it a memorable and enriching trip for all participants.

On completion of this industrial visit, the following Pos and PSOs were enabled.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
✓				✓		✓		✓	✓	✓	✓			

*P. Rani*  
FACULTY  
CO-ORDINATOR  
(Dr. P. Rani, Asp/Maths)

*Dr. P. S. Sathesh Kumar*  
HOD



*Dr. J. Sundararajan*  
IQAC

*Dr. J. Sundararajan*  
PRINCIPAL  
B.E., M.Tech., Ph.D.

NPR College of Engineering & Technology  
Poonamallee, Chennai - 600 099



## COURSE OBJECTIVES:

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

## UNIT I ELECTRICAL CIRCUITS

9

DC Circuits: Circuit Components: **Conductor, Resistor, Inductor, Capacitor** - Ohm's Law - Kirchhoff's Laws - Independent and Dependent Sources - Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor - Steady state analysis of RLC circuits (Simple problems only)

## UNIT II ELECTRICAL MACHINES

9

Construction and Working principle- **DC Separately and Self excited Generators**, EMF equation, Types and Applications. **Working Principle of DC motors**, Torque Equation, Types and Applications. Construction, Working principle and **Applications of Transformer**, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.

## UNIT III ANALOG ELECTRONICS

9

**Resistor, Inductor and Capacitor in Electronic Circuits**- Semiconductor Materials: Silicon & Germanium - PN Junction Diodes, Zener Diode - Characteristics Applications - Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT - Types, I-V Characteristics and Applications, **Rectifier and Inverters**

## UNIT IV DIGITAL ELECTRONICS

9

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only)

## UNIT V MEASUREMENTS AND INSTRUMENTATION

9

Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

TOTAL: 45 PERIODS

## COURSE OUTCOMES:

After completing this course, the students will be able to

1. Compute the electric circuit parameters for simple problems
2. Explain the working principle and applications of electrical machines
3. Analyze the characteristics of analog electronic devices
4. Explain the basic concepts of digital electronics
5. Explain the operating principles of measuring instruments

## TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
2. S.K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
3. Sedha R.S., "A text book book of Applied Electronics", S. Chand & Co., 2008
4. James A. Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

## REFERENCES:

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.

Dr. SUNDARARAJAN.  
B.E., M.Tech, Ph.D.,  
Principal

NAR. College of Engineering & Technology  
Natham, Dindigul (TN) - 624 501.







## Industrial Visit to VEI Technologies, Chennai

### PERMISSION LETTER

From

Dr. P.S. Satheesh Kumar,  
Head of the Department,  
Department of Science and Humanities,  
NPR College of Engineering & Technology, Natham,  
Dindigul - 624 401.

To

The Administrative Office,  
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We assure you that all necessary arrangements regarding transportation, supervision, and safety measures will be diligently taken care of throughout the visit.

We kindly request your approval for this industrial visit, as it will significantly contribute to the academic and professional development of our students. We eagerly await your favorable response.

Natham,  
12.06.2023

Yours Faithfully,

(Dr. P. S. Satheesh Kumar)

**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.

Principal

N.P.R. College of Engineering & Technology  
Natham, Dindigul - 624 401





## Industrial Visit to VEI Technologies, Chennai REQUISITION LETTER

From,  
Dr. P.S. Satheesh Kumar,  
Head of the Department,  
Department of Science and Humanities,  
NPR College of Engineering & Technology, Natham,  
Dindigul - 624 401.

To,  
Dr B Ezhilavan,  
Managing Director,  
VEI Technologies,  
Chennai.

Dear Sir,  
Greetings!

I hope this letter finds you in good health and high spirits. I am writing on behalf of NPR College of Engineering and Technology, situated in Natham, Dindigul district. Our institution is dedicated to the personal and professional development of students from rural backgrounds, offering a range of UG and PG courses.

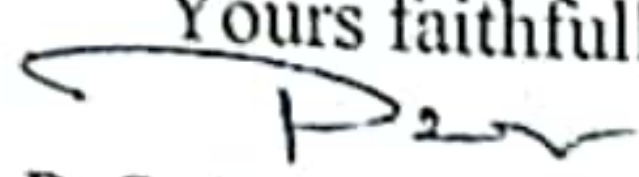
It has been a longstanding practice in our Science and Humanities Department to organize industrial visits for our students every semester, aiming to provide them with practical exposure and industry insights. In line with this, we have planned an industrial visit to VEI Technologies for our 270 first year students and 6 accompanying staff members. The visit is scheduled for two days, with two batches visiting on 20/6/23 and 21/6/23, respectively.

We assure you, sir, that our students will adhere strictly to safety protocols and will not disrupt your regular operations during their visit.

We humbly request your esteemed organization to grant us permission for this industrial visit. We would greatly appreciate if you could confirm the permission through a formal letter or email correspondence.

We look forward to the opportunity for our students to benefit from this valuable learning experience at VEI Technologies.

Natham,  
12.06.23

Yours faithfully,  
  
(Dr. P. S. Satheesh Kumar)







## Industrial Visit to VEI Technologies, Chennai

### CONFIRMATION LETTER FROM INDUSTRY

#### Gmail

Inbox

[info@veitechnologies.com](mailto:info@veitechnologies.com)

Wed, JUNE 14, 2023, 12.28 PM

To:

[hodmathematicsnpccet@gmail.com](mailto:hodmathematicsnpccet@gmail.com)

Dear Sir,

We are happy to give permission for the industrial visit to your wards in VEI Technologies, Chennai. Kindly remind us one day in advance for the visit schedule also send the original letter copy with your hand during the visit.

Thanks and Regards,

Dr B Ezhilavan,  
Managing Director,  
VEI Technologies,  
Chennai.







# NPR

**COLLEGE OF ENGINEERING & TECHNOLOGY  
(AUTONOMOUS)**

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NPR Nagar, Natham - 624 401, Dindigul Dist, Tamil Nadu. Ph: 04544 - 246500, 501, 502.



**DEPARTMENT OF SCIENCE AND HUMANITIES**  
**Industrial Visit to VEI Technologies, Chennai**

S. No.	REGISTER NUMBER	NAME OF THE STUDENT	DEPARTMENT	GENDER
113.	920822114001	Abdul Ajees A	MECH	Male
114.	920822114002	Alaguraja V	MECH	Male
115.	920822114003	Arvinth Nagarathinam B J	MECH	Male
116.	920822114004	Bala K	MECH	Male
117.	920822114005	Bala N	MECH	Male
118.	920822114015	Muthuvel S	MECH	Male
119.	920822114016	Nandhagopal C	MECH	Male
120.	920822114017	Naveen Kumar M	MECH	Male
121.	920822114018	Riswanth S	MECH	Male
122.	920822114019	Sabariganapathy S	MECH	Male

HOD- I Year

(Dr. P. S. Sathyaesh Kumar)

PRINCIPAL

**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal

N.P.R. College of Engineering & Technology  
Natham, Dindigul (Dt) - 624 401.



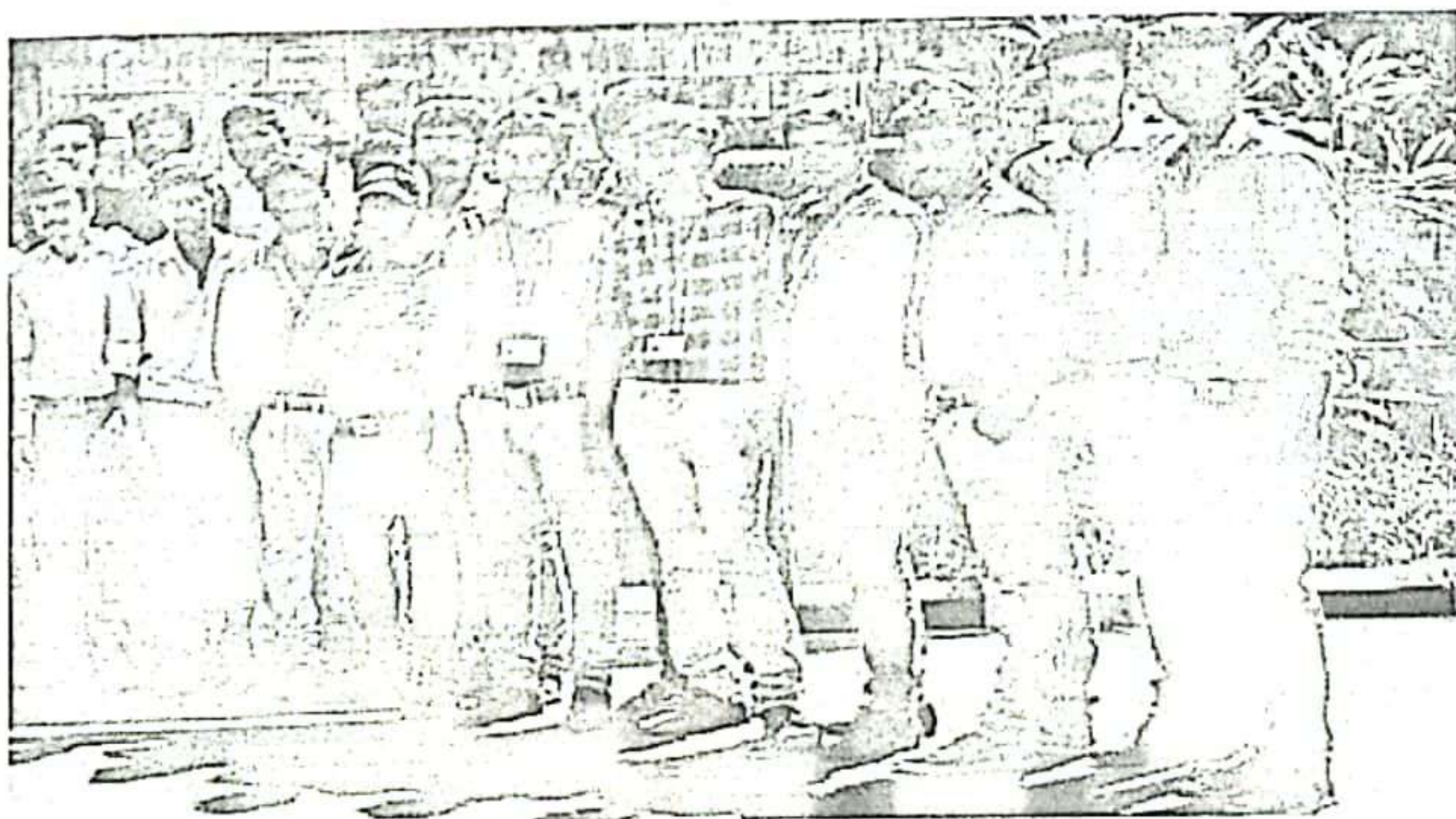


## DEPARTMENT OF SCIENCE AND HUMANITIES

### Industrial Visit to VEI Technologies, Chennai

### PHOTO GALLERY

Date: 20/6/23 & Date: 21/6/23



I Year students are standing in front of VEI Technologies





## DEPARTMENT OF SCIENCE AND HUMANITIES

### Industrial Visit to VEI Technologies, Chennai

### Summary Report

**Date:** June 20<sup>th</sup>, 2023 (I Batch) and June 21<sup>st</sup>, 2023 (II Batch)

**Venue:** VEI Technologies, Poonamallee, Chennai

**Purpose:** The industrial visit to VEI Technologies aimed to offer students from NPRCET a practical insight into industry operations and various departments. It provided an opportunity for 270 first-year students (90 girls and 180 boys) in two batches, accompanied by six staff members, to gain valuable knowledge about the functioning of an R&D company specializing in web development and software solutions.

