MOHAMED SATHAK A J COLLEGE OF ENGINEERING

Sponsored by Mohamed Sathak Trust

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Siruseri IT Park, Egattur, Chennai 603 103

B.E - MECHANICAL ENGINEERING

S.No	Name of the course that include experiential learning through Project work/ Internship (2018 - 2019)
1	GE6253 - Engineering Mechanics
2	CE6306 - Strength of Materials
3	ME6301 - Engineering Thermodynamics
4	CE6451 - Fluid Mechanics and Machinery
5	ME6302 - Manufacturing Technology - I
6	EE6351 - Electrical Drives and Controls
7	ME6401 - Kinematics of Machinery
8	ME6402 - Manufacturing Technology– II
9	ME6403 - Engineering Materials and Metallurgy
10	GE6351 - Environmental Science and Engineering
11	ME6404 - Thermal Engineering
12	ME6501 - Computer Aided Design
13	ME6502 - Heat and Mass Transfer
14	ME6503 - Design of Machine Elements
15	ME6504 - Metrology and Measurements
16	ME6505 - Dynamics of Machines
17	ME6601 - Design of Transmission Systems
18	ME6602 - Automobile Engineering
19	ME6603 - Finite Element Analysis
20	ME6604 - Gas Dynamics and Jet Propulsion
21	ME6701 - Power Plant Engineering
22	ME6702 - Mechatronics
23	ME6703 - Computer Integrated Manufacturing Systems
24	GE6757 - Total Quality Management
25	MG6863 - Engineering Economics

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26	ME6001	-	Quality Control and Reliability Engineering
27	ME6002	-	Refrigeration and Air conditioning
28	ME6003	-	Renewable Sources of Energy
29	ME6004	-	Unconventional Machining Processes
30	ME6005	-	Process Planning and Cost Estimation
31	ME6006	-	Design of Jigs, Fixtures and Press Tools
32	ME6007	-	Composite Materials and Mechanics
33	ME6008	-	Welding Technology
34	ME6009	-	Energy Conservation and Management
35	ME6011	-	Thermal Turbo Machines
36	IE6605	-	Production Planning and Control
37	MG6851	-	Principles of Management
38	ME6014	-	Computational Fluid Dynamics
39	ME6015	-	Operations Research
40	ME6016	-	Advanced I.C. Engines
41	ME6017	-	Design of Heat Exchangers
42	ME6019	-	Non Destructive Testing and Materials
43	ME6020	-	Vibration and Noise Control

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	GE6253	Engineering Mechanics	Free Body diagram, Types of supports, Action and reaction forces

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2018-2019

GE6253 **ENGINEERING MECHANICS** L T P C
3 1 0 4

OBJECTIVES:

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

UNIT I BASICS AND STATICS OF PARTICLES 12

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

UNIT II EQUILIBRIUM OF RIGID BODIES 12

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

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

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

UNIT IV DYNAMICS OF PARTICLES 12

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

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

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

TOTAL : 60 PERIODS

OUTCOMES:

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

ability to analyse the forces in any structures.

ability to solve rigid body subjected to dynamic forces.

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	CE6306	Strength of Materials	Tension, Compression and shear stresses, Shear force, Torsion formulation stresses and deformation in circular shafts

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CE6306 **STRENGTH OF MATERIALS** L T P C
3 1 0 4

OBJECTIVES:

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

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

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

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

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

UNIT III TORSION 9

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

UNIT IV DEFLECTION OF BEAMS 9

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

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

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

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

OUTCOMES:

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

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

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6301	Engineering Thermodynamics	P-V diagram, Zeroth law of thermodynamics, concept of temperature and thermal equilibrium, relationship between temperature scales, Heat Reservoir, source and sink. T-s Diagram, Tds Equations, entropy change for pure substance, thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams.

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ME6301 **ENGINEERING THERMODYNAMICS** L T P C 3 0 0 3

OBJECTIVES:

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

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

UNIT I BASIC CONCEPTS AND FIRST LAW 9

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

UNIT II SECOND LAW AND AVAILABILITY ANALYSIS 9

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

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9

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

UNIT IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 9

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

UNIT V GAS MIXTURES AND PSYCHROMETRY 9

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

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to apply the Thermodynamic Principles to Mechanical Engineering Application.

Apply mathematical fundamentals to study the properties of steam, gas and gas mixtures.

TEXT BOOKS :

1. Nag.P.K., "Engineering Thermodynamics", 4th Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	CE6451	Fluid Mechanics and Machinery	Mass density, specific weight, specific volume, Reciprocating pump, working principle.

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CE6451 **FLUID MECHANICS AND MACHINERY** L T P C 3 0 0 3

OBJECTIVES:

The applications of the conservation laws to flow through pipes and hydraulic machines are studied

To understand the importance of dimensional analysis.

To understand the importance of various types of flow in pumps and turbines.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 8

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

UNIT II FLOW THROUGH CIRCULAR CONDUITS 8

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

UNIT III DIMENSIONAL ANALYSIS 9

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

UNIT IV PUMPS 10

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

UNIT V TURBINES 10

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

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to apply mathematical knowledge to predict the properties and characteristics of a fluid.

Can critically analyse the performance of pumps and turbines.

TEXT BOOK:

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2004.

REFERENCES:

1. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2004
3. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
4. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint 2011

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6302	Manufacturing Technology – I	Gas Tungsten arc welding Gas metal arc welding, Characteristics of plastics, molding of thermoplastics, Bonding of Thermoplastics.

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ME6302 MANUFACTURING TECHNOLOGY – I

L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I METAL CASTING PROCESSES 9

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; **Melting furnaces** : Blast and Cupola Furnaces; **Principle of special casting processes** : Shell - investment – Ceramic mould – Pressure die casting - Centrifugal Casting - CO_2 process – Stir casting; **Defects in Sand casting**

UNIT II JOINING PROCESSES 9

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

UNIT III METAL FORMING PROCESSES 9

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

UNIT IV SHEET METAL PROCESSES 9

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

UNIT V MANUFACTURE OF PLASTIC COMPONENTS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2006

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	EE6351	Electrical Drives and Control	DC motors starters Speed control of DC series and Shunt Motors, Three phase induction motor.

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EE6351 **ELECTRICAL DRIVES AND CONTROL** L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION 8

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

UNIT II DRIVE MOTOR CHARACTERISTICS 9

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

UNIT III STARTING METHODS 8

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

UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES 10

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

UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES 10

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

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

1. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications", Tata McGraw-Hill, 2001
2. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 1998

REFERENCES:

1. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 1998
2. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 1998
3. Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 1994

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6402	Manufacturing Technology II	Single point cutting tool, forces in machining, Types of chip, cutting tools, nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials. tool wear, tool life, surface finish, cutting fluids and machinability, Centre lathe, constructional features, specification, operations, taper turning methods, thread cutting, drilling, micro machining.

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ME6402 **MANUFACTURING TECHNOLOGY – II** L T P C
3 0 0 3

OBJECTIVES:

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

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

UNIT I THEORY OF METAL CUTTING 9

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

UNIT II TURNING MACHINES 9

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

UNIT III SHAPER, MILLING AND GEAR CUTTING MACHINES 9

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

UNIT IV ABRASIVE PROCESS AND BROACHING 9

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

UNIT V CNC MACHINING 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6401	Kinematics of Machinery	Basic kinematic concepts and definitions, degree of freedom, Displacement velocity and acceleration analysis of simple mechanisms.

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ME6401 KINEMATICS OF MACHINERY L T P C 3 0 0 3

OBJECTIVES:

To understand the basic components and layout of linkages in the assembly of a system / machine.

To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.

To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.

To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

UNIT I BASICS OF MECHANISMS 9

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

UNIT II KINEMATICS OF LINKAGE MECHANISMS 9

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

UNIT III KINEMATICS OF CAM MECHANISMS 9

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

UNIT IV GEARS AND GEAR TRAINS 9

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

UNIT V FRICTION IN MACHINE ELEMENTS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to apply fundamentals of mechanism for the design of new mechanisms and analyse them for optimum design.

TEXT BOOKS:

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

REFERENCES:

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
3. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
4. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961
5. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
6. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
7. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
8. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 2002.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6403	Engineering Materials and Metallurgy	Mg alloys, Titanium alloys, Polymers, types, commodity and engineering polymers, composites, classifications, metal matrix and FRP, application of Composites, Testing of materials under tension, compression, and shear loads, Hardness tests(Brinell, Vickers, and Rockwell) Impact test Izod and Charpy fatigue.

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ME6403 **ENGINEERING MATERIALS AND METALLURGY** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I ALLOYS AND PHASE DIAGRAMS **9**

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

UNIT II HEAT TREATMENT **10**

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

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

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

UNIT IV NON-METALLIC MATERIALS **9**

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

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS **8**

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

OUTCOMES:

Upon completion of this course, the students can able to apply the different materials, their processing, heat treatments in suitable application in mechanical engineering fields.

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

1. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 1999.
2. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint 2002.
3. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.
4. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Mettalurgy", First Edition, Dorling Kindersley, 2012

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6404	Thermal Engineering	p-V diagram of four stroke and two stroke engines, carburetor, various types of compressor, work of compression

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ME6404 **THERMAL ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

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

To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems

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

UNIT I GAS POWER CYCLES 8

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

UNIT II INTERNAL COMBUSTION ENGINES 10

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

UNIT III STEAM NOZZLES AND TURBINES 9

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

UNIT IV AIR COMPRESSOR 9

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

UNIT V REFRIGERATION AND AIR CONDITIONING 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6502	Heat and Mass Transfer	General differential equation of Heat Conduction, Free and forced Convection.

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ME6502 **HEAT AND MASS TRANSFER** L T P C
3 0 0 3

OBJECTIVES:

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

(Use of standard HMT data book permitted)

UNIT I CONDUCTION 9

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

UNIT II CONVECTION 9

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

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

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

UNIT IV RADIATION 9

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

UNIT V MASS TRANSFER 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

TEXT BOOK:

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

REFERENCE BOOKS:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6501	Computer Aided Design	Computer aided design, CAD system architecture, co-ordinate systems, 2D and 3D transformations, Hidden Line surface, Solid removal algorithms, assembly modeling.