#### Schedule:

- **Departure:** Students were picked up from NPRCET on 20.6.23(I Batch) and on 21.6.23(II Batch) at 9:30 pm and traveled by bus to Chennai.
- **Arrival:** The group reached Chennai at 6:00 am the following day.
- **Visit to VEI Technologies:** From 9:00 am to 12:00 pm, students toured the facility, gaining insights into the company's various departments and operations.
- **Meeting with Director:** Students had the opportunity to meet Mr. Babu Ezhilavan, the Director of VEI Technologies, who provided information about the company's services, including web application development, website designing, e-commerce solutions, and more. They also learned about value-added courses offered by the company in areas such as IoT, Java and Python.
- **Leisure Activities:** After lunch at a nearby restaurant from 12:00 p.m to 1:00 p.m, students visited the planetarium from 1:00 p.m to 3:00 p.m, followed by a visit to the zoo from 3:00 p.m to 5:00 p.m, and a trip to the beach from 5:00 p.m to 6:30 p.m.
- **Return:** The students began their return journey at 8:00 p.m and reached NPRCET on 20.6.23(I Batch) and on 21.6.23(II Batch) at 5:00 a.m the next day.

**Outcome:** The industrial visit provided students with a practical understanding of industry operations and exposed them to various aspects of web development and software solutions. The interaction with staff and the Director of VEI Technologies enhanced the students' knowledge about the industry and its potential career paths. Additionally, the inclusion of leisure activities ensured a well-rounded experience for the students.

**Conclusion:** The visit to VEI Technologies was a valuable learning experience for the students, allowing them to bridge the gap between theoretical knowledge and practical application in the industry. The well-organized itinerary balanced educational insights with recreational activities, making it a memorable and enriching trip for all participants.

On completion of this industrial visit, the following Pos and PSOs were enabled.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
✓				✓		✓		✓	✓	✓	✓			

*P. Rani*  
FACULTY  
CO-ORDINATOR  
(Dr. P. Rani, Asp/Maths)

*Dr. P. S. Sathesh Kumar*  
HOD



*Dr. J. Sundararajan*  
IQAC

*Dr. J. Sundararajan*  
PRINCIPAL  
B.E., M.Tech., Ph.D.

NPR College of Engineering & Technology  
Poonamallee, Chennai - 600 099



**COURSE OBJECTIVES:**

- 1 To Learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures
- 2 To introduce the equilibrium of rigid bodies, vector methods and free body diagram
- 3 To study and understand the distributed forces, surface, loading on beam and intensity.
- 4 To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.
- 5 To develop basic dynamics concepts - force, momentum, work and energy;

**UNIT I STATICS OF PARTICLES**

9

Fundamental Concepts and Principles, **Systems of Units**, Method of Problem Solutions. Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

**UNIT II EQUILIBRIUM OF RIGID BODIES**

9

**Principle of Transmissibility, Equivalent Forces**, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force - Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - **Reactions at Supports and Connections**.

**UNIT III DISTRIBUTED FORCES**

9

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, **Distributed Loads on Beams**, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, **Composite Bodies**, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, **Moments of Inertia of a Mass** - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

**UNIT IV FRICTION**

9

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, **Wheel Friction**, Rolling Resistance, Ladder friction.

**UNIT V DYNAMICS OF PARTICLES**

9

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, **Principle of Work and Energy**, Principle of Impulse and Momentum, Impact of bodies.

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

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

- Illustrate the vector and scalar representation of forces and moments
- Analyse the rigid body in equilibrium
- Evaluate the properties of distributed forces
- Determine the friction and the effects by the laws of friction
- Calculate dynamic forces exerted in rigid body

**TEXT BOOKS:**

Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12th Edition, 2019.  
Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

Dr. J. SUNDARARAJAN  
Principal  
M.P.R. College of Engineering & Technology  
Nathan, District: Madurai - 625 012







## Industrial Visit to VEI Technologies, Chennai

### PERMISSION LETTER

From

Dr. P.S. Satheesh Kumar,  
Head of the Department,  
Department of Science and Humanities,  
NPR College of Engineering & Technology, Natham,  
Dindigul - 624 401.

To

The Administrative Office,  
NPR Group of Institutions,  
Natham,  
Dindigul - 624 401.

Through Proper Channel

Sub: Requesting permission for Industrial visit - Reg.

Respected Sir,

I am writing to formally request permission for an industrial visit to VEI Technologies for our 1<sup>st</sup> Year students. The visit is scheduled to take place on two days, as outlined below:

I Batch - Departments: CSE A, CSE B, and EEE on 20.06.2023

II Batch - Departments: ECE, AI & DS, MECH and IT on 21.06.2023

We are planning for a total of 270 students from the 1<sup>st</sup> Year, consisting of 180 boys and 90 girls, accompanied by 6 staff members. The staff members accompanying the students are Dr. P.S. Satheesh Kumar, Prof/Physics, Dr. N. Kavitha, ASP/Physics, Dr. P. Rani, ASP/Maths, Dr. P. Shanmuga Priya, ASP/English, Dr. N. Prabakaran, ASP/Chemistry and Mrs. C. Yogitha, AP/Maths.

We assure you that all necessary arrangements regarding transportation, supervision, and safety measures will be diligently taken care of throughout the visit.

We kindly request your approval for this industrial visit, as it will significantly contribute to the academic and professional development of our students. We eagerly await your favorable response.

Natham,  
12.06.2023

Yours Faithfully,

(Dr. P. S. Satheesh Kumar)

**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.

Principal

N.P.R. College of Engineering & Technology  
Natham, Dindigul - 624 401





## Industrial Visit to VEI Technologies, Chennai REQUISITION LETTER

From,  
Dr. P.S. Satheesh Kumar,  
Head of the Department,  
Department of Science and Humanities,  
NPR College of Engineering & Technology, Natham,  
Dindigul - 624 401.

To,  
Dr B Ezhilavan,  
Managing Director,  
VEI Technologies,  
Chennai.

Dear Sir,  
Greetings!

I hope this letter finds you in good health and high spirits. I am writing on behalf of NPR College of Engineering and Technology, situated in Natham, Dindigul district. Our institution is dedicated to the personal and professional development of students from rural backgrounds, offering a range of UG and PG courses.

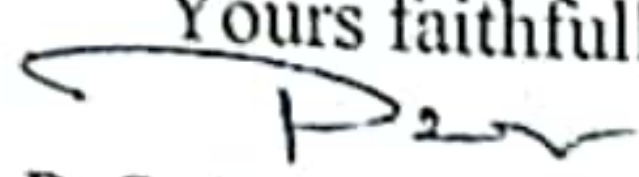
It has been a longstanding practice in our Science and Humanities Department to organize industrial visits for our students every semester, aiming to provide them with practical exposure and industry insights. In line with this, we have planned an industrial visit to VEI Technologies for our 270 first year students and 6 accompanying staff members. The visit is scheduled for two days, with two batches visiting on 20/6/23 and 21/6/23, respectively.

We assure you, sir, that our students will adhere strictly to safety protocols and will not disrupt your regular operations during their visit.

We humbly request your esteemed organization to grant us permission for this industrial visit. We would greatly appreciate if you could confirm the permission through a formal letter or email correspondence.

We look forward to the opportunity for our students to benefit from this valuable learning experience at VEI Technologies.

Natham,  
12.06.23

Yours faithfully,  
  
(Dr. P. S. Satheesh Kumar)





## Industrial Visit to VEI Technologies, Chennai

### CONFIRMATION LETTER FROM INDUSTRY

#### Gmail

Inbox

[info@veitechnologies.com](mailto:info@veitechnologies.com)

Wed, JUNE 14, 2023, 12.28 PM

To:

[hodmathematicsnpccet@gmail.com](mailto:hodmathematicsnpccet@gmail.com)

Dear Sir,

We are happy to give permission for the industrial visit to your wards in VEI Technologies, Chennai. Kindly remind us one day in advance for the visit schedule also send the original letter copy with your hand during the visit.

Thanks and Regards,

Dr B Ezhilavan,  
Managing Director,  
VEI Technologies,  
Chennai.







# NPR

**COLLEGE OF ENGINEERING & TECHNOLOGY  
(AUTONOMOUS)**

Approved by AICTE, New Delhi & Affiliated to Anna University Chennai | Accredited by NAAC with 'A' GRADE  
Recognised by UGC under 2(f) | ISO 9001:2015 Certified | Web: [www.nprcolleges.org](http://www.nprcolleges.org) | E-Mail: [nprcetprincipal@nprcolleges.org](mailto:nprcetprincipal@nprcolleges.org)  
NPR Nagar, Natham - 624 401, Dindigul Dist, Tamil Nadu. Ph: 04544 - 246500, 501, 502.



**DEPARTMENT OF SCIENCE AND HUMANITIES**  
**Industrial Visit to VEI Technologies, Chennai**

S. No.	REGISTER NUMBER	NAME OF THE STUDENT	DEPARTMENT	GENDER
113.	920822114001	Abdul Ajees A	MECH	Male
114.	920822114002	Alaguraja V	MECH	Male
115.	920822114003	Arvinth Nagarathinam B J	MECH	Male
116.	920822114004	Bala K	MECH	Male
117.	920822114005	Bala N	MECH	Male
118.	920822114015	Muthuvel S	MECH	Male
119.	920822114016	Nandhagopal C	MECH	Male
120.	920822114017	Naveen Kumar M	MECH	Male
121.	920822114018	Riswanth S	MECH	Male
122.	920822114019	Sabariganapathy S	MECH	Male

HOD- I Year

(Dr. P. S. Sathyaesh Kumar)

PRINCIPAL

**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal

N.P.R. College of Engineering & Technology  
Natham, Dindigul (Dt) - 624 401.



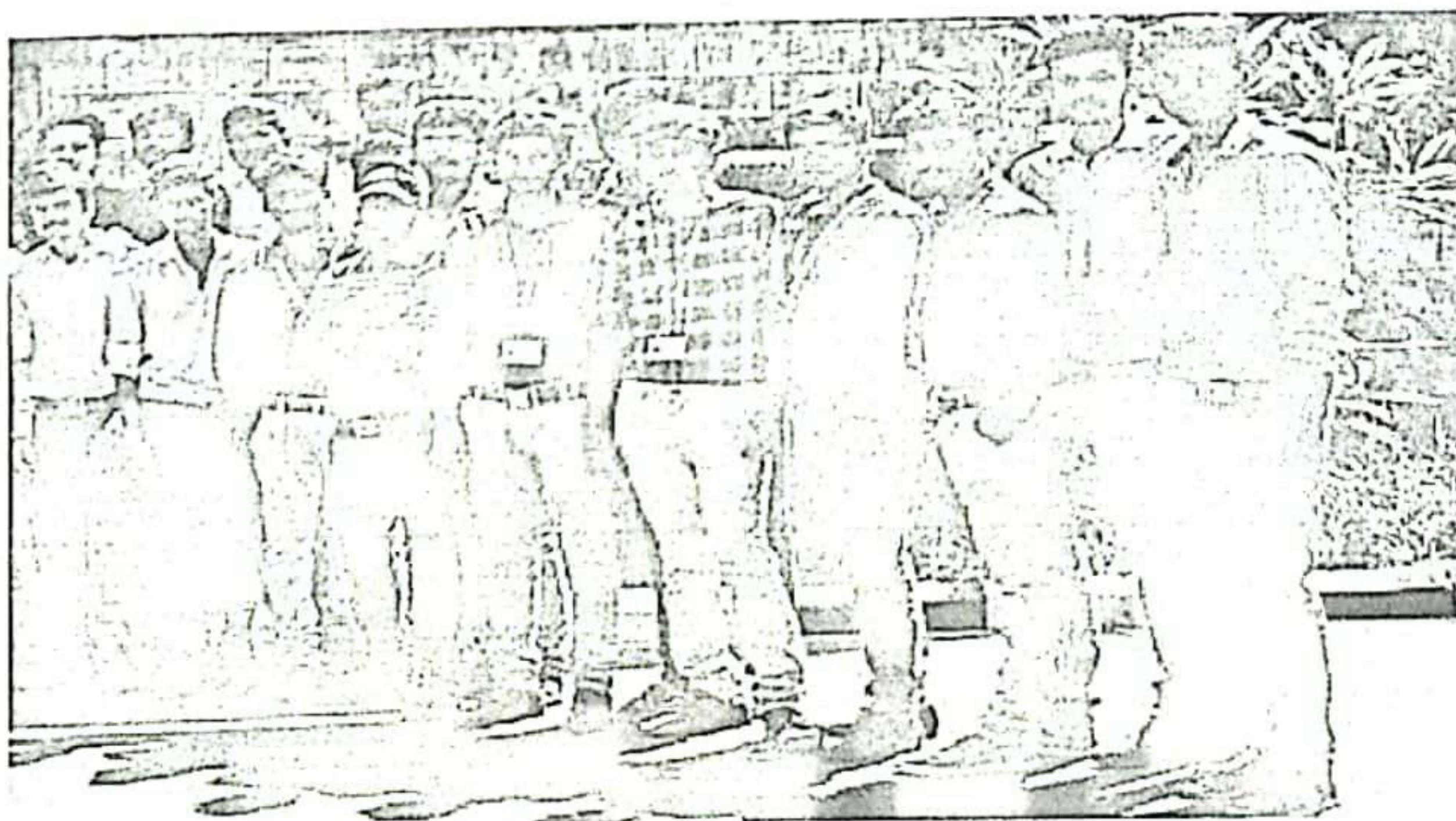


**DEPARTMENT OF SCIENCE AND HUMANITIES**

**Industrial Visit to VEI Technologies, Chennai**

**PHOTO GALLERY**

Date: 20/6/23 & Date: 21/6/23



I Year students are standing in front of VEI Technologies





## DEPARTMENT OF SCIENCE AND HUMANITIES

### Industrial Visit to VEI Technologies, Chennai

### Summary Report

**Date:** June 20<sup>th</sup>, 2023 (I Batch) and June 21<sup>st</sup>, 2023 (II Batch)

**Venue:** VEI Technologies, Poonamallee, Chennai

**Purpose:** The industrial visit to VEI Technologies aimed to offer students from NPRCET a practical insight into industry operations and various departments. It provided an opportunity for 270 first-year students (90 girls and 180 boys) in two batches, accompanied by six staff members, to gain valuable knowledge about the functioning of an R&D company specializing in web development and software solutions.

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**Conclusion:** The visit to VEI Technologies was a valuable learning experience for the students, allowing them to bridge the gap between theoretical knowledge and practical application in the industry. The well-organized itinerary balanced educational insights with recreational activities, making it a memorable and enriching trip for all participants.

On completion of this industrial visit, the following Pos and PSOs were enabled.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
✓				✓		✓		✓	✓	✓	✓			

*P. Rani*  
FACULTY  
CO-ORDINATOR  
(Dr. P. Rani, Asp/Maths)

*Dr. P. S. Sathesh Kumar*  
HOD



*Dr. J. Sundararajan*  
IQAC

*Dr. J. Sundararajan*  
PRINCIPAL  
B.E., M.Tech., Ph.D.

NPR College of Engineering & Technology  
Poonamallee, Chennai - 600 099



**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.

**Dr. J.SUNDARARAJAN,**

B.E., M.Tech., Ph.D.,

Principal

NPR. College of Engineering & Technology  
Natham, Dindigul (TN) - 624 401.



CIN: U28131TZ2009PTC015549

Date:01.08.2023

**TO WHOM IT MAY CONCERN**


This is to certify that **Mr.Vidhya Shankar P** studying in second year Mechanical Engineering of NPR College of Engineering & Technology, Natham has undergone In-Plant training in our organization from **24.07.2023 to 28.07.2023**.

During the period, his conduct was found to be good.

With regards,



(For Thermo Solutions (INDIA) Pvt. Ltd)

  
**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NPR. College of Engineering & Technology  
Natham, Dindigul (TN) - 624 401.



**THERMO SOLUTIONS (INDIA) PRIVATE LIMITED**

Corp. Office : #10/76, 2nd Cross St, Kumaran Nagar, Virugambakkam, Chennai - 600 092. Telefax : +91 44 2479 2151

Factory : #12A, Sidco Industrial Estate, Dindigul - 624 003. Telefax : +91 451 2470238 / 424

tsi@thermosolutions.net / www.thermosolutions.net



**COURSE OBJECTIVES:**

1. To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2. To impart basic knowledge of the dynamics of fluids and boundary layer concept.
3. To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
4. To exposure to the significance of boundary layer theory and its thicknesses.
5. To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

**UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS****10+3**

Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold's transportation theorem - Continuity equation, energy equation and momentum equation - Applications.

**UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER****9+3**

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

**UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES****8+3**

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

**UNIT IV TURBINES****9+3**

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

**UNIT V PUMPS****9+3**

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies- Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps.

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

On completion of the course, the student is expected to be able to

1. Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.
3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
4. Explain the working principles of various turbines and design the various types of turbines.
5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

**TEXT BOOKS:**

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
3. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.

**Dr. J. SUNDARARAJAN,**

B.E., M.Tech., Ph.D.,

Principal

N.P.R. College of Engineering &amp; Technology

Natham, Dist. Sivakasi - 624 401.



CIN: U28131TZ2009PTC015549

Date:01.08.2023

**TO WHOM IT MAY CONCERN**


This is to certify that **Mr.Santhosh Kumar K** studying in second year Mechanical Engineering of NPR College of Engineering & Technology, Natham has undergone In-Plant training in our organization from **24.07.2023 to 28.07.2023**.

During the period, his conduct was found to be good.

With regards,



(For Thermo Solutions (INDIA) Pvt. Ltd)

  
**Mr. J.SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NPR College of Engineering & Technology  
Natham, Dindigul (Tamil Nadu) - 624 561.



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tsi@thermosolutions.net / www.thermosolutions.net



**COURSE OBJECTIVES:**

- 1 To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.
- 2 To learn selecting and applying various heat treatment processes and its microstructure formation.
- 3 To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.
- 4 To illustrate the different polymer, ceramics and composites and their uses in engineering field.
- 5 To learn the various testing procedures and failure mechanism in engineering field.

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

9

Constitution of alloys - 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 tempering of steel. Isothermal transformation diagrams - cooling curves superimposed on 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 ideas on sintering.

**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 of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers - 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- applications of Composites - Nano composites.

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

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

1. Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
2. Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
3. Clarify the effect of alloying elements on ferrous and non-ferrous metals.
4. Summarize the properties and applications of non-metallic materials.
5. Explain the testing of mechanical properties.

**Dr. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal

NRR College of Engineering & Technology  
Nathan, Dindigul (Dt) - 624 401.

**TEXT BOOKS:**

1. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 9<sup>th</sup> edition, 2018.
2. Sydney H. Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994







JM Fricttech India Pvt Ltd (JMI)  
G27, SIPCOT Industrial Park,  
Katrambakkam Village, Irungattukottai,  
Chennai-Nadu 602105

Date: 04/08/2023

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. Deepak R** studying IV year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Thirty days internship from **03/07/2023 to 01/08/2023** in our company. During the period the training period he was has been extremely inquisitive and hard working. He summed to be writing to learn the functions/process with kwon interest.

We wish him every success in life.

  
**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NPR College of Engineering & Technology  
Natham, Dindigul - 624 401.