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ME6501 **COMPUTER AIDED DESIGN** L T P C 3 0 0 3

OBJECTIVES:

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

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 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

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 VISUAL REALISM 9

Hidden – Line-Surface-Solid removal algorithms – shading – colouring – computer animation.

UNIT IV ASSEMBLY OF PARTS 9

Assembly modelling – interferences of positions and orientation – tolerance analysis-massproperty calculations – mechanism simulation and interference checking.

UNIT V CAD STANDARDS 9

Standards for computer graphics- **Graphical Kernel System** (GKS) - standards for exchangeimages- **Open** Graphics Library **(OpenGL)** - Data exchange standards - IGES, STEP, CALSetc. - communication standards.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use computer and CAD software's for modeling of mechanical components.

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6504	Metrology and Measurements	Precision and accuracy

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ME6504 METROLOGY AND MEASUREMENTS L T P C
3 0 0 3

OBJECTIVES:

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

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

UNIT I .BASICS OF METROLOGY 5

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

UNIT II LINEAR AND ANGULAR MEASUREMENTS 10

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

UNIT III ADVANCES IN METROLOGY 12

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

UNIT IV FORM MEASUREMENT 10

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

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE 8

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

TOTAL : 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6503	Design of Machine Elements	Factors influencing machine design, selection of materials based on mechanical properties, Design of solid and hollow shafts based on strength, rigidity and critical speed, helical springs.

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ME6503 **DESIGN OF MACHINE ELEMENTS** **L T P C**
3 0 0 3

OBJECTIVES

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

(Use of P S G Design Data Book is permitted)

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS **10**

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

UNIT II SHAFTS AND COUPLINGS **8**

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

UNIT III TEMPORARY AND PERMANENT JOINTS **9**

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

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

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

UNIT V BEARINGS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOK:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6601	Design of Transmission System	Design of flat belts and pulleys, speed ratios and number of teeth, force analysis, tooth stresses.

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ME6601 **DESIGN OF TRANSMISSION SYSTEMS** **L T P C 3 0 0 3**

OBJECTIVES:

To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.

To understand the standard procedure available for Design of Transmission of Mechanical elements

To learn to use standard data and catalogues (Use of P S G Design Data Book permitted)

UNIT I DESIGN OF FLEXIBLE ELEMENTS **9**

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

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS **9**

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

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS **9**

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

UNIT IV GEAR BOXES **9**

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

UNIT V CAMS, CLUTCHES AND BRAKES **9**

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

TOTAL : 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6505	Dynamics of Machinery	Degrees of freedom, single degree of freedom, Free vibration, Response of one degree freedom systems.

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ME6505 DYNAMICS OF **MACHINES** **L T P C**
3 0 0 3

OBJECTIVES:

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

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

To understand the effect of Dynamics of undesirable vibrations.

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

UNIT I FORCE ANALYSIS **9**

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

UNIT II BALANCING **9**

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

UNIT III SINGLE DEGREE FREE VIBRATION **9**

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

UNIT IV FORCED VIBRATION **9**

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

UNIT V MECHANISM FOR CONTROL **9**

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

TOTAL : 45 PERIODS

OUTCOMES:

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

TEXT BOOK:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6603	Finite Element Analysis	Mathematical modeling of field problems in engineering, one dimensional second order equations.

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ME6603 **FINITE ELEMENT ANALYSIS** **L T P C**
3 0 0 3

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 – RitzTechnique – 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:

Upon completion of this course, the students can able to understand different mathematical Techniques used in FEM analysis and use of them in Structural and thermal problem

TEXT BOOK:

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. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004
2. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.
4. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990
5. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6602	Automobile Engineering	IC engines, components, functions and materials, Pneumatic and Hydraulic Braking systems antilock braking system, electronic brake force distribution, Bio-diesel, Combustion and emission characteristics of SI and CI engines with these alternate fuels.

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ME6602 **AUTOMOBILE ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I VEHICLE STRUCTURE AND ENGINES **9**

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

UNIT II ENGINE AUXILIARY SYSTEMS **9**

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

UNIT III TRANSMISSION SYSTEMS **9**

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

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS **9**

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

UNIT V ALTERNATIVE ENERGY SOURCES **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6604	Gas Dynamics and Jet Propulsion	Flow through constant area ducts with heat transfer, Variation of flow parameters across the normal and oblique shocks.

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ME6604 **GAS DYNAMICS AND JET PROPULSION** **L T P C**
3 0 0 3

OBJECTIVES: To understand the basic difference between incompressible and compressible flow.

To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.
(Use of Standard Gas Tables permitted)

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS **6**

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers

UNIT II FLOW THROUGH DUCTS **9**

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.

UNIT III NORMAL AND OBLIQUE SHOCKS **10**

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT IV JET PROPULSION **10**

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V SPACE PROPULSION **10**

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to successfully apply gas dynamics principles in the Jet and Space Propulsion

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", 3rd Edition, McGraw Hill, 2003.
2. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 1996.

REFERENCES:

1. Hill. P. and C. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley Publishing company, 1992.
2. Zucrow. N.J., "Aircraft and Missile Propulsion", Vol.1 & II, John Wiley, 1975.
3. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970.
4. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York,1986,.
5. Shapiro. A.H.," Dynamics and Thermodynamics of Compressible fluid Flow", John wiley, New York, 1953.
6. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 1999.
7. Somasundaram. PR.S.L., "Gas Dynamics and Jet Propulsions", New Age International Publishers, 1996.
8. Babu. V., "Fundamentals of Gas Dynamics", ANE Books India, 2008.
9. Cohen, H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd., 1980.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6701	Power Plant Engineering	Rankine Cycle, Otto, Diesel, Dual & Brayton Cycle, Hydro electric power plants

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ME6701 **POWER PLANT ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

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 **10**

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 **10**

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 **7**

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boil*ing Water Reactor* (BWR), P*ressurized 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 **10**

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 **8**

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 completion of this course, the students can able to understand different types of power plant, and its functions and their flow lines and issues related to them.

Analyse and solve energy and economic related issues in power sectors.

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. Black & Veatch, Springer, "Power Plant Engineering", 1996.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6702	Mechatronics	Sensors and transducers, static and dynamic characteristics of sensor, LVDT, stepper and servo motors, Engine management system, Automatic car park barrier system.

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ME6702 **MECHATRONICS** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION **12**

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 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER **10**

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 **8**

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 **7**

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 **8**

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

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6703	Computer Integrated Manufacturing	CAD and CAM Manufacturing planning manufacturing control, Process planning, computer aided process planning,CAPP, Group technology, part families, parts classification and coding, simple problems.

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ME6703 **COMPUTER INTEGRATED MANUFACTURING SYSTEMS** **L T P C 3 0 0 3**

OBJECTIVES:

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

UNIT I INTRODUCTION **10**

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING **10**

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III CELLULAR MANUFACTURING **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 – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) **8**

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V INDUSTRIAL ROBOTICS **8**

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student can able to understand the use of computers in process planning and use of FMS and Robotics in CIM

TEXT BOOK:

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCES:

1. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
2. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.
3. Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	GE6757	Total Quality Management	Need for quality, evolution of quality, definitions of quality, quality councils, 5S

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GE6757 **TOTAL QUALITY MANAGEMENT** L T P C
3 0 0 3

OBJECTIVES

To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors..

TOTAL: 45 PERIODS

OUTCOMES:

The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2006.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	MG6863	Engineering Economics	Law of supply and demand, engineering efficiency economic efficiency, make or buy decision, value engineering, value engineering procedure, time value of money, replacement and maintenance analysis, Depreciation.

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MG6863 **ENGINEERING ECONOMICS** **L T P C**
3 0 0 3

OBJECTIVES:

To enable students to understand the fundamental economic concepts applicable to engineering and to learn the techniques of incorporating inflation factor in economic decision making.

UNIT I INTRODUCTION TO ECONOMICS **8**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis - V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT II VALUE ENGINEERING **10**

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT III CASH FLOW **9**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS **9**

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TOTAL: 45 PERIODS

OUTCOMES :

Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions.

TEXT BOOKS:

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

REFERENCES:

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6002	Refrigeration and Air Conditioning	Vapor compression cycle, p-h and T-s Diagrams, types of compressors.

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ME6002 **REFRIGERATION AND AIR CONDITIONING** **L T P C**
3 0 0 3

OBJECTIVES:

To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.

To provide knowledge on design aspects of Refrigeration & Air conditioning systems

UNIT I INTRODUCTION **5**

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM **10**

Vapor compression cycle : p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system - low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III OTHER REFRIGERATION SYSTEMS **8**

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems.

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES **10**

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION **12**

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to demonstrate the operations in different Refrigeration & Air conditioning systems and also able to design Refrigeration & Air conditioning systems .

TEXT BOOK:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.

REFERENCES:

1. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
2. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.
3. ASHRAE Hand book, Fundamentals, 2010
4. Jones W.P., "Air conditioning engineering", 5th edition,Elsevier Butterworth-Heinemann, 2001

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6001	Quality Control and Reliability Engineering	Definition of quality basic concept of quality lot by lot sampling, reliability improvements.

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ME6001 QUALITY CONTROL AND RELIABILITY ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

To introduce the concept of SQC
To understand process control and acceptance sampling procedure and their application.
To learn the concept of reliability.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES **10**

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and □chart - process capability – process capability studies and simple problems. Six sigma concepts

UNIT II PROCESS CONTROL FOR ATTRIBUTES **8**

Control chart for attributes –control chart for non conformings– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III ACCEPTANCE SAMPLING **9**

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT IV LIFE TESTING – RELIABILITY **9**

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABLITY **9**

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

TOTAL: 45 PERIODS

Note: Use of approved statistical table permitted in the examination.

OUTCOMES:

- Upon successful completion of this course, the students can able to apply the concept of SQC in process control for reliable component production

TEXT BOOKS:

1. Douglas.C. Montgomery, " Introduction to Statistical quality control", 4th edition, John Wiley 2001.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 1991.

REFERENCES:

1. John.S. Oakland. "Statistical process control", 5th edition, Elsevier, 2005
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993
3. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
4. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
5.. Gupta. R.C "Statistical Quality control", Khanna Publishers, 1997.
6. Besterfield D.H., "Quality Control", Prentice Hall, 1993.
7. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6003	Renewable Sources of Energy	Solar radiation measurements of solar radiation, collectors, solar thermal power generation.