  
**JM Fricttech India Pvt. Ltd,**  
G-27, SIPCOT Industrial Park,  
Irungattukottai,  
Chennai-602 105.

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**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 Materials - Pattern allowances - Molding sand 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 - CO2 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 plastics components.

**TEXT BOOKS:**

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

**Dr. JSUNDARARAJAN,**

B.E., M.Tech, Ph.D.,

Principal

NAR College of Engineering &amp; Technology

Natham, Dindigur (Dist) - 624 401.



CIN: U28131TZ2009PTC015549

Date:01.08.2023

**TO WHOM IT MAY CONCERN**

This is to certify that **Mr.Manokaran K** studying in second year Mechanical Engineering of NPR College of Engineering & Technology, Natham has undergone In-Plant training in our organization from **24.07.2023 to 28.07.2023**.

During the period, his conduct was found to be good.

With regards,



(For Thermo Solutions (INDIA) Pvt. Ltd)

  
**Dr. J.SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal

NPR College of Engineering & Technology  
Natham, Dindigul (Dt) - 624 401.



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tsi@thermosolutions.net / www.thermosolutions.net



**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 - nonstandard teeth - gear trains - parallel axis gears 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.

**TEXT BOOKS:**

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.

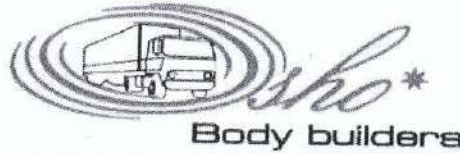


**Dr. J. SUNDARARAJAN,**  
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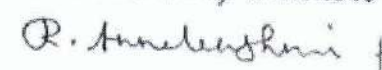
**Date: 01.08.2023**

**TO WHOM IT MAY CONCERN**

This to certify that **Mr.Charanjith.P** a student of BE (Mechanical Engineering – Second Year) NPR College of Engineering and Technology, Natham, Dindigul, India has successfully completed Internship (**30.06.2023 to 28.07.2023**) at Osho Body builders, Madurai. During the period of his Internship with us, he was found punctual, Hardworking and inquisitive.

We wish him every success in life.

  
**Dr. J.SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NPR College of Engineering & Technology  
Natham, Dindigul - 624 401.

For Osho Body Builders  
  
Partner



**ELEGANCE IN SHAPE AND EXCELLENCE IN QUALITY IS OUR WATCH WORD**



**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

**TEXT BOOKS:**

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.



**Dr. JSUNDARARAJAN,**  
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G27, SIPCOT Industrial Park,  
Katrambakkam Village, Irungattukottai,  
Chennai-Nadu 602105


Date: 04/08/2023

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. Arikaran N** studying IV year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Thirty days. internship from **03/07/2023 to 01/08/2023** in our company. During the period the training period he was has been extremely inquisitive and hard working. He summed to be writing to learn the functions/process with kwon interest.

We wish him every success in life.

  
**Dr. J. SUNDARARAJAN,**  
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**COURSE OBJECTIVES:**

1. To provide the knowledge on the working principles of fluid power systems.
2. To study the fluids and components used in modern industrial fluid power system.
3. To develop the design, construction and operation of fluid power circuits.
4. To learn the working principles of pneumatic power system and its components.
5. To provide the knowledge of trouble shooting methods in fluid power systems.

**UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS**

9

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

**UNIT – II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS**

9

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

**UNIT – III HYDRAULIC CIRCUITS AND SYSTEMS**

9

Accumulators, Intensifiers, **Industrial hydraulic circuits** - Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, -Servo and Proportional valves - **Applications**- Mechanical, hydraulic servo systems.

**UNIT – IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**

9

Properties of air -Air preparation and distribution - Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, **Pneumatic actuators**, Design of Pneumatic circuit -classification- single cylinder and multi cylinder circuits-Cascade method -Integration of fringe circuits, **Electro Pneumatic System** - Elements - Ladder diagram - timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits

**UNIT – V TROUBLE SHOOTING AND APPLICATIONS**

9

**Installation, Selection, Maintenance**, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. - Low-cost Automation - Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics

Note: (Use of standard Design Data Book is permitted in the University examination)

**TOTAL: 45 PERIODS**

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

1. Apply the working principles of fluid power systems and hydraulic pumps.
2. Apply the working principles of hydraulic actuators and control components.
3. Design and develop hydraulic circuits and systems.
4. Apply the working principles of pneumatic circuits and power system and its components.
5. Identify various troubles shooting methods in fluid power systems.

**Dr. L. SUNDARARAJAN**  
B.E., M.Tech., Ph.D.,  
Principal

**NPR. College of Engineering & Technology**  
Nathan, Dindigul (TN) - 624 401.

**TEXT BOOKS:**

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997

**REFERENCES:**

1. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.








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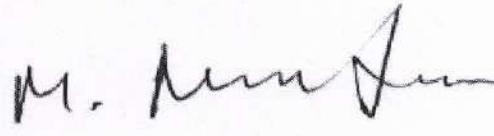
Date: 04/08/2023

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr.Aathiraja D** studying IV year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Thirty days internship from **03/07/2023 to 01/08/2023** in our company. During the period the training period he was has been extremely inquisitive and hard working. He summed to be writing to learn the functions/process with kwon interest.

We wish him every success in life.

  
**Dr. J.SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
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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 - multi spindle.

**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 - micro finishing 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 - Work holding 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 tools through planning, writing codes and setting up CNC machine tools to manufacture a given component.

**TEXT BOOKS:**

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.



**M. J. SUNDARARAJAN,**  
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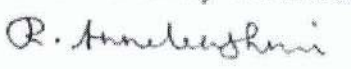
**Date: 01.08.2023**

**TO WHOM IT MAY CONCERN**

This to certify that **Mr.Sukumar.K** a student of BE (Mechanical Engineering – Second Year) NPR College of Engineering and Technology, Natham, Dindigul, India has successfully completed Internship (**30.06.2023 to 28.07.2023**) at Osho Body builders, Madurai. During the period of his Internship with us, he was found punctual, Hardworking and inquisitive.

We wish him every success in life.

  
**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
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Natham, Dindigul Dist. - 626 002

For Osho Body Builders  
  
Partner



**ELEGANCE IN SHAPE AND EXCELLENCE IN QUALITY IS OUR WATCH WORD**



**COURSE 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 - Cantilever, Simply supported 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

Theory of Torsion - Stresses and Deformations in Solid and Hollow Circular Shafts - Combined bending moment and torsion of shafts - Power transmitted to shaft - Shaft in series and parallel - Closed and Open Coiled helical springs - springs in series and parallel.

**UNIT IV DEFLECTION OF BEAMS**

9

Elastic curve - Governing differential equation - Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams.

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

9

Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders - Spherical shells subjected to internal pressure - Deformation in spherical shells - Thick cylinders - Lamé's theory.

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

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

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

**TEXT BOOK**

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 7<sup>th</sup> edition, 2018.
2. Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.



**Dr. J.SUNDARARAJAN,**  
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Chennai-Nadu 602105

Date: 04/08/2023

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr.Dhayal Priyadharsan S** studying IV year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Thirty days internship from **03/07/2023 to 01/08/2023** in our company. During the period the training period he was has been extremely inquisitive and hard working. He summed to be writing to learn the functions/process with kwon interest.

We wish him every success in life.

  
**Dr. J.SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
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**OBJECTIVES:**

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

**UNIT I ENVIRONMENT AND BIODIVERSITY**

6

Definition, scope and importance of environment – need for public awareness. **Eco-system and Energy flow-** ecological succession. Types of biodiversity: genetic, species and ecosystem diversity- values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: **In-situ and ex-situ.**

**UNIT II ENVIRONMENTAL POLLUTION**

6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. **Solid, Hazardous and E-Waste management.** Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

**UNIT III RENEWABLE SOURCES OF ENERGY**

6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

**UNIT IV SUSTAINABILITY AND MANAGEMENT**

6

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. **Environmental management in industry-A case study.**

**UNIT V SUSTAINABILITY PRACTICES**

6

**Zero waste and R concept,** Circular economy, ISO 14000 Series, **Material Life cycle assessment,** Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. **Sustainable energy:** Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

**TOTAL : 30 PERIODS****OUTCOMES:**

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
- To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

**Dr. J. SUNDARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal




#### TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

#### REFERENCES :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

  
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Rajappa Nagar,  
Kovil Pappakudi (P.O.)  
MADURAI - 625 018

**Date: 01.08.2023**

**TO WHOM IT MAY CONCERN**

This to certify that **Mr.Kannan.S** a student of BE (Mechanical Engineering – Second Year ) NPR College of Engineering and Technology, Natham, Dindigul, India has successfully completed Internship (**30.06.2023 to 28.07.2023**) at Osho Body builders, Madurai. During the period of his Internship with us, he was found punctual, Hardworking and inquisitive.

We wish him every success in life.

**Dr. J.SUNDARARAJAM.**  
B.E., M.Tech., Ph.D.,  
Principal  
NPR College of Engineering & Technology  
Natham, Dindigul - 624 401.

For Osho Body Builders

*R. Anantharaman*  
Partner



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**OBJECTIVES:**

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

**UNIT I STEAM NOZZLE**

9

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

**UNIT II BOILERS**

9

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

**UNIT III STEAM TURBINES**

9

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

**UNIT IV COGENERATION AND RESIDUAL HEAT RECOVERY**

9

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

**UNIT V REFRIGERATION AND AIR – CONDITIONING**

9

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

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

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

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

**REFERENCES:**

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

**TEXT BOOKS:**

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



**Dr. J.SUNDARARAJAN,**

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CIN: U28131TZ2009PTC015549

Date: 03.02.2023

**TO WHOM IT MAY CONCERN**

This is to certify that **Mr. Sanjay Kumar K** studying in Third year Mechanical Engineering of NPR College of Engineering & Technology, Natham has undergone Internship in our organization from **16.01.2023 to 31.01.2023**.

During the period, his conduct was found to be good.

With regards,



(For Thermo Solutions (INDIA) Pvt. Ltd)

  
**Dr. JSUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NPR College of Engineering & Technology  
Natham, Dindigul - 624 003.



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**OBJECTIVES**

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

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

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

**UNIT II SHAFTS AND COUPLINGS 9**

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

**UNIT III TEMPORARY AND PERMANENT JOINTS 9**

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

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

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

**UNIT V BEARINGS 9**

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

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

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

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

**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", 9th Edition, Tata McGraw-Hill, 2011.

**REFERENCES:**

1. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010
2. Ansel Ugural, "Mechanical Design - An Integral Approach", 1<sup>st</sup> Edition, Tata McGraw-Hill Book Co, 2003.