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ME6003 **RENEWABLE SOURCES OF ENERGY** **L T P C**
3 0 0 3

OBJECTIVES:

At the end of the course, the students are expected to identify the new methodologies / technologies for effective utilization of renewable energy sources.

UNIT I INTRODUCTION **9**

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamil nadu, India and around the World – Potentials - Achievements / Applications – Economics of renewable energy systems.

UNIT II SOLAR ENERGY **9**

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

UNIT III WIND ENERGY **9**

Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects

UNIT IV BIO - ENERGY **9**

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration - Biomass Applications

UNIT V OTHER RENEWABLE ENERGY SOURCES **9**

Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro-Geothermal Energy – Hydrogen and Storage - Fuel Cell Systems – Hybrid Systems.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to identify the new methodologies / technologies for effective utilization of renewable energy sources.

TEXT BOOKS:

1. Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
2. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.

REFERENCES:

1. Sukhatme. S.P., "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 1996.
3. Tiwari. G.N., Solar Energy – "Fundamentals Design, Modelling & Applications", Narosa Publishing House, New Delhi, 2002.
4. Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990.
5. Johnson Gary, L. "Wind Energy Systems", Prentice Hall, New York, 1985
6. David M. Mousdale – "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA 2010
7. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2009.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6004	Unconventional Machining Process	Unconventional machining process, need, water jet machining, abrasive water jet machining.

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ME6004 **UNCONVENTIONAL MACHINING PROCESSES** **L T P C 3 0 0 3**

OBJECTIVES:

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

UNIT I INTRODUCTION

Unconventional machining Process – Need – classification – Brief overview . **6**

UNIT II MECHANICAL ENERGY BASED PROCESSES

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. **9**

UNIT III ELECTRICAL ENERGY BASED PROCESSES

Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications. **9**

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES

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. **11**

UNIT V THERMAL ENERGY BASED PROCESSES

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications. **10**

OUTCOMES: **TOTAL: 45 PERIODS**

Upon completion of this course, the students can able to demonstrate different unconventional machining processes and know the influence of difference process parameters on the performance and their applications.

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6005	Process Planning and Cost Estimation	Material evaluation, steps in process selection, production equipment and tooling selection, estimation of machining time, importance of machine time calculation.

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2018 - 2019

ME6005 **PROCESS PLANNING AND COST ESTIMATION** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO PROCESS PLANNING **10**

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

UNIT II PROCESS PLANNING ACTIVITIES **10**

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 **8**

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 **8**

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 completion of this course, the students can able to use the concepts of process planning and cost estimation for various products.

TEXT BOOKS:

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.

REFERENCES:

1. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.
2. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6006	Design of Jigs, Fixtures and Press Tools	Pneumatic and hydraulic actuation, types of bending dies.

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ME6006 **DESIGN OF JIGS, FIXTURES AND PRESS TOOLS** **L T P C**
3 0 0 3

OBJECTIVES:

To understand the functions and design principles of Jigs, fixtures and press tools
To gain proficiency in the development of required views of the final design.

UNIT I LOCATING AND CLAMPING PRINCIPLES: **8**

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT II JIGS AND FIXTURES **10**

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES **10**

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT IV BENDING AND DRAWING DIES **10**

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V OTHER FORMING TECHNIQUES **7**

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke.

TOTAL: 45 PERIODS

Note: (Use of P S G Design Data Book is permitted in the University examination)

OUTCOMES:

Upon completion of this course, the students can able to design jigs, fixtures and press tools.

TEXT BOOKS:

1. Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
2. Joshi P.H "Press tools - Design and Construction", wheels publishing, 1996

REFERENCES:

1. Venkataraman. K., "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2005.
2. Donaldson, Lecain and Goold "Tool Design", 3rd Edition, Tata McGraw Hill, 2000.
3. Kempster, "Jigs and Fixture Design", Third Edition, Hoddes and Stoughton, 1974.
4. Hoffman "Jigs and Fixture Design", Thomson Delmar Learning, Singapore, 2004.
5. ASTME Fundamentals of Tool Design Prentice Hall of India.
6. Design Data Hand Book, PSG College of Technology, Coimbatore.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6008	Welding Technology	TIG & MIG, Friction stir welding, destructive and non destructive testing.

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ME6008 **WELDING TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

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

UNIT I GAS AND ARC WELDING PROCESSES: **9**

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

UNIT II RESISTANCE WELDING PROCESSES: **9**

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

UNIT III SOLID STATE WELDING PROCESSES: **9**

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

UNIT IV OTHER WELDING PROCESSES: **9**

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

UNIT V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS **9**

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

TOTAL : 45 HOURS

OUTCOMES:

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

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6007	Composite Materials and Mechanics	Applications fibers, glass, carbon, polymer, graphite, rule of mixtures, manufacturing, other manufacturing processes, laminates, laminate structural moduli. Evaluation of lamina properties from laminate tests, quasi-isotropic laminates. Determination of lamina stresses within laminates. Maximum stress and strain criteria, von-misses, yield criterion for isotropic materials.

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ME6007 **COMPOSITE MATERIALS AND MECHANICS** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING 12

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

UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 10

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

UNIT III LAMINA STRENGTH ANALYSIS 5

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

UNIT IV THERMAL ANALYSIS 8

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

UNIT V ANALYSIS OF LAMINATED FLAT PLATES 10

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies.

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6009	Energy Conservation and Management	Energy, power, past & present scenario of world, Energy auditing, Energy economics.

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ME6009 **ENERGY CONSERVATION AND MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

At the end of the course, the student is expected to

understand and analyse the energy data of industries
carryout energy accounting and balancing
conduct energy audit and suggest methodologies for energy savings and
utilise the available resources in optimal ways

UNIT I INTRODUCTION **8**

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization –Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II ELECTRICAL SYSTEMS **12**

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III THERMAL SYSTEMS **12**

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES **8**

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V ECONOMICS **5**

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to analyse the energy data of industries.

Can carryout energy accounting and balancing
Can suggest methodologies for energy savings

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6011	Thermal and Turbo Machines	Types stage and design parameters, construction details.

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ME6011 **THERMAL TURBO MACHINES** **L T P C**
3 0 0 3

OBJECTIVES:

To understand the various systems, principles, operations and applications of different types of turbo machinery components.

UNIT I PRINCIPLES **9**

Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless parameters-specific speed-applications-stage velocity triangles-work and efficiency.

UNIT II CENTRIFUGAL FANS AND BLOWERS **9**

Types- stage and design parameters-flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise.

UNIT III CENTRIFUGAL COMPRESSOR **9**

Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

UNIT IV AXIAL FLOW COMPRESSOR **9**

Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done simple stage design problems and performance characteristics.

UNIT V AXIAL AND RADIAL FLOW TURBINES **9**

Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to explain the various systems, principles and applications and different types of turbo machinery components.

TEXT BOOKS:

1. Yahya, S.H., Turbines, Compressor and Fans, Tata McGraw Hill Publishing Company, 1996.

REFERENCES:

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1992.
3. Dixon, S.I., "Fluid Mechanics and Thermodynamics of Turbomachinery", Pergamon Press, 1990.
4. Shepherd, D.G., "Principles of Turbomachinery", Macmillan, 1969.
5. Ganesan, V., "Gas Turbines", Tata McGraw Hill Pub. Co., 1999.
6. Gopalakrishnan .G and Prithvi Raj .D, "A Treatise on Turbo machines", Scifech Publications (India) Pvt. Ltd., 2002.

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SiruseriIT Park, Egattur, Chennai - 603 103

S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6017	Design of Heat Exchangers	Heat transfer correlations, overall heat transfer coefficient, analysis of heat exchangers.

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ME6017 **DESIGN OF HEAT EXCHANGERS** **L T P C**
3 0 0 3

OBJECTIVES:

To learn the thermal and stress analysis on various parts of the heat exchangers
To analyze the sizing and rating of the heat exchangers for various applications

UNIT I INTRODUCTION **9**

Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA)

UNIT II PROCESS DESIGN OF HEAT EXCHANGERS **9**

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers – LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

UNIT III STRESS ANALYSIS **9**

Stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration.

UNIT IV COMPACT AND PLATE HEAT EXCHANGER **9**

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

UNIT V CONDENSERS AND COOLING TOWERS **9**

Design of surface and evaporative condensers – cooling tower – performance characteristics.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the mathematical knowledge for thermal and stress analysis on various parts of the heat exchangers components.

TEXT BOOKS:

1. SadikKakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. Shah,R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.

REFERENCES:

1. Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elesevier, 2007.
2. Sarit Kumar Das, "Process heat transfer", Alpha Science International, 2005
3. John E. Hesselgreaves, "Compact heat exchangers: selection, design, and operation", Elsevier science Ltd, 2001.
4. Kuppan. T., "Heat exchanger design hand book", New York : Marcel Dekker, 2000.
5. Eric M. Smith, "Advances in thermal design of heat exchangers: a numerical approach: direct-sizing, step-wise rating, and transients", John Wiley & Sons, 1999.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6016	Advanced IC Engines	Mixture requirements fuel injection system, combustion chambers, fuel spray behavior, spray structure, Bio-Diesel properties.

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ME6016 **ADVANCED I.C ENGINES** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I SPARK IGNITION ENGINES **9**

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

UNIT II COMPRESSION IGNITION ENGINES **9**

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

UNIT III POLLUTANT FORMATION AND CONTROL **9**

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

UNIT IV ALTERNATIVE FUELS **9**

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

UNIT V RECENT TRENDS **9**

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

TOTAL : 45 PERIODS

OUTCOME:

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

TEXT BOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6019	Non Destructive Testing and Materials	Visual inspection unaided and aided, principles types and properties of liquid penetrate developers.

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ME6019 **NON DESTRUCTIVE TESTING AND MATERIALS** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I OVERVIEW OF NDT **7**

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 **8**

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) **10**

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) **10**

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) **10**

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 completion of this course, the students can able to use the various Non Destructive Testing and Testing methods understand for defects and characterization of industrial components

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010

REFERENCES:

1. ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier," Handbook of Nondestructive evaluation", McGraw Hill, New York 2001.
4. 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, Vol. 7, Ultrasonic Testing

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6020	Vibration and Noise Control	Introduction classification of vibration free and forced vibration un-damped and damped vibration, noise characteristics of engines, engine overall noise level, Methods for control of engine noise, combustion noise, mechanical noise.

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ME6020 **VIBRATION AND NOISE CONTROL** **L T P C**
3 0 0 3

OBJECTIVES:

The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

UNIT I BASICS OF VIBRATION **9**

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II BASICS OF NOISE **9**

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT III AUTOMOTIVE NOISE SOURCES **9**

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT IV CONTROL TECHNIQUES **9**

Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT V SOURCE OF NOISE AND CONTROL **9**

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TOTAL: 45 PERIODS

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	IE6605	Production Planning and Control	Benefits of planning and control, functions of production control, types of productions, method study basic procedure, selection, recording of process, product planning.

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IE6605 **PRODUCTION PLANNING AND CONTROL** **L T P C**
3 0 0 3

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.

OUTCOMES: **TOTAL: 45 PERIODS**

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

REFERENCES:

1. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition, John Wiley and Sons, 2000.
3. Kanishka Bedi, " Production and Operations management", 2nd Edition, Oxford university press, 2007.
4. Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgraw hill.
5. Norman Gaither, G. Frazier, "Operations Management", 9th edition, Thomson learning IE, 2007

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	MG6851	Principles of Management	Definition of management, nature and purpose of planning, planning process, types of planning, planning tools and techniques, budgetary and non budgetary control techniques.

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MG6851 **PRINCIPLES OF MANAGEMENT** L T P C 3 0 0 3

OBJECTIVES:

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

OUTCOMES:

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

TEXTBOOKS:

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

REFERENCES:

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

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6014	Computational Fluid Dynamics	Basics of computational fluid dynamics, Steady one-dimensional convection and diffusion.

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ME6014 **COMPUTATIONAL FLUID DYNAMICS** **L T P C**
3 0 0 3

OBJECTIVES:

To introduce Governing Equations of viscous fluid flows

To introduce numerical modeling and its role in the field of fluid flow and heat transfer

To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.

To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS **8**

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION **9**

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION **10**

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT IV FLOW FIELD ANALYSIS **9**

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V TURBULENCE MODELS AND MESH GENERATION **9**

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able

To create numerical modeling and its role in the field of fluid flow and heat transfer

To use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd.Second Edition, 2007.
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCES:

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
5. ProdipNiyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.
6. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	ME6015	Operations Research	Networks models, Stochastic inventory models, decision models.

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ME6015 **OPERATIONS RESEARCH** **L T P C**
3 0 0 3

OBJECTIVES:

To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

UNIT I LINEAR MODELS **15**

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS **8**

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

UNIT III INVENTORY MODELS **6**

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS **6**

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V DECISION MODELS **10**

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems

TEXT BOOK:

1. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.

REFERENCES:

1. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
2. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Hillier and Libeberman, "Operations Research", Holden Day, 1986
5. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
6. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

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S.No.	Subject Code	Subject Name	Course that include experimental learning through project work
1	GE6351	Environmental Science and Engineering	Physical and chemical properties of terrestrial and marine water, Forest resources, use and over-exploitation deforestation, land resources, land as a resource land degradation.

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GE6351 **ENVIRONMENTAL SCIENCE AND ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

To finding and implementing scientific, technological, economic and political solutions to environmental problems.

To study the interrelationship between living organism and environment.

To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

To study the dynamic processes and understand the features of the earth's interior and surface.

To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY **12**

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

UNIT II ENVIRONMENTAL POLLUTION **10**

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES **10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical

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

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT **7**

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

UNIT V HUMAN POPULATION AND THE ENVIRONMENT **6**

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

TOTAL : 45 PERIODS

OUTCOMES:

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

Public awareness of environmental is at infant stage.
Ignorance and incomplete knowledge has lead to misconceptions
Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS :

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

REFERENCES :

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

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STUDY AND ANALYSIS OF INVENTORY MANAGEMENT IN AN AUTOMOBILE RUBBER COMPONENTS MANUFACTURING INDUSTRY

A PROJECT REPORT

Submitted by

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in

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APRIL/MAY 2019

ANNA UNIVERSITY: CHENNAI 600 025

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INTERNAL EXAMINER

EXTERNAL EXAMINER

CHAPTER - 9

9. VISUAL MANAGEMENT SYSTEM (VMS)

The Visual control/Visual management system is a bu management technique where the information is communicated by using signals instead of texts or other written instructions. In The Toyota Prod System, it is also known as "mieruka" . The design is deliberate in allowing recognitionof the information being communicated, in order to increase eff and clarity.

9.1 THE PURPOSE OF VISUAL MANAGEMENT SYSTEM

Visual control methods aim to increase the efficiency and effectiven process by making the steps in that process more visible. The theory behin control is that if something is clearly visible or in plain sight, it is remember and keep at the forefront of the mind. There are many techniques that are used to apply visual control in the workplace. Visu andsignals communicate information that is needed to make effective d These decisions may be safety oriented or they may give reminders as steps should be taken to resolve a problem. Most companies use visual c one degree or another, many of them not even realizing that the visual con they are making have a name and a function in the workplace.

Visual controls are designed to make the control and manager company as simple as possible. This entails making problems, abnorm to everyone. When these deviations

CHAPTER - 9

9. VISUAL MANAGEMENT SYSTEM (VMS)

The Visual control/Visual management system is a business management technique where the information is communicated by using visual signals instead of texts or other written instructions. In The Toyota Production System, it is also known as "mieruka" . The design is deliberate in allowing quick recognitionof the information being communicated, in order to increase efficiency and clarity.

9.1 THE PURPOSE OF VISUAL MANAGEMENT SYSTEM

Visual control methods aim to increase the efficiency and effectiveness of a process by making the steps in that process more visible. The theory behind visual control is that if something is clearly visible or in plain sight, it is easy to remember and keep at the forefront of the mind. There are many different techniques that are used to apply visual control in the workplace. Visual signs andsignals communicate information that is needed to make effective decisions. These decisions may be safety oriented or they may give reminders as to what steps should be taken to resolve a problem. Most companies use visual controls in one degree or another, many of them not even realizing that the visual controls that they are making have a name and a function in the workplace.

Visual controls are designed to make the control and management of a company as simple as possible. This entails making problems, abnormalities, or deviations from standards visible to everyone. When these deviations are visible and apparent to all, corrective action can be taken to immediately correct these problems.

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INTERNAL EXAMINER

2/4/19
EXTERNAL EXAMINER

ABSTRACT

In the modern era, the vehicles are focused to be automated to give human driver relaxed driving. In the field of automobile various aspects have been considered which makes a vehicle automated. The biggest network has started working on the self-driving cars since 2010 and still developing new changes to give a whole new level to the automated vehicles. In this paper we have focused on two applications of an automated car, one in which two vehicles have same destination and one knows the route, where other don't. The following vehicle will follow the target (i.e. Front) vehicle automatically. The other application is automated driving during the heavy traffic jam, hence relaxing driver from continuously pushing brake, accelerator or clutch. Defining the one aspect here under consideration is making the destination dynamic. This can be done by a vehicle automatically following the destination of another vehicle. Since taking intelligent decisions in the traffic is also an issue for the automated vehicle so this aspect has been also under consideration in this paper.

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11.CONCLUSION

If the people's thought hasn't changed about the self-driving cars being safe, these cars are already safe and are becoming safer. Only if they believe and give a try to technology, they get to enjoy the luxury of computerized driving.

11.1. Technology:

Driverless cars appear to be an important next step in transportation technology. They are a new all-media capsule- text to your heart's desire and it's safe.

11.2. Developments in our Self Driving Car:

Developments in autonomous cars is continuing and the software in the car is continuing to be updated. Though it all started from a driverless thought to radio frequency, cameras, sensors, more semi-autonomous features will come up, thus reducing the congestion, increasing the safety with faster reactions and fewer errors.

11.3. Future of Self-Driving Customers:

People who currently reject self-driving cars would've said no to modern technology and automatic systems.

EXPERIMENTAL INVESTIGATION OF STAINLESS STEEL 316 COATED VS UNCOATED WITH AL2O3 POWDER

A PROJECT REPORT

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ABSTRACT

The aim of our project is to coat on the Stainless steel pin with the use of Physical Vapour Deposition(PVD) and we are going to measure the wear resistance using Pin on Disc Apparatus & SEM Analysis. In PVD the coating temperature is about 400-600°c. The Aluminium oxide(AL203) is selected to coat on Stainless steel to measure the wear resistance. Vapour deposition coating for high-speed machining consist of multiple layers because of the requirements for high adhesion strength to the strength, high thermal stability, hardness. In this process the Stainless steel pin is coated with the Aluminium oxide which is in pellet form. The source material is evaporate by the heat source (electron beam) which is maintaining a few cm distance from the substrate. After coating the coated and uncoated Stainless steel pin is set on the pin on disc machine to measure wear resistance one after the another. And the SEM images are taken for both uncoated cast iron and coated cast iron.

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CHAPTER 9

CONCLUSION

- This aluminium oxide coated stainless steel enhances wear resistance significantly.
- These coated materials have high melting and boiling points which makes this material to be used in a place where more heat is produced.
- The surface coated materials have its own value of usage in the advanced material development.

The solution to the physical vapour deposition coating with Aluminium oxide on stainless steel it is experimentally explained that in wear resistance tester with same speed and different load there is a variation in decrease of coefficient of friction and frictional force in coated material when compared to uncoated material. We conclude that the coated material having maximum wear resistance when compared to uncoated material

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DRIVER FREE VEHICLE

A PROJECT REPORT

Submitted by

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INTERNAL EXAMINER

EXTERNAL EXAMINER

1. INTRODUCTION

1.1 Self Driving Car:

A self-driving car (sometimes called an autonomous car or driverless car) is a vehicle that uses a combination of sensors, cameras, radar and artificial intelligence (AI) to travel between destinations without a human operator. To qualify as fully autonomous, a vehicle must be able to navigate without human intervention to a predetermined destination over roads that have not been adapted for its use.