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**Date: 20.01.2023**

### TO WHOM IT MAY CONCERN

This to certify that **Mr. Dhakshinamoorthi.T** a student of BE (Mechanical Engineering – Third Year) NPR College of Engineering and Technology, Natham, Dindigul, India has successfully completed Internship (02.01.2023 to 12.01.2023) at Osho Body builders, Madurai. During the period of his Internship with us, he was found punctual, Hardworking and inquisitive.

We wish him every success in life.



**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech, Ph.D.,  
Principal  
NPR College of Engineering & Technology  
Natham, Dindigul

For Osho Body Builders  
*R. Anantharaman*  
Partner

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**OBJECTIVES:**

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

**UNIT I BASICS OF METROLOGY**

9

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

**UNIT II LINEAR AND ANGULAR MEASUREMENTS**

9

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

**UNIT III ADVANCES IN METROLOGY**

9

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

**UNIT IV FORM MEASUREMENT**

9

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

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

9

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

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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

1. Alan S. Morris, "The essence of Measurement", Prentice Hall of India 1996.
2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2014.
3. Charles Reginald Shotbolt, "Metrology for Engineers", 5<sup>th</sup> edition, Cengage Learning EMEA, 1990.
4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.
5. Raghavendra, Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.



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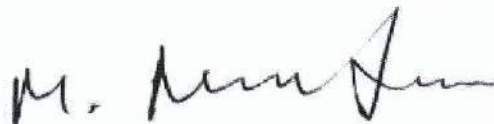
Date: 20/01/2023

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. Maheswaran S** studying III year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Twenty-One days internship from **21/12/2023 to 12/01/2023** in our company. During the period the training period he has been extremely inquisitive and hard working. He summed to be writing to learn the functions/process with kwon interest.

We wish him every success in life.

  
**Dr. J. SUNDARARAJAN,**  
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**OBJECTIVES:**

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

**UNIT I FORCE ANALYSIS****12**

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

**UNIT II BALANCING****12**

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

**UNIT III FREE VIBRATION****12**

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

**UNIT IV FORCED VIBRATION****12**

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

**UNIT V MECHANISM FOR CONTROL****12**

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

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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014



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MADURAI - 625 018

**Date: 30.01.2023**

**TO WHOM IT MAY CONCERN**

This to certify that **Mr. Ruban.P** a student of BE (Mechanical Engineering – Final Year) NPR College of Engineering and Technology, Natham, Dindigul, India has successfully completed In-Plant Training (23.01.2023 to 28.01.2023) at Osho Body builders, Madurai. During the period of his In-Plant Training with us, he was found punctual, Hardworking and inquisitive.

We wish him every success in life.

*[Signature]*  
**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NPR College of Engineering & Technology  
Natham, Dindigul (Dist) - 624 401.

For Osho Body Builders

*[Signature]*  
Partner



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**OBJECTIVES:**

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

**UNIT I AUTOMOTIVE ENGINE AUXILIARY SYSTEMS**

9

Automotive engines- External combustion engines –Internal combustion engines -classification of engines- SI Engines- CI Engines- two stroke engines -four stroke engines- construction and working principles - IC engine components- functions and materials -valve timing –port timing diagram- Injection system -Unit injector system- Rotary distributor type - Electronically controlled injection system for SI engines-CI engines-Ignition system - Electronic ignition system -Transistorized ignition system, capacitive discharge ignition system.

**UNIT II VEHICLE FRAMES AND STEERING SYSTEM**

9

Vehicle construction and different Chassis layouts –classifications of chassis- types of frames- frameless chassis construction –articulated vehicles- vehicle body - Vehicle aerodynamics-various resistances and its effects - steering system –conventional – sophisticated vehicle- and types of steering gear box-Power Steering- Steering geometry-condition for true rolling motion-Ackermann's- Devi's steering system - types of stub axle – Types of rear axles.

**UNIT III TRANSMISSION SYSTEMS**

9

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

**UNIT IV SUSPENSION AND BRAKES SYSTEMS**

9

Suspension Systems- conventional Suspension Systems -independent Suspension Systems –leaf spring – coil spring –taper-lite - eligo,s spring Types of brakes -Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brakes on plain surface - inclined road-gradient .

**UNIT V ALTERNATIVE ENERGY SOURCES**

9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell. Turbo chargers -Engine emission control by three way catalytic converter system.

Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

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

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

**TEXT BOOKS:**

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
3. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997.



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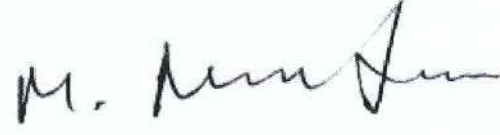
Date: 20/01/2023

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr.Raj Mohan R** studying III year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Twenty-One days internship from **21/12/2023 to 12/01/2023** in our company. During the period the training period he was has been extremely inquisitive and hard working. He summed to be writing to learn the functions/process with kwon interest.

We wish him every success in life.

  
**Dr. J.SUNDARARAJAN,**  
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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 -axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes - Internal expanding shoe brake.

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

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

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

**TEXT BOOKS:**

1. Bhandari V, "Design of Machine Elements", 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.

**REFERENCES:**

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8<sup>th</sup> Edition, Printice Hall, 2003.



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Kovil Pappakudi (Po)  
MADURAI - 625 018

**Date: 30.01.2023**

**TO WHOM IT MAY CONCERN**

This to certify that **Mr.Iman Mohammed.T** a student of BE (Mechanical Engineering – Final Year) NPR College of Engineering and Technology, Natham, Dindigul, India has successfully completed In-Plant Training (**23.01.2023 to 28.01.2023**) at Osho Body builders, Madurai. During the period of his In-Plant Training with us, he was found punctual, Hardworking and inquisitive.

We wish him every success in life.

**Dr. JSUNDARARAJAN,**  
B.E., M.Tech, Ph.D.,

Principal

NPR College of Engineering & Technology  
Natham, Dindigul (Dist) - 624 401.

For Osho Body Builders

*R. Anantharaman*

Partner



**ELEGANCE IN SHAPE AND EXCELLENCE IN QUALITY IS OUR WATCH WORD**



**OBJECTIVES:**

- To provide an overview of how computers are being used in mechanical component design
- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

**UNIT I INTRODUCTION**

9

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

**UNIT II GEOMETRIC MODELING**

9

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

**UNIT III CAD STANDARDS**

9

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

**UNIT IV FUNDAMENTAL OF CNC AND PART PROGRAMING**

9

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

**UNIT V CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS)**

9

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

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

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

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

**TEXT BOOKS:**

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



**Dr. J. SUNDARARAJAN,**  
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Principal  
N.P.R. College of Engineering & Technology  
Natham, Dist. Tirupur - 624 401.





# DESIGN AND FABRICATION OF E-CYCLE WITH GEAR BOX



A PROJECT REPORT

*Submitted by*

ABISHEK KUMAR.M	(920820114001)
ARUN KUMAR.K.E	(920820114003)
RAGURAM.B	(920820114005)
SIVA BALAN.N	(920820114008)

*in partial fulfillment for the award of the degree*

*Of*

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**

**NPR COLLEGE OF ENGINEERING AND TECHNOLOGY**

**ANNA UNIVERSITY: CHENNAI 600 025**

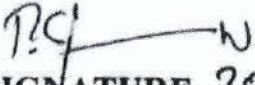
**MAY 2023**





## BONAFIDE CERTIFICATE

Certified that this project report "DESIGN AND FABRICATION OF E-CYCLE WITH GEAR BOX" is the bonafide work of "ABISHEK KUMAR.M (920820114001), ARUN KUMAR.K.E(920820114003), RAGURAM.B (920820114005), SIVA BALAN.N(920820114008)" who carried out the project work under my supervision.

  
SIGNATURE 30.5.23

Dr.T.SARAVANA KANNAN M.Tech., Ph.D.

**HEAD OF THE DEPARTMENT**

Professor

Mechanical Engineering

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Technology

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Dindigul-624401

  
SIGNATURE

Mr.G.SUNDARA RAJAN M.E.,

**SUPERVISOR**

Assistant Professor

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Natham

Dindigul- 624401

Submitted for the viva-voce Examination held on... 30/5/2023.

  
INTERNALEXAMINER

  
EXTERNALEXAMINER





## ABSTRACT

Now-a-days there are so many vehicles on road, which consumes more fuel and also hazards our environment. It is our responsibility to reduce the consumption of fuel and its hazardous emission products. Taking this into consideration it is our small step towards reducing the use of more fuel consuming vehicles and attract the eye of people towards its alternatives i.e. Electric bicycle. The main aim of this project is to present the idea of harnessing the various energy and use it in today's existence of human life .Now-a-days there are so many vehicles on road, which consumes more fuel and also hazards our environment. It is our responsibility to reduce the consumption of fuel and its hazardous emission products. Taking this into consideration it is our small step towards reducing the use of more fuel consuming vehicles and attract the eye of people towards its alternatives i.e. Electric bicycle.

So we intend to design a cycle which would run on an alternative source and also reducing human efforts called as Battery Operated Cycle. We need to increase the speed of the battery vehicles using gear box. In this project we design an alternative mode of transport for betterment of social and environment.





## CHAPTER 11

### CONCLUSION

With the increasing consumption of natural resources of petrol, diesel it is necessary to shift our way towards alternate resources like the Electric bike and others because it is necessary to identify new way of transport. Electric bike is a modification of the existing cycle by using electric energy and also solar energy if solar panels are provided, that would sum up to increase in energy production. Since it is energy efficient, electric bike is cheaper and affordable to anyone. It can be used for shorter distances by people of any age. It can be contrived throughout the year. The most vital feature of the electric bike is that it does not consume fossil fuels thereby saving crores of foreign currencies. The second most important feature is it is pollution free, eco – friendly and noiseless in operation. For offsetting environmental pollution using of on – board Electric Bike is the most viable solution. It can be charged with the help of AC adapter if there is an emergency. The Operating cost per/km is very less and with the help of solar panel it can lessen up more. Since it has fewer components it can be easily dismantled to small components, thus requiring less maintenance.



**Dr. J. VINODARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NATHAN College of Engineering & Technology  
Nathan, Dindigul (TN) - 624 001.