1.2 Levels of autonomy in self-driving cars:

The U.S. National Highway Traffic Safety Administration (NHTSA) lays out six levels of automation, beginning with zero, where humans do the driving, through driver assistance technologies up to fully autonomous cars. Here are the five levels that follow zero automation:

1.2.1 Level 1:

Advanced driver assistance system (ADAS) aid the human driver with either steering, braking or accelerating, though not simultaneously. ADAS includes rearview cameras and features like a vibrating seat warning to alert drivers when they drift out of the traveling lane.

1.2.2 Level 2:

An ADAS that can steer and either brake or accelerate simultaneously while the driver remains fully aware behind the wheel and continues to act as the driver.

11.CONCLUSION

If the people's thought hasn't changed about the self-driving cars being safe, these cars are already safe and are becoming safer. Only if they believe and give a try to technology, they get to enjoy the luxury of computerized driving.

11.1. Technology:

Driverless cars appear to be an important next step in transportation technology. They are a new all-media capsule- text to your heart's desire and it's safe.

11.2. Developments in our Self Driving Car:

Developments in autonomous cars is continuing and the software in the car is continuing to be updated. Though it all started from a driverless thought to radio frequency, cameras, sensors, more semi-autonomous features will come up, thus reducing the congestion, increasing the safety with faster reactions and fewer errors.

INVESTIGATIONS ON FSW WELDING OF DISSSIMILAR MAGNESIUM ALLOYS

FINAL YEAR PROJECT REPORT

submitted by

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S. ASHOK KUMAR (311815114013)

K. MADHAN (311815114043)

N. MOHAMEDAMEENUL RAHMAN (311815114044)

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IN

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PROGRESS THROUGH KNOWLEDGE

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APRIL 2019

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INTERNAL EXAMINER

2/4/19
EXTERNALEXAMINER

which are aluminum, zinc, manganese, silicon, copper, rare earths and zirconium. Magnesium is the lightest structural metal. Magnesium alloys have a hexagonal lattice structure, which affects the fundamental properties of these alloys. Plastic deformation of the hexagonal lattice is more complicated than in cubic latticed metals like aluminium, copper and steel; therefore, magnesium alloys are typically used as cast alloys, but research of wrought alloys has been more extensive since 2003. Cast magnesium alloys are used for many components of modern automobiles have been used in some high-performance vehicles; die-cast magnesium is also used for camera bodies and components in lenses.

Practically, all the commercial magnesium alloys manufactured in the United States contain aluminum (3 to 13 percent) and manganese (0.1 to 0.4 percent). Many also contain zinc (0.5 to 3 percent) and some are hardenable by heat treatment. All the alloys may be used for more than one product form, but alloys AZ63 and AZ92 are most used for sand castings, AZ91 for die castings, and AZ92 generally employed for permanent mold castings (while AZ63 and A10 are sometimes also used in the latter application as well). For forgings, AZ61 is most used, and here alloy M1 is employed where low strength is required and AZ80 for highest strength. For extrusions, a wide range of shapes, bars, and tubes are made from M1 alloy where low strength suffices or where welding to M1 castings is planned. Alloys AZ31, AZ61 and AZ80 are employed for extrusions in the order named, where increase in strength justifies their increased relative costs.

CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 SUMMARY

Magnesium and its alloys have attracted great attention in industry application and academic research due to their properties such as light weight, high specific strength, stiffness, machinability and recyclability. However, the development of new alloy types, manufacturing techniques such as welding play an important role in exploiting the new fields of application. The extruded plates of AZ31B and AZ91 magnesium alloy were machined to the required dimensions (300 mm x 150 mm x 6 mm). The smooth (unnotched) tensile specimens were prepared to evaluate yield strength, tensile strength, elongan and reduction in cross sectional area. Microstructural examination was carried out using an optical microscope (OM).

6.2 CONCLUSIONS

- With the reference with their tensile, hardness tests the parameters of the sample three is suggested for welding dissimilar Mg alloys
- Also the micro structure , macro structure , and SEM analysis also shows that the sample three has the best structure and fusion of nugget and parent material , so the parameter for the sample three is suggested for further welding process of the dissimilar alloys.

The present investigation on FSW welding of AZ31B magnesium alloy alloys has given some important information related to the effect of welding parameters on mechanical and metallurgical properties of the joints. However, there are few other aspects need to be investigated to understand the process effectively. In this regard, following suggestions are to be considered for further research on this topic.

DESIGN ANALYSIS AND COMPARISON OF PISTON HEAD PROFILE OF FOUR STROKE ENGINE

A PROJECT REPORT

Submitted by

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ABSTRACT

Engine is one of the most complex components among all automotive mponents which is called the Heart of the vehicle and the piston may be considered the most portant part of an engine .Engine operate with a lean stratified mixture in most load nditions.However,their entire performance and emissions are dependent on stratification at :ferent load conditions.In fact stratification in these engines depends upon in-cylinder flows d air -fuel interaction,which in turn dependent on combustion chamber shape,compression :io and engine speed etc.Among them,combustion chamber shape plays a significant role and nce understanding its effect is very much essential to optimize its configuration in these gines.Therefore,in this study, a CFD analysis using ANSYS Fluent 16.2 Academic version has :en carried out with combustion chamber shapes like flat,recessed in a two valve four stroke gine.With the various piston head profiles In-cylinder flow in the engine can be changed nich further increases the efficiency,reduces knocking and emissions.

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CHAPTER 5

CONCLUSION

In this study, a CFD analysis has been carried out with four combustion chamber shapes of a SI engine to understand the behaviour of in-cylinder flows and air-fuel interactions.

From the analysis, following conclusions are drawn:

- At 540 CAD, tumble vortex was formed in all piston configurations, it is located slightly away from center.
- Flat piston has slightly higher tumble ratio compared to recessed piston configurations.
- The TKE is distributed all over the combustion chamber. TKE of flat piston is high compared to recessed piston configuration.
- Flat piston has 25.22% more TKE than recessed piston.

Finally , it s concluded that flat piston is more efficient in terms of TKE and TR. From this study flat piston is suitable for combustion chamber of SI engine in terms of better TKE, high TR, and better power output and easy of piston manufacturing.

MODIFICATION OF RAPH BASKET CHANGING PROVISION FROM GAS SIDE TO AIR SIDE

A PROJECT REPORT

Submitted by

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

It is observed that, basket changing in gas side of RAPH is very unsafe and it may lead to severe accidents and it is very difficult to access the working spot and more time consuming. To prevent this we are modifying the RAPH basket changing door from gas side to air side, which provides high level of safety to the workers. This modification also enables the workers to easily access the working spot with considerably less time.

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CONCLUSION:

From the above details we can conclude that, it takes nearly 11days for completely changing all the hot and intermediate end baskets of one RAPH in old method. Whereas in new method it takes only 8days to complete the same work. Therefore , the modification RAPH basket changing door from gas side to air side helps saving time and cost and also it ensures the safety of workers.

IMPLEMENTATION OF 5S PRACTICE ALONG WITH REDUCTION OF TRANSPORTATION WASTAGES PRESENT IN THE AUTOMOBILE RUBBER COMPONENTS MANUFACTURING INDUSTRY

A FINAL YEAR PROJECT REPORT

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in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

5S is a systematic technique used by organizations comes from five Japanese words: Seiri (sort), Seiton (set in order). Seiso (shine). Seiketsu (standardize), and Shitsuke (sustain). This system helps to organize a work space for efficiency and decrease wasting and optimize quality and productivity via monitoring an organized environment and use visual evidences to obtain more firm results effectiveness. As importance role of 5S implementation in oday"s organizations, this study aims to review previous studies about benefits of 5S implementation and its efficiency in organizations. Consequently 5S can upport the objectives of organization to achieve continuous improvement in erformance and productivity. .The improvements before and after 5S nplementation is shown by pictures in the paper. It also intends to build a ronger work ethic within the management and workers who would be pected to continue the good practices.

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5S Tecnique, Transportation wastages

CHAPTER 14

CONCLUSION

The outcome of the surveys at the company demonstrates clearly that the 5S practice is seen as an effective technique that can improve housekeeping, environmental performance, health and safety standards in an integrated holistic way. It can be observed that there are some similarities in the approaches adopted by the companies. It can be regarded as the promotion of the 5S activity amongst the staff and as a training method for the staff.

The survey demonstrates, however, that there are obstacles in the effective implementation of the 5S for any improvement purpose. The most significant barriers identified are related to lack of communication and gap between the top management and shop floor employees and also the lack of training and consciousness of this activity amongst the staff. Poor communication will influence the poor results in managing the resources i.e. time, budget and materials with resultant lowered morale and motivation amongst employees.

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OPTIMIZATION OF SUB-MERGED ARC WELDING FOR NON-LINEAR APPLICATION

A PROJECT REPORT

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INTERNAL EXAMINER

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ABSTRACT

In current scenario one of the ma[illegible] in SAW welding is that it requires more space for setup and [illegible] weld in straight line. We had deeply analyzed the process of [illegible]ng and found a prototype which consumes less space, elimina[illegible] requirement of big guide ways and enables us to perform SA[illegible] in a curved path. Ultimately the solution to our prob[illegible]ify the structure of the tractor from four wheels to three wh[illegible]e grooved wheel at the front instead of two and a single flex[illegible] guide way.

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CHAPTER 11

CONCLUSION

We conclude that this prototype has simple design and consumes less space as we know that space is one of the major concern in workshops. It enables to perform SAW welding in curved path which saves us from complications of manual welding. This setup is also portable and saves labour cost which in turn increases productivity.