**OBJECTIVES:**

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

**UNIT I CONDUCTION**

9+6

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

**UNIT II CONVECTION**

9+6

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

**UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**

9+6

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

**UNIT IV RADIATION**

9+6

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

**UNIT V MASS TRANSFER**

9+6

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

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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998.
2. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 1998.
3. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.



**Dr. JSUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NATHAN College of Engineering & Technology  
Nathan, Dindigul - 626 001.



CIN: U28131TZ2009PTC015549

Date:03.02.2023

**TO WHOM IT MAY CONCERN**


This is to certify that **Mr.Raj Venkatesh R** studying in Third year Mechanical Engineering of NPR College of Engineering & Technology, Natham has undergone Internship in our organization from **16.01.2023 to 31.01.2023**.

During the period, his conduct was found to be good.

With regards,



(For Thermo Solutions (INDIA) Pvt. Ltd)

  
**Dr. J.SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.  
Principal  
NPR College of Engineering & Technology  
Natham, Dindigul - 624 401.



**THERMO SOLUTIONS (INDIA) PRIVATE LIMITED**

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tsi@thermosolutions.net / www.thermosolutions.net



**OBJECTIVES:**

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

**UNIT I INTRODUCTION**

9

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

**UNIT II ONE-DIMENSIONAL PROBLEMS**

9

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

**UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS**

9

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

**UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS**

9

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

**UNIT V ISOPARAMETRIC FORMULATION**

9

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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)\*
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990
3. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
4. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004.



**Dr. J.SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,

Principal

NRR College of Engineering & Technology  
Natham, Dindigul (Dn) - 624 401.



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98430 - 83074



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Plot No 32, (S.V.D. Nagar)  
Rajappa Nagar,  
Kovil Pappakudi (P.O.)  
MADURAI - 625 018

Date: 20.01.2023

### TO WHOM IT MAY CONCERN

This to certify that **Mr. Seenivasan.A** a student of BE (Mechanical Engineering – Third Year) NPR College of Engineering and Technology, Natham, Dindigul, India has successfully completed Internship (02.01.2023 to 12.01.2023) at Osho Body builders, Madurai. During the period of his Internship with us, he was found punctual, Hardworking and inquisitive.

We wish him every success in life.



**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NPR College of Engineering & Technology  
Natham, Dindigul (TN) - 624 401.

For Osho Body Builders

*R. Annadurai*  
Partner

ELEGANCE IN SHAPE AND EXCELLENCE IN QUALITY IS OUR WATCH WORD



**OBJECTIVES:**

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

**UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS**

9

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

**UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS**

9

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

**UNIT III HYDRAULIC CIRCUITS AND SYSTEMS**

9

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

**UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**

9

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

**UNIT V TROUBLE SHOOTING AND APPLICATIONS**

9

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

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

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

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

**TEXT BOOKS:**

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



**Dr. J.SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal

N.P.R. College of Engineering & Technology  
Nathan, Bidar Road - 574 301.





**DESIGN & FABRICATION OF PNEUMATIC VICE**  
**A PROJECT REPORT**



**Submitted by**

<b>ELANCHERAN.A</b>	<b>(920820114307)</b>
<b>RAJ MOHAN.R</b>	<b>(920820114323)</b>
<b>SIVA KUMAR.S</b>	<b>(920820114331)</b>
<b>MAHESWARAN.S</b>	<b>(920820114340)</b>

*in partial fulfillment for the award of the degree*

*of*

**BACHELOR OF ENGINEERING**

*in*

**MECHANICAL ENGINEERING**

**NPR COLLEGE OF ENGINEERING TECHNOLOGY**

**NATHAM,DINDIGUL**

**ANNA UNIVERSITY :: CHENNAI 600 025**

**MAY 2023**








ANNA UNIVERSITY :: CHENNAI 600 025

### BONAFIDE CERTIFICATE

Certified that this project report "DESIGN AND FABRICATION OF PNEUMATIC VICE" is the bonafide work of **ELANCHERAN. A (920820114307)**, **RAJ MOHAN.R (920820114323)**, **SIVA KUMAR.S (920820114331)**, **MAHESWARAN.S (920820114340)** who carried out the project work under super vision

  
SIGNATURE 30.5.23

  
SIGNATURE

Dr. T. SARAVANA KANNAN, M.Tech., Ph.D.,  
**HEAD OF THE DEPARTMENT**  
Professor,  
Mechanical Engineering,  
NPR College of Engineering  
& Technology,  
Natham, Dindigul – 624001.

Mr. S. LATSU KUMAR, M.E.,  
**SUPERVISOR,**  
Assistant Professor,  
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NPR College of Engineering  
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Natham, Dindigul – 624001.

Submitted for the ANNA UNIVERSITY viva-voice examination held on

...30/5/23.....

  
INTERNAL EXAMINER

  
EXTERNAL EXAMINER





## ABSTRACT

A vice is a mechanical screw apparatus used for holding or clamping a work piece to allow work to be performed on it with tools such as saws, planes, drills, mills, screwdrivers, sandpaper, etc. Vices usually have one fixed jaw and another parallel jaw which is moved towards or away from the fixed jaw by the screw. Vice is used to drill a wood, metal, etc. by holding your workpiece tightly, it gives you all stability you need so you can make precise cuts. A pneumatic system is controlled through manual or automatic process. In this pneumatic vice project for metal working is provided widely and quick movable clamping jaw and fixed jaw, when the workpiece can be accurate and unchangeable. Using automatically operated pneumatic vice will help you to get the work down easily and save energy.






## CHAPTER – 10

### CONCLUSION

The project thus gives a system that can easily fix the work piece & work on it. The pneumatic vice provides extremely high clamping force & high accuracy and repeatability. Pneumatic systems can get high production rates. When compressed air is released from the pneumatic components then noise can be produced. The operation of pneumatic systems does not produce pollutants. So, the pneumatic vice can be used easily.



  
**M. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
N.P.R. College of Engineering & Technology  
Natham, Dindigur (Dist) - 624 401.



**OBJECTIVE:**

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

**UNIT I GAS AND ARC WELDING PROCESSES:**

9

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

**UNIT II RESISTANCE WELDING PROCESSES:**

9

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

**UNIT III SOLID STATE WELDING PROCESSES:**

9

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

**UNIT IV OTHER WELDING PROCESSES:**

9

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

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

9

Various weld joint designs – Welding defects – causes and remedies - Weldability of Aluminium, Copper, and Stainless steels. Destructive and non destructive testing of weldments.

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

Upon completion of this course, the students can able

- Understand the construction and working principles of gas and arc welding process.
- Understand the construction and working principles of resistance welding process.
- Understand the construction and working principles of various solid state welding process.
- Understand the construction and working principles of various special welding processes.
- Understand the concepts on weld joint design, weldability and testing of weldments.

**TEXT BOOKS**

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

**REFERENCES**

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



**Dr. J.SUNDARARAJAN,**  
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Natham, Erode (TN) - 624 401.





# DESIGN & FABRICATION OF MINI EXCAVATOR



*Submitted by*

**AJAY KUMAR.B**

**(920820114002)**

**THANGAVIMAL.V**

**(920820114010)**

**NITHESH.M**

**(920820114320)**

**SANJAY KUMAR.M.K**

**(920820114325)**

*in partial fulfillment for the award of the degree*

*Of*

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**

**NPR COLLEGE OF ENGINEERING & TECHNOLOGY**

**NATHAM,DINDIGUL**

**ANNA UNIVERSITY :: CHENNAI 600 025**

**MAY 2023**








**ANNA UNIVERSITY :: CHENNAI 600 025**

**BONAFIDE CERTIFICATE**

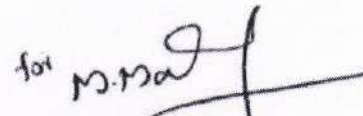
Certified that this project report "MINI EXCAVATOR" is the bonafide work of  
**B.AJAY KUMAR (920820114002) ,V.THANGAVIMAL(920820114010)**  
**,M.NITHESH(920820114320) ,M.K.SANJAY KUMAR(920820114325)** ,  
who carried out the project work under super vision

  
**SIGNATURE** 30.5.23

**Dr.T,SARAVANA KANNAN,M.Tech.,Ph.D**

**HEAD OF THE DEPARTMENT**

Professor,  
Mechanical Engineering,  
NPR College of Engineering  
& Technology,  
Natham, Dindigul-624001.


  
**SIGNATURE**

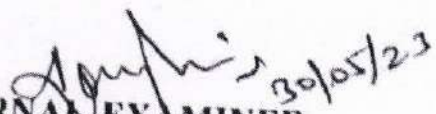
**Mr.K.ARUNA SENTHIL KUMAR, M.E.,**

**SUPERVISOR**

Assistant Professor,  
Mechanical Engineering  
NPR college of Engineering  
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Natham,Dindigul-624001.

**Submitted for the ANNA UNIVESITY viva-voce examination held on 30/5/23**

  
**INTERNAL EXAMINER**

  
**EXTERNAL EXAMINER** 30/05/23

II





## ABSTRACT

- Excavator is a work machine used in excavation works and also used to break hard objects such as concrete and rock, in rapidly growing industry excavators, on the ground, are expected to have a better performance.
- Especially during excavation, the excavating force produced by the actuators, undertakes a critical task: Furthermore, the excavating forces developed by the excavators must be larger than the resistance forces of the ground
- In this study, it is aimed to manufacture mini excavators, which are not manufactured and assembled in our country and Imported from abroad, and to reduce our dependency on the outside in this sector.
- In line with this goal, this study includes design and analysis of a mini excavator electric drive.






## CHAPTER 11

### CONCLUSION

We the students took the initiative in doing this project work "MINI EXCAVATOR " to the peak of success. We have gained sufficient technical as well as practical knowledge as how a work machine is to be designed, fabricated and priced.

Finally the mini excavator are economy affordable for every one of our country. We hope that this will be one among the most versatile and interchangeable one even in future.



  
**M. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NATHAN College of Engineering & Technology  
Nathan, Dindigur (Dist) - 624 401.



**OBJECTIVE:**

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

**UNIT I COAL BASED THERMAL POWER PLANTS**

9

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

**UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS**

9

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

**UNIT III NUCLEAR POWER PLANTS**

9

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

**UNIT IV POWER FROM RENEWABLE ENERGY**

9

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

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

9

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

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

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

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

**TEXT BOOK:**

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

**REFERENCES:**

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



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Natham, Dindigul (TN) - 624 401.