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DESIGN ANALYSIS AND COMPARISON OF PISTON HEAD PROFILE OF FOUR STROKE ENGINE

A PROJECT REPORT

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INTERNAL EXAMINER

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1.1 OVERVIEW OF THE PROJECT

Today, the lean-burn stratified and direct injection spark ignition (SI) internal combustion (IC) engines are becoming more popular because of their low fuel consumption and exhaust emissions. But, they have the problem of formation and control of the charge. This in turn affects the engine stability which is mainly dependent on the in-cylinder fluid flow structures. A practical approach to improve the engine stability with the lean mixtures is to shorten the combustion duration. This can be achieved by enhancing the tumble motion within the engine cylinder, which enhances the mean flow and turbulence of the mixture. Generating a significant vortex flows inside the IC engine cylinder during the intake process generates high turbulence intensity during the later stages of compression stroke leading to fast burning rates.Fluid motion in an IC engine is generated during induction process, and later,it will be modified during compression process.A good knowledge of the in-cylinder flow fields of an IC engine is very much essential for optimization of it.In general ,there are two types of in-cylinder flows. Rotating motion of fluid parallel and perpendicular to axis of cylinder known as swirl and tumble flows respectively.kinectic energy of both swirl and tumble flows will be dissipated as turbulence at end of compression stroke.Thus ,fast burning rates can be achieved in spark ignition engines by having higher swirl and tumble flows in beginning of cycle.In direct injection SI engine,the tumble helps to deflect the injected fuel plume directly into the cylinder towards the spark plug by the guidance of piston cavity.

1.2 COMPUTATIONAL FLUID DYNAMICS

Computational fluid dynamics (CFD) is a branch of fluid mechanics that uses numerical analysis and data structures to solve and analyze problems that involve fluid flows. Computers are used to perform the calculations required to simulate the interaction of liquids and gases with surfaces defined by boundary conditions. With high-speed supercomputers, better solutions can be achieved. Ongoing research yields software that improves the accuracy and speed of complex

CHAPTER 5

CONCLUSION

In this study, a CFD analysis has been carried out with four combustion chamber shapes of a SI engine to understand the behaviour of in-cylinder flow and air fuel interactions.

From the analysis, following conclusions are drawn:

- At 540 CAD, tumble vortex was formed in all piston configurations, it is located slightly away from center.
- Flat piston has slightly higher tumble ratio compared to recessed piston configurations.
- The TKE is distributed all over the combustion chamber; TKE of flat piston is high compared to recessed piston configuration.
- Flat piston has 25.22% more TKE than recessed piston.

Finally , it s concluded that flat piston is more efficient in terms of TKE and TR. From this study flat piston is suitable for combustion chamber of SI engine in terms of better TKE, high TR, and better power output and easy of piston manufacturing.

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EXPERIMENTAL ANALYSIS OF SOLAR PANEL BY USING REFLECTING MIRRORS IN A PLOUGHING VEHICLE

A PROJECT REPORT

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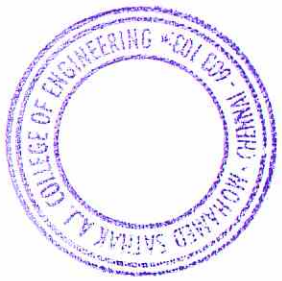
ABSTRACT

Solar energy being a clean, environment-friendly and profusely available energy source can either be used as heat or electricity. Solar power conversion to electricity through PV cells has become more favored but high price of cells and lower efficiency has obstructed its use in developing countries. One way to reduce the high cost per kWh of electricity is to enhance the performance of PV module systems. Low cost reflecting mirrors, lenses and light focusing concentrators may be a good solution. These mirrors concentrate the light intensity over the whole surface of the panel. The effect is more electrons are generated and hence the output power of solar module increases. The PV module with only tracking gives higher output than the system without tracking; but the system with reflecting mirror gives greater output power. With the help of negligible power consumption by concentrators and reduced complexity compared to solar tracking, use of concentrator or reflecting mirrors would be economical when compared with solar tracking. The average power output during midday as increased substantially using mirrors, the solar panels equipped with such mirrors can also be utilized for loads/equipments requiring power inputs during that period of the day. In addition to that, setup of reflectors and concentrators is easy. The method is comparatively efficient and less in maintenance, no other moving parts are required.



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CHAPTER 7

CONCLUSION

The paper has presented a means of increase in efficiency in ploughing vehicle by using Reflecting mirrors, which gives a clear view of charging the battery with low time period. The ploughing machine represents a hard working machinery that meets the requirements of today's modern agricultural implements and must be utilized to the full potential within a wide range of agricultural applications.

The main drawback of the vehicle is charging, it consists of high charge time with respect to varied radiation level from the sun. With a altered idea of implementing Reflecting mirrors increases the radiations exceeding the solar panel and it directs to focus over the solar panel. Moreover it provides reflective radiation excessively with lowering the value of charge time.

It must prove a special speed control capacity of Electronic vehicles helps to work efficiently, meaning that it fullfils the innovative idea of future requirements.

Today's automobile systems have been replaced, most of the IC engines into electrically powered motors to avoid pollution and damage to ecosystem and promotes the idea based on renewable source of energy for future generation engineers.

The emission standards for agricultural tractors continuously change in order to reduce pollutants released into the atmosphere, while agricultural productivity requires more innovative ideas based on less harmful, non-polluting, less cost, renewable energy usage and less complicated usage ideas.

ENERGY CONSERVATION OF AIR COMPRESSOR USING VENTURI SYSTEM

A PROJECT REPORT

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ABSTRACT

An air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air i.e., compressed air. By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches its engineered upper limit, the air compressor shuts off. The compressed air, then, is held in the tank until called into use.The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank. An air compressor must be differentiated from a pump because it works for any gas/air, while pumps work on a liquid. Installation of venturi system in an air compressor to reduce the heat caused by the air compressor and make it work efficiently. By using a venturi system, the air flow temperature will be reduced while passing through the inlet. so it supplies air at a lower temperature when compared to air which enters through normal inlet.

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8.6 CONCLUSION

The rotary screw air compressor used in Hanon Systems has a rating of 1250 CFM(Cubic feet per minute) and has the power consumption of around 210 KWh(Kilo-Watt hour).

On calculating for per day, the rotary screw air compressor has the rating of 18,00,000 CFM for one day and the power consumption is 5040 units per day.

In order to reduce the cost involved in the power consumption and the load acting on the compressor,we select the venturi system.

The following analysis were performed on the rotary screw air compressor and the results before installing the venturi system at the suction side were:

DATE/MONTH/YEAR	POWER CONSUMPTION
06/02/2019	5040 units
07/02/2019	5030 units
08/02/2019	5010 units
11/02/2019	5025 units
12/02/2019	5040 units
13/02/2019	5005 units
14/02/2019	5015 units
15/02/2019	5040 units
18/02/2019	5020 units

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5S is a systematic technique used by organizations comes from five Japanese words: Seiri (sort), Seiton (set in order), Seiso (shine), Seiketsu (standardize), and Shitsuke (sustain). This system helps to organize a work space for efficiency and decrease wasting and optimize quality and productivity via monitoring an organized environment and use visual evidences to obtain more firm results effectiveness. As importance role of 5S implementation in today"s organizations, this study aims to review previous studies about benefits of 5S implementation and its efficiency in organizations. Consequently 5S can support the objectives of organization to achieve continuous improvement in performance and productivity. .The improvements before and after 5S implementation is shown by pictures in the paper. It also intends to build a stronger work ethic within the management and workers who would be expected to continue the good practices.

Keywords:-

5S Tecnique,Transportation wastages

CHAPTER 14

CONCLUSION

The outcome of the surveys at the company demonstrates clearly that the 5S practice is seen as an effective technique that can improve housekeeping, environmental performance, health and safety standards in an integrated holistic way. It can be observed that there are some similarities in the approaches adopted by the companies. It can be regarded as the promotion of the 5S activity amongst the staff and as a training method for the staff.

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INVESTIGATIONS ON TIG WELDING OF DISSSIMILAR MAGNESIUM ALLOYS

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

Magnesium is a lightest structural alloy, which has been widely used in transportation industries mainly due to their low density and has high strength-to-weight ratio. In addition, magnesium alloys have good castability sound damping capabilities, electromagnetic interfere shielding properties, excellent machinability and recyclability. Welding of dissimilar magnesium alloys is an important issue because of their increasing application in industries. In this document, the research and progress of a variety of welding parameters for joining dissimilar Mg alloys are reviewed from different perspectives. This project deal with welding of two dissimilar **Magnesium alloys** and to investigate the welding parameters of TIG welding of AZ31 and AZ91 to provide a basis for further research. This project deals about parametric study of welding similar to the Mg alloys by altering the welding parameters using TIG welding. The welding parameters welding speed, current, voltage and temperature are changed for 6 specimens and each specimen is tested to determine the quality of weld. From successfully welded samples the best parameters is detected.

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CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 SUMMARY

Magnesium and its alloys have attracted great attention in industry application and academic research due to their properties such as light weight, high specific strength, stiffness, machinability and recyclability. However, the development of new alloy types, manufacturing techniques such as welding play an important role in exploiting the new fields of application. The extruded plates of AZ31B a. 1 AZ91 magnesium alloy were machined to the required dimensions (300 mm x 150 mm x 6 mm). The smooth (unnotched) tensile specimens were prepared to evaluate yield strength, tensile strength, elongan and reduction in cross sectional area.. Microstructural examination was carried out using an optical microscope (OM).

6.2 CONCLUSIONS

- With the reference with their tensile, hardness tests the parameters of the sample 3 is suggested for welding dissimilar Mg alloys
- Also the micro structure , macro structure , and SEM analysis also shows that the sample 3 has the best structure and fusion of nuddget and parent material , so the parameter for the sample 3 is suggested for further welding process of the dissimilar alloys.

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EXPERIMENTAL STUDY ON FLAT PLATE SOLAR COLLECTOR

A PROJECT REPORT

Submitted by

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INTERNAL EXAMINER

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ABSTRACT

The conventional energy sources are inadequate to accommodate the demand of energy which increases due to rapid industrialization and population growth. To overcome these problem non-conventional energy resources are used. Solar flat plate collector is a solar energy collector which is used to absorb solar radiation from sun and employed for heating the fluid flowing through it. Generally it uses fins through which fluid is flow. Solar flat plate absorber which utilizes sun rays to produce energy are commonly used for domestic and industrial purposes and have the largest commercial application amongst the various solar collector, here we use water as a fluid due to sun rays the infrared radiation strikes the absorber plate and retain the heat to flow of water. Analyse the temperature of water increases due to variation of attachment of fins. This collector absorbs both direct and diffuse solar radiation. Due to this reason it can works effectively on cloudy days. Hence, performance of solar flat plate collector is increased.