CIN: U28131TZ2009PTC015549

Date:01.02.2023

**TO WHOM IT MAY CONCERN**

This is to certify that **Mr. Ramakrishnan B** studying in final year Mechanical Engineering of NPR College of Engineering & Technology, Natham has undergone In-Plant training in our organization from **23.01.2023 to 28.01.2023**.

During the period, his conduct was found to be good.

With regards,



(For Thermo Solutions (INDIA) Pvt. Ltd)

  
**Dr. J. SUNDARARAJAN,**  
B.E., M.Tech., Ph.D.,  
Principal  
NPR College of Engineering & Technology  
Natham, Dindigul Dist. - 624 003.



**THERMO SOLUTIONS (INDIA) PRIVATE LIMITED**

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tsi@thermosolutions.net / www.thermosolutions.net



**OBJECTIVES:**

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

**UNIT I FUNDAMENTALS OF ROBOT**

9

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

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

9

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

**UNIT III SENSORS AND MACHINE VISION**

9

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

**UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING**

9

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

**UNIT V IMPLEMENTATION AND ROBOT ECONOMICS**

9

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

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2012.
2. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.

**REFERENCES:**

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 2013.
3. Fu.K.S., Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
4. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
5. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.



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# FABRICATION OF DUAL PROCESS AGRICULTURE ROBOT



A PROJECT REPORT

*Submitted by*

**ASFAR SHARUK HUSSAIN L**

**(920820114303)**

**MOHAMMED ALI JINNAH S**

**(920820114318)**

*in partial fulfillment for the award of the degree*

*Of*

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**

**NPR COLLEGE OF ENGINEERING AND TECHNOLOGY**

**ANNA UNIVERSITY: CHENNAI 600 025**

**MAY 2023**





## ABSTRACT

The agriculture industry is constantly looking for ways to improve the efficiency and productivity of farming practices. One solution to this problem is the fabrication of a dual-purpose agriculture vehicle for seeding and plowing. This vehicle would be designed to perform both tasks in a single pass, reducing the time and effort required for planting crops. To fabricate such a vehicle, a combination of mechanical engineering and agricultural science would be required. The vehicle would need to have a powerful engine, good ground clearance, and a comfortable operator's cabin. The dimensions of the vehicle would be determined by the size of the fields and the type of crops being planted. The seeding mechanism of the vehicle would be designed to distribute seeds uniformly across the land, using a hopper and a metering mechanism. The ploughing mechanism would be a series of blades or disks that turn over the soil, creating furrows for planting. Both mechanisms would be integrated into a single system that can be controlled by the operator using hydraulics. Safety features such as roll bars and seat belts would be added to protect the operator in case of an accident. Once the vehicle is built, it would be tested on a variety of terrains to ensure that it can handle the load and operate safely. Overall, the fabrication of a dual-purpose agriculture vehicle for seeding and plowing is an innovative solution to increase the efficiency of farming practices. By combining two important tasks into a single pass, farmers can save time and increase productivity, leading to a more sustainable and profitable agricultural industry.





## CHAPTER-8

### CONCLUSION

Dual-purpose agriculture robots for seeding and plowing have the potential to revolutionize the way that crops are planted and harvested. These robots can reduce labor costs, increase efficiency, and optimize crop growth and yield. They work by using a combination of sensors, mapping technology, and advanced algorithms to navigate and perform tasks in the field. However, there are also some challenges and limitations associated with these robots. They require significant upfront investment and may not be practical for all farming operations. They also require specialized training to operate and maintain, and may not be able to handle all soil and weather conditions. Overall, dual-purpose agriculture robots represent an exciting development in the field of agriculture technology, and are likely to become increasingly important in the years to come as farmers seek new ways to increase productivity and reduce costs.



  
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NPR College of Engineering & Technology  
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**OBJECTIVES:**

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

**UNIT I VEHICLE STRUCTURE AND ENGINES**

9

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

**UNIT II ENGINE AUXILIARY SYSTEMS**

9

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

**UNIT III TRANSMISSION SYSTEMS**

9

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

**UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS**

9

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

**UNIT V ALTERNATIVE ENERGY SOURCES**

9

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

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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
2. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
3. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
4. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978.
5. Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.



**Dr. J. SUNDARARAJAN,**  
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Principal

N.P.R. College of Engineering & Technology  
Nathan, Dindigul - 624 011





# **RETROFITTINGS OF NORMAL BICYCLE INTO ELECTRICAL BICYCLE**



**A PROJECT REPORT**

*Submitted by*

<b>AYYAMPERUMAL P</b>	<b>(920819114005)</b>
<b>BALAKUMARESAN S</b>	<b>(920819114006)</b>
<b>MUTHUSAMY P</b>	<b>(920819114021)</b>
<b>NAVEENRAJ K</b>	<b>(920819114023)</b>

*in partial fulfillment for the award of the degree*

*Of*

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**

**NPR COLLEGE OF ENGINEERING AND TECHNOLOGY**

**ANNA UNIVERSITY: CHENNAI 600 025**

**MAY 2023**





## BONAFIDE CERTIFICATE

Certified that this project report "RETROFITTINGS OF NORMAL BICYCLE INTO ELECTRICAL BICYCLE" is the bonafied work of "AYYAMPERUMAL P (920819114005), BALAKUMARESAN S (920819114006), MUTHUSAMY P (920819114021), NAVEENRAJ K (920819114023)" who carried out the project work under my supervision.

  
SIGNATURE

Dr.T.SARAVANA KANNAN M.Tech., Ph.D.

HEAD OF THE DEPARTMENT

Professor

Mechanical Engineering

NPR College of Engineering and  
Technology

Natham

Dindigul-624401

  
SIGNATURE

Mr.B.GOPI B.E.,M.E.,

SUPERVISOR

Assistant Professor

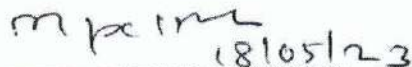
Mechanical Engineering

NPR College of Engineering and  
Technology

Natham

Dindigul- 624401

Submitted for the viva-voce Examination held on 18-05-23

  
INTERNALEXAMINER

  
EXTERNALEXAMINER





## ABSTRACT

Now-a-days there are so many vehicles on road, which consumes more fuel and also hazards our environment. It is our responsibility to reduce the consumption of fuel and its hazardous emission products. Taking this into consideration it is our small step towards reducing the use of more fuel consuming vehicles and attract the eye of people towards its alternatives i.e. Electric bicycle. The main aim of this review paper is to present the idea of harnessing the various energy and use it in today's existence of human life .Now-a-days there are so many vehicles on road, which consumes more fuel and also hazards our environment. It is our responsibility to reduce the consumption of fuel and its hazardous emission products. Taking this into consideration it is our small step towards reducing the use of more fuel consuming vehicles and attract the eye of people towards its alternatives i.e. Electric bicycle.

So we intend to design a cycle which would run on an alternative source and also reducing human efforts called as Battery Operated Cycle. In this paper we design an alternative mode of transport for betterment of social and environment.





## CHAPTER 11

### CONCLUSION

With the increasing consumption of natural resources of petrol, diesel it is necessary to shift our way towards alternate resources like the Electric bike and others because it is necessary to identify new way of transport. Electric bike is a modification of the existing cycle by using electric energy and also solar energy if solar panels are provided, that would sum up to increase in energy production. Since it is energy efficient, electric bike is cheaper and affordable to anyone. It can be used for shorter distances by people of any age. It can be contrived throughout the year. The most vital feature of the electric bike is that it does not consume fossil fuels thereby saving crores of foreign currencies. The second most important feature is it is pollution free, eco – friendly and noiseless in operation. For offsetting environmental pollution using of on – board Electric Bike is the most viable solution. It can be charged with the help of AC adapter if there is an emergency. The Operating cost per/km is very less and with the help of solar panel it can lessen up more. Since it has fewer components it can be easily dismantled to small components, thus requiring less maintenance.



  
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**OBJECTIVE:**

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

**UNIT I INTRODUCTION**

9

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

**UNIT II MICROPROCESSOR AND MICROCONTROLLER**

9

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

**UNIT III PROGRAMMABLE PERIPHERAL INTERFACE**

9

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

**UNIT IV PROGRAMMABLE LOGIC CONTROLLER**

9

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

**UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN**

9

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

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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

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



**D. JSUNDARARAJAN,**  
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Chennai-Nadu 602105

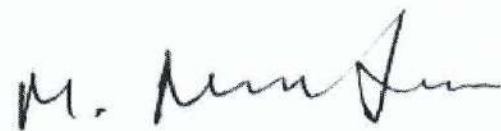
Date: 04/02/2023

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr.Rakesh S** studying IV year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Fourteen days internship from **17/01/2023 to 31/01/2023** in our company. During the period the training period he was has been extremely inquisitive and hard working. He summed to be writing to learn the functions/process with kwon interest.

We wish him every success in life.

  
**Dr. J.SUNDARARAJAN**  
B.E., M.Tech., Ph.D.,  
Principal  
NPR College of Engineering & Technology/  
Natham, Dindigul (Dist) - 626 401.

  
**JM Frictech India Pvt. Ltd,**  
**G-27, SIPCOT Industrial Park,**  
**Irrungattukottai,**  
**Chennai-602 105.**

G27, SIPCOT Industrial Park, Katrambakkam Village, Irrungattukottai, Chennai-Nadu 602105

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**OBJECTIVE:**

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

**UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9**

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

**UNIT II THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9**

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

**UNIT III CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9**

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

**UNIT IV ADVANCED NANO FINISHING PROCESSES 9**

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

**UNIT V RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES 9**

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

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

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

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

**TEXT BOOKS:**

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

**REFERENCES:**

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



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**STUDY OF MECHANICAL PROPERTIES OF ALUMINIUM  
GRAPHENE COMPOSITES**



*Submitted by*

<b>S. JEGATHGURUNAATHA ASHWIN</b>	<b>( 920819114004 )</b>
<b>R. MANIKANDAN</b>	<b>( 920819114015 )</b>
<b>P. MOHANA RAGUL</b>	<b>( 920819114019 )</b>
<b>M. RAMANAN</b>	<b>( 920819114030 )</b>

*in partial fulfillment for the award of the degree*

of

**BACHELOR OF ENGINEERING**

in

**MECHANICAL ENGINEERING**

**NPR COLLEGE OF ENGINEERING TECHNOLOGY**

**NATHAM, DINDIGUL**

**ANNA UNIVERSITY :: CHENNAI 600 025**

**MAY 2023**

**I**





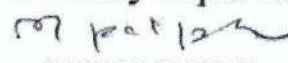


ANNA UNIVERSITY :: CHENNAI 600 025

### BONAFIDECERTIFICATE

Certified that this project report " STUDY OF MECHANICAL PROPERTIES OF ALUMINIUM GRAPHENE COMPOSITES " S. JEGATHGURUNAATHA ASHWIN(920819114004), R. MANIKANDAN (920819114015),P. MOHANA RAGUL (920819114019), M. RAMANAN (920819114030)who carried out the project work under my supervision.