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CHAPTER 10

CONCLUSION

The experiments are conducted at the environments with the solar experimental setup. The promising results are obtained around 21% improved heat gain as well as around 20% reduction in the heat input required to provide the same heat requirements.

Flate plate solar collector which are used for water heating, are long lasting, and also in the long term they are cheaper than other water heating system. However they requires large areas if high energy output is a requirement. Also solar energy is free if we do not include initial cost for installation and maintenance.

Finally besides these we should remember by using solar energy we can protect nature.

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ABSTRACT

Wire electric discharge machining is a controlled machining process. Which is used to manufacture geometrically intricate shapes with great accuracy and good surface finish that are difficult to machine with the help conventional machining process. Wire EDM is now growing as an important process in various fields. In this project we discussed the optimization of process parameter by machining Titanium grade 5 (Ti6Al4V). The input process parameter which are used are Ton, Toff, Voltage, and Wire feed. The output parameter are MRR and Surface roughness. This project also discussed the lowest surface roughness value and the comparision between Taguchi and RSM method. And we found that the best accuracy is Taguchi method over RSM method of value 1.77 (86% acurracy).

CHAPTER 7

RESULTS AND DISCUSSION

Lowest Surface Roughness	1.525	100%
Taguchi Surface Roughness	1.77	86%
RSM surface Roughness	2.395	63.97%

The result shows that

- The lowest surface roughness is 1.525
- By comparing taguchi and RSM method, we found that the best accuracy is Taguchi method over RSM method of value 1.77 (86% acurracy).

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INVESTIGATIONS ON FSW WELDING OF DISSSIMILAR MAGNESIUM ALLOYS

FINAL YEAR PROJECT REPORT

submitted by

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ABSTRACT

Magnesium is a lightest structural alloy, which has been widely used in transportation industries mainly due to their low density and has high strength-to-weight ratio. In addition, magnesium alloys have good castability sound damping capabilities, electromagnetic interfere shielding properties, excellent machinability and recyclability. Welding of dissimilar magnesium alloys is an important issue because of their increasing application in industries. In this document, the research and progress of a variety of welding parameters for joining dissimilar Mg alloys are reviewed from different perspectives. This project deal with welding of two dissimilar **Magnesium alloys** and to investigate the welding parameters of welding of AZ31 and AZ91 to provide a basis for further research. This project deals about parametric study of welding similar to the Mg alloys by altering the welding parameters using FSW welding. The welding parameters welding speed, rpm of tool, shape of tool pin and temperature are changed for 5 specimens and each specimen is tested to determine the quality of weld. From successfully welded samples the best parameters is detected

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CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 SUMMARY

Magnesium and its alloys have attracted great attention in industry application and academic research due to their properties such as light weight, high specific strength, stiffness, machinability and recyclability. However, the development of new alloy types, manufacturing techniques such as welding play an important role in exploiting the new fields of application. The extruded plates of AZ31B and AZ91 magnesium alloy were machined to the required dimensions (300 mm x 150 mm x 6 mm). The smooth (unnotched) tensile specimens were prepared to evaluate yield strength, tensile strength, elongan and reduction in cross sectional area. Microstructural examination was carried out using an optical microscope (OM).

6.2 CONCLUSIONS

- With the reference with their tensile, hardness tests the parameters of the sample three is suggested for welding dissimilar Mg alloys
- Also the micro structure , macro structure , and SEM analysis also shows that the sample three has the best structure and fusion of nugget and parent material . so the parameter for the sample three is suggested for further welding process of the dissimilar alloys.

The present investigation on FSW welding of AZ31B magnesium alloy alloys has given some important information related to the effect of welding parameters on mechanical and metallurgical properties of the joints. However, there are few other aspects need to be investigated to understand the process effectively. In this regard, following suggestions are to be considered for further research on this topic.

OPTIMIZATION OF SUB-MERGED ARC WELDING FOR NON-LINEAR APPLICATION

A PROJECT REPORT

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EXTERNAL EXAMINER

ABSTRACT

In current scenario one of the major concern in SAW welding is that t requires more space for setup and can only weld in straight line. We iad deeply analyzed the process of SAW welding and found a prototype vhich consumes less space, eliminates the requirement of big guide vays and enables us to perform SAW welding in a curved path. Ultimately the solution to our problem is to modify the structure of the ractor from four wheels to three wheels using one grooved wheel at the ront instead of two and a single flexible rod as guide way.

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CHAPTER 11

CONCLUSION

We conclude that this prototype has simple design and consumes less space as we know that space is one of the major concern in industries. It enables to perform SAW welding in curved path which saves us a lot of complications of manual welding. This setup is also portable and saves a lot of time which in turn increases productivity.

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BUTTON OPERATED ELECTROMAGNETIC GEAR SHIFTING IN TWO WHEELER

PROJECT REPORT

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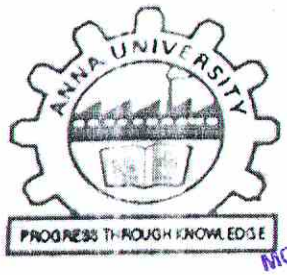

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EXTERNAL EXAMINER

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A method of controlling a gear change of an automobile, said automobile omprising an internal combustion engine.Anautomatic transmission connected to in output rotation shaft of said engine so as to transmit the rotational output of said engine to drive wheels of said automobile through any selected one of a plurality of gear ratios. a load device selectively connectable to said output rotation shaft of said engine via selectively-connecting means; and means for generating a gear change control for selecting one of said gear ratios of said automatic transmission in accordance with one of operational conditions of said automobile and said engine said method comprising the steps of controlling said selectively-connecting means when said gear. An automatic gear change control apparatus for an automobile, said automobile comprising an internal combustion engine. an automatic transmission connected to an output rotation shaft of said engine so as to transmit the rotational output of said engine to drive wheels of said automobile through any selected one of a plurality of gear ratios; said apparatus comprising a load device for applying a load; means for connecting said load device to said output rotation shaft of said engine and for generating a gear change control for

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CHAPTER-11

CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries.

We are proud that we have completed the work with the limited time successfully. The **BUTTON OPERATED ELECTROMAGNETIC GEAR SHIFTING IN TWO WHEELER**is working with satisfactory conditions. We can able to understand the difficulties in maintaining the tolerances and also the quality. We have done to our ability and skill making maximum use of available facilities.

In conclusion remarks of our project work, let us add a few more lines about our impression project work. Thus we have developed a **"BUTTON OPERATED ELECTROMAGNETIC GEAR SHIFTING IN TWO WHEELER"** which helps to know how to achieve low cost automation. The application of electro-magnetic coil produces smooth operation. By using more techniques, they can be modified and developed according to the applications.

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Certified that this project report **"EXPERIMENTAL ANALYSIS OF CAMPHOR OIL BLENDS FOR PERFORMANCE, EMISSION CHARACTERISTICS AND FUNCTIONAL GROUPS IN DIESEL ENGINE"** is the bonafide work of **"G.P.GRACE SAMSON, R.HARISH BABU, R.INBASEKARAN AND K.KASIMUTHURAJA"** who carried out the project work under my supervision.

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

Typically I.C. engine used in automobiles have a problem of pollutant emission, which mainly depends on combustion process occurs in I.C. engines. Incomplete combustion produces large amount of emission gases and gives lower efficiency. In this project, the pure diesel (PD), camphor oil (C), diesel (90%) - camphor oil (10%) (by volume), diesel (80%) - camphor oil (20%), diesel (70%) - camphor oil (30%) fuels were tested to evaluate effects of camphor oil blends with diesel on the performance and exhaust emissions of diesel engine. Engine performance and exhaust gas emission such as Nitrogen oxide (NOx), carbon monoxide (CO), unburned Hydro carbon (HC) and smoke were measured. The Fourier Transform infrared spectroscopy is used to recognize the functional groups of the sample.

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CHAPTER-5

CONCLUSION

The performance and emission characteristics of camphor oil biodiesel blended with diesel at the composition of diesel 90%- camphor oil biodiesel 10% (D90-C10), D80-C20 and D70-C30 are tested and the result is analysed and compared with the diesel fuel. The biodiesel is produced of camphor oil by blende with diesel. The test for the properties of camphor oil biodiesel is blended with diesel demonstrates that almost all the important properties are in close agreement with diesel fuel. Thus the diesel engine can be performed satisfactorily on camphor oil biodiesel is blended with diesel values were investigated. The results are followed below:

1. The brake thermal efficiency for diesel, C10,C20 and C30 samples are 23.95%, 24.71%, 24.74 and 23.69% respectively. From these efficiency values C20 sample is increases when compared with other fuel samples.
2. The brake specific fuel consumption values for diesel,C10, C20 and C30 are 0.33,0.34,0.35 and 0.36 Kg/kwhr. To compare diesel fuel **BSFC** values are increase for all the camphor oil blends.
3. The carbon monoxide values for diesel, C10, C20 and C30 are 0.02, 0.03, 0.01and 0.03 respectively. From these values C20 value is decreased compare with other sample values.
4. The NOx values for disel,C10,C20 and C30 are decreased compare with disel fuel.

FTIR Spectrum of biodiesel confirmed the conversion of fatty acid to methyl esters. FTIR spectrums of C10,C20 and C30 are almost equal.

DESIGN AND SIMULATION OF SMART FACTORY SYSTEM

A PROJECT REPORT

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INTERNAL EXAMINER

EXTERNAL EXAMINER

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ABSTRACT

Smart Factory Automation is an integrated, computer ed, automated manufacturing system that covers material g system, CNC machine tools, processing station, quality on, and robotics that can simultaneously process medium olumes of a variety of parts. It is also known as Computer ed Manufacturing (CIM) System. The parts are produced on achines, assembled automatically on the assembly station, d by built-in VISION system. In addition to this, a Coordinate ement Machine (CMM) can also be used to check the onal accuracy of the component produced by the CIM system. actory Automation system is built on the integral principles of manufacturing system; it is designed to be flexible, modular, ble and affordable.

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CHAPTER 16

CONCLUSION

- Our automation system allows the process to be managed, monitored and implemented through various control technologies. It offers the users insight and dynamic operation of a smarter factory, where automation and data from individual stations can be used to drive processes through the entire ecosystem.
- Smart Factory Automation system is built on the integral principles of modern manufacturing system; it is designed to be flexible, modular, expandable and affordable.