  
SIGNATURE 18.5.23

  
SIGNATURE

Dr.N.SARAVANA KANNAN, M.Tech.,Ph.D. Dr.M.PAL PANDI,M.E,Ph.D.,

HEAD OF THE DEPARTMENT

SUPERVISOR

PROFESSOR

Associate Professor,

Mechanical Engineering,

Mechanical Engineering

NPR College of Engineering

NPR college of Engineering

And Technology, Natham,


and Technology, Natham,

Dindigul-624001.

Dindigul-624001.

Submitted for the ANNA UNIVERSITY viva-voce Examination held on

18.5.2023.....at NPR College of Engineering and Technology,Natham.

  
INTERNAL EXAMINER 18/05/23

  
EXTERNAL EXAMINE

II





## ABSTRACT

This abstract describes the study of the properties and potential applications of Aluminium 7178 and graphene composite materials. The research aimed to investigate the potential of graphene as a reinforcement material for Aluminium 7178 to enhance its mechanical and thermal properties..

This paper analysis the material on mechanical properties of the graphene , Aluminium 7178 material by using composite model Leaf spring and evaluate the mechanical properties

This study investigates the fabrication of leaf springs using a metal matrix composite (MMC) material made from aluminum 7178 reinforced with graphene. The purpose of this study is to evaluate the feasibility of using this MMC material as a replacement for traditional leaf spring materials such as steel. The study focuses on the mechanical properties of the MMC material, including its tensile strength, compressive strength, and fatigue behaviour.





## CHAPTER-5

### CONCLUSION

In conclusion, the present study investigated the effect of graphene reinforcement on the mechanical properties of Aluminium 7178 Metal Matrix Composite (MMC) for fabricating leaf springs. The mechanical properties of the MMC were studied through tensile, hardness and compression test . The results showed that the addition of graphene to the MMC resulted in an improvement in the tensile and hardness properties of the composite. Overall, the results demonstrate that the addition of graphene can significantly enhance the mechanical and wear properties of Aluminium 7178 MMC, making it a promising material for fabricating leaf springs. The findings of this study can be utilized in the design and development of lightweight and high-performance leaf springs for automotive and aerospace applications.



  
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**OBJECTIVE:**

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

**UNIT I OVERVIEW OF NDT**

9

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

**UNIT II SURFACE NDE METHODS**

9

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

**UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET)**

9

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

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

9

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

**UNIT V RADIOGRAPHY (RT)**

9

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

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

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

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

**TEXT BOOKS:**

- Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2014.
- Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010

**REFERENCES:**

- ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
- ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, V.7.

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Date: 04/02/2023

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Ms.Shobana K** studying IV year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Fourteen days internship from **17/01/2023 to 31/01/2023** in our company. During the period the training period she was has been extremely inquisitive and hard working. She summed to be writing to learn the functions/process with kwon interest.

We wish her every success in life.

  
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**OBJECTIVE:**

- To introduce the process planning concepts to make cost estimation for various products after process planning

**UNIT I INTRODUCTION TO PROCESS PLANNING**

9

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

**UNIT II PROCESS PLANNING ACTIVITIES**

9

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

**UNIT III INTRODUCTION TO COST ESTIMATION**

9

Importance of costing and estimation -methods of costing-elements of cost estimation -Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

**UNIT IV PRODUCTION COST ESTIMATION**

9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

**UNIT V MACHINING TIME CALCULATION**

9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

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

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

- CO1 select the process, equipment and tools for various industrial products.
- CO2 prepare process planning activity chart.
- CO3 explain the concept of cost estimation.
- CO4 compute the job order cost for different type of shop floor.
- CO5 calculate the machining time for various machining operations.

**TEXT BOOKS:**

- Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
- Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.

**REFERENCES:**

- Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
- Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9<sup>th</sup> Edition, John Wiley, 1998.
- Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
- Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
- K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 1990.



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### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr.Nagaraj S** studying IV year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Fourteen days internship from **17/01/2023 to 31/01/2023** in our company. During the period the training period he was has been extremely inquisitive and hard working. He summed to be writing to learn the functions/process with kwon interest.

We wish him every success in life.

  
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**OBJECTIVE:**

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization

**UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**

9

Definition of Management - Science or Art - Manager Vs Entrepreneur - types of managers - managerial roles and skills - Evolution of Management - Scientific, human relations, system and contingency approaches - Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment - Current trends and issues in Management.

**UNIT II PLANNING**

9

Nature and purpose of planning - **planning process** - types of planning - objectives - setting objectives - policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

**UNIT III ORGANISING**

9

Nature and purpose - Formal and informal organization - **organization chart** - **organization structure** - types - Line and staff authority - departmentalization - delegation of authority - centralization and decentralization - Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, **Career planning and management**.

**UNIT IV DIRECTING**

9

Foundations of individual and group behaviour - motivation - motivation theories - motivational techniques - job satisfaction - **job enrichment** - **leadership** - types and theories of leadership - communication - process of communication - barrier in communication - effective communication - communication and IT.

**UNIT V CONTROLLING**

9

System and process of controlling - budgetary and non-budgetary control techniques - use of **computers and IT in Management control** - **Productivity problems and management** - control and performance - direct and preventive control - reporting.

**TOTAL: 45 PERIODS****OUTCOME:**

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

**TEXT BOOKS:**

- JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
- Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India) Pvt. Ltd., 10<sup>th</sup> Edition, 2009.

**REFERENCES:**

- Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.
- Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
- Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7<sup>th</sup> Edition, Pearson Education, 2011.
- Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999

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Date: 04/02/2023

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Ms.Maha Lakshmi G** studying IV year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Fourteen days internship from **17/01/2023 to 31/01/2023** in our company. During the period the training period she has been extremely inquisitive and hard working. She summed to be writing to learn the functions/process with kwon interest.

We wish her every success in life.

  
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**OBJECTIVES:**

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

**UNIT I INTRODUCTION**

9

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

**UNIT II WORK STUDY**

9

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

**UNIT III PRODUCT PLANNING AND PROCESS PLANNING**

9

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

**UNIT IV PRODUCTION SCHEDULING**

9

Production Control Systems>Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance - Flow production scheduling- Batch production scheduling-Product sequencing - Production Control systems-Periodic batch control-Material requirement planning kanban - Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

**UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC**

9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

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

- Upon completion of this course, the students can able to prepare production planning and control activities such as work study, product planning, production scheduling, Inventory Control.
- They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

**TEXT BOOKS:**

1. James. B. Dilworth, "Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.

**REFERENCES:**

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000



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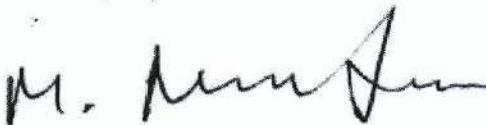
Date: 14/05/2023

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. BHUVANESWARAN C** studying IV year BE Mechanical Engineering in NPR College of Engineering & Technology, Natham, Dindigul, has successfully completed Twenty-Nine days internship from **25/04/2023 to 14/05/2023** in our company. During the period the training period he was has been extremely inquisitive and hard working. He summed to be writing to learn the functions/process with kwon interest.

We wish him every success in life.

  
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**OBJECTIVE:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 300 PERIODS****OUTCOME:**

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.



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# **Design and Fabrication of Development of Humanoid Robot System for Cleaning Sewage by 3D Printed Parts.**

## **A PROJECT REPORT**

*Submitted by*

**GOWTHAMAN.M (920819114010)**

**IMAN MOHAMMED.T (920819114012)**

**RAKESH.M (920819114027)**

**RUBAN.P (920819114032)**

*In partial fulfillment for the award of the degree*

*Of*

**BACHELOR OF ENGINEERING**

**in**

**MECHANICAL ENGINEERING**

**NPR COLLEGE OF ENGINEERING TECHNOLOGY**

**NATHAM,DINDIGUL**

**ANNA UNIVERSITY :: CHENNAI 600 025**

**MAY 2023**





ANNA UNIVERSITY::CHENNAI 600 025

**BONAFIDE CERTIFICATE**

Certified that this project report on "Development of Humanoid Robot System for Cleaning Sewage by 3D Printed Parts" is the bonafide work of **RAKESH .M (920819114027)** who carried out the work under my supervision.

  
SIGNATURE

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INTERNAL EXAMINER

  
EXTERNAL EXAMINAR





## ABSTRACT

3D printing which has turned into a remarkable point in today's innovative exchange. In this paper, we will look at additive manufacturing or 3D printing. We will firstly characterize what we mean by this term and what is so noteworthy about it. We will dive a bit into the history. At that point, we should see about the procedure of 3D printing and the materials utilized as a part of the production of 3D printed objects. We might likewise see the focal points and burdens of 3D printing. We should watch the various applications it is being out to utilize today. At last, the future capability of this innovation is illustrated.

A conceptual model of the manipulator has been created in solid model using solid works. It will give a clear understanding of the manipulator and its subsystem interactions. A prototype model of the manipulator has been developed based on the design concept and its working environment i. e, various goals that robot has to do after entering the sewage pipe and hence the functional requirements are finalized. It consists of various links and joints.

The joints are drive through the various motors which are discussed in the paper. Preliminary investigations are carried out on the developed prototype model and some of the results are discussed in the paper.

**KEYWORDS :** 3D PRINTING , SEWAGE CLEANING ,






## CHAPTER 10

### CONCLUSION

The present study investigated the application of 3D printing in different physicochemical and biological treatment techniques along with its limitations and sustainable aspects. The research on the 3D printing applications in waste water treatment is found to be at the beginning of the growth phase and is showing considerable promise. The advent of 3D printing has shown different advantages over conventional manufacturing techniques. In this regard, the present study reviewed the various 3D and We solved it.



  
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