MECHANICAL CHARACTERISATION OF KEVLAR FIBRE REINFORCED POLYMER COMPOSITE EMBEDDED WITH SMA WIRE

A PROJECT REPORT

Submitted by

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INTERNAL EXAMINER

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EXTERNAL EXAMINER

ABSTRACT

The main aim of the project is to study the effect of the addition of a shape memory alloy wire in between the layers of Kevlar in a Kevlar fiber reinforced polymer matrix composite. Kevlar is a heat-resistant and strong synthetic fiber, related to other aramids such as Nomex and Technora. Kevlar is the branded name of Poly-paraphenyleneterephthalamide. Kevlar is a well-known component of personal armor such as combat helmets, ballistic face masks, and ballistic vests. A shape-memory alloy (SMA, smart metal, memory metal, memory alloy, muscle wire, smart alloy) is an alloy that "remembers" its original shape and that when deformed returns to its pre-deformed shape when heated. It gets its name because it exhibits the shape memory effect. But, the property of interest in this mechanical characterization is its toughness and energy absorption capacity. The composite material will be manufactured with hand layup method with the SMA wire between the layers of the Kevlar fabric(reinforcement) and epoxy resin as matrix. The resulting composite is then tested with various tests to identify its properties.

CHAPTER 9

CONCLUSION

The tensile test and flexural test result shows that the tensile strength and flexural strength of the ordinary Kevlar is more than the tensile strength and flexural strength of the Kevlar fiber reinforced with SMA wire. This occurs due to the improper load distribution between the Kevlar fiber and the SMA wire. Eventhough the tensile strength and flexural strength of the Kevlar fiber reinforced with SMA wire is decreased the results of the impact test shows that the impact strength of the Kevlar fiber reinforced with SMA wire is increased when compared with ordinary Kevlar. This shows that the objective of the project is met. That the impact strength of the Kevlar has been improved by making a composite material with SMA wire. Since the energy absorption capacity of the material increased it can be used in the manufacturing of the military vest with less layer of Kevlar fiber and this will reduce the weight of vest. The tensile strength and flexural strength can be not considered when compared with the Impact strength as far as bullet penetration is concerned. So that the mobility of the personnel can be increased with the help of using the Kevlar fiber reinforced with SMA wire. I here conclude that this project can be further carried out to further reduce the weight of the military vest by using only few layers of Kevlar fiber.

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BUTTON OPERATED ELECTROMAGNETIC GEAR SHIFTING IN TWO WHEELER

PROJECT REPORT

Submitted by

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J.NOORUL AMEEN	(311815114073)
M.SARAN	(311815114083)
S.SIDHARTH BALU	(311815114087)

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING

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APRIL/MAY 2019

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BONAFIDE CERTIFICATE

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INTERNAL EXAMINER

EXTERNAL EXAMINER

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ABSTRACT

There are disclosed an electromagnetic Type Gear Change System control apparatus or an automobile and a method of controlling such apparatus. A rotational output of an internal combustion engine is connected to drive wheels of the automobile and a load device. When a gear shifting-up of a electromagnetic type transmission is to be effected, the load applied by the load device is increased, or the load is connected to an output rotation shaft of the engine via a selectively-connecting device, thereby reducing the rotational speed of the output rotation shaft of the engine to a required level. In our project, two electromagnetic coils are coupled to the gear rod of the two ends. The two BUTTONs are used to activate the electro-magnetic coil so that the gear will be shifted.

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CHAPTER-11

CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries.

We are proud that we have completed the work with the limited time successfully. The **BUTTON OPERATED ELECTROMAGNETIC GEAR SHIFTING IN TWO WHEELERis** working with satisfactory conditions. We can able to understand the difficulties in maintaining the tolerances and also the quality. We have done to our ability and skill making maximum use of available facilities.

In conclusion remarks of our project work, let us add a few more lines about our impression project work. Thus we have developed a **"BUTTON OPERATED ELECTROMAGNETIC GEAR SHIFTING IN TWO WHEELER"** which helps to know how to achieve low cost automation. The application of electro-magnetic coil produces smooth operation. By using more techniques, they can be modified and developed according to the applications.

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OPTIMIZATION OF SUB-MERGED ARC WELDING FOR NON-LINEAR APPLICATION

A PROJECT REPORT

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ABSTRACT

In current scenario one of the major concern in SAW welding is that it requires more space for setup and can only weld in straight line. We had deeply analyzed the process of SAW welding and found a prototype which consumes less space, eliminates the requirement of big guide ways and enables us to perform SAW welding in a curved path. Ultimately the solution to our problem is to modify the structure of the tractor from four wheels to three wheels using one grooved wheel at the front instead of two and a single flexible rod as guide way.

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CHAPTER 11

CONCLUSION

We conclude that this prototype has simple design and consumes less space as we know that space is one of the major concern in industries. It enables to perform SAW welding in curved path which saves us a lot of complications of manual welding. This setup is also portable and saves a lot of time which in turn increases productivity.

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ENERGY CONSERVATION OF AIR COMPRESSOR USING VENTURI SYSTEM

A PROJECT REPORT

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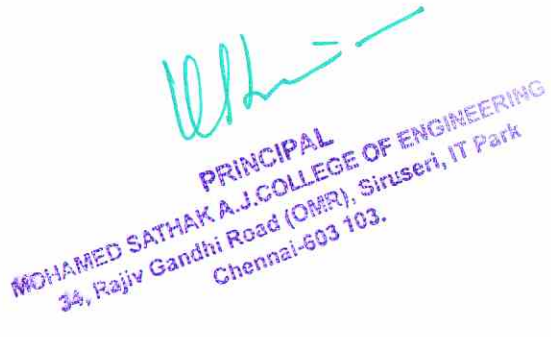

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

An air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air i.e., compressed air. By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches its engineered upper limit, the air compressor shuts off. The compressed air, then, is held in the tank until called into use.The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank. An air compressor must be differentiated from a pump because it works for any gas/air, while pumps work on a liquid. Installation of venturi system in an air compressor to reduce the heat caused by the air compressor and make it work efficiently. By using a venturi system, the air flow temperature will be reduced while passing through the inlet, so it supplies air at a lower temperature when compared to air which enters through normal inlet.

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8.6 CONCLUSION

The rotary screw air compressor used in Hanon Systems has a rating of 1250 CFM(Cubic feet per minute) and has the power consumption of around 210 KWh(Kilo-Watt hour).

On calculating for per day, the rotary screw air compressor has the rating of 18,00,000 CFM for one day and the power consumption is 5040 units per day.

In order to reduce the cost involved in the power consumption and the load acting on the compressor,we select the venturi system.

The following analysis were performed on the rotary screw air compressor and the results before installing the venturi system at the suction side were:

DATE/MONTH/YEAR	POWER CONSUMPTION
06/02/2019	5040 units
07/02/2019	5030 units
08/02/2019	5010 units
11/02/2019	5025 units
12/02/2019	5040 units
13/02/2019	5005 units
14/02/2019	5015 units
15/02/2019	5040 units
18/02/2019	5020 units

BONAFIDE CERTIFICATE

Certified that this project report titled **"OPTIMIZATION OF MACHINING PARAMETER DURING MACHINING OF TITANIUM 6AL-4V USING ABRASIVE WATER JET MACHINE"** is the bonafide work of **"MOHAMED NIYAS.M(311815114055), SARAVANAN.M(311815114084), SYED SULAIMAN.T(311815114092), JUNAITH.B(311815114303)**who carried out the project work under my supervision.

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INTERNAL EXAMINER

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ABSTRACT

Abrasive water jet machine is a non conventional machining technique in which, material removal take place from the work piece by impact erosion high pressure and high velocity water jet mixed with abrasive material to provide smooth surface finish.Abrasive Water Jet Machining is more suitable for cutting thick materials.This technology is widely used in industry for cutting difficult to machine materials, milling slots, polishing hard materials, cleaning contaminated surfaces, etc.Experiments were conducted to study the influence of various input process parameters of abrasive water jet machining on kerf, material removal rate (MRR) and surface roughness (RA) of Titanium 6al-4v.Experiments are carried out by varying Stand of distance, pressure (Pr), abrasive flow rate (AFR) for Titanium 6al-4v material.Analysis Of Variance (ANOVA) method is used for identifying the effect of machining parameters on volumetric Material Removal Rate and Surface Roughness. We achieved the Results by optimizing the values using Response Surface Methodology. The AWJ Machining of titanium 6al-4v with the condition, Kerf width is minimum, Material Removal Rate is maximum & Surface Roughness is minimum, and Optimized parameters for Abrasive Water Jet machining in this paper are abrasive flow rate – 340 g/min, pressure–300 mpa& Stand of distance – 5 mm.

CHAPTER 5

5. CONCLUSION

Table 5 COMPARISION TABLE:

	Ra			MRR		
	value	%	Error	value	%	Error
Original	1.77	100	0	2.137	100	0
Taguchi	1.85	104.51	-4.5	2.23	104.35	-4.5
Rsm	1.77	100	0	1.616	75.62	24.382

- In this project we have optimized the input parameters to obtain minimum surface roughness, kerf Taper and maximum material removal rate. And during this research the following results were observed.
- From the table we are observed that the abrasive flow rate influences more than the other two parameters for obtaining the surface roughness is minimum.
- For achieving kerf taper minimum, the abrasive flow rate influences more than the other two parameters.
- To achieve the Material removal rate maximum the Pressure and stand of distance influences among other parameters.
- The Optimized parameter for Abrasive Water Jet machining in this paper are abrasive flow rate – 385 g/min, Pressure – 300bar & Stand of distance – 3.12 mm.

BONAFIDE CERTIFICATE

Certified that this project report **"OPTIMIZATION OF SUB-MERGED ARC WELDING FOR NON-LINEAR PURPOSE"** is the bonafide work of **M.AHAMED OWISE, J.AHAMED RIDWAN, R.DHINAHARAN, B.HALILUR RAHMAN** ,who carried out the project under my supervision.

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DG/PROJECT/99/COMPLN /95/18-19 29.03.2019

TO WHOMSOEVER IT MAY CONCERN

This is to certify that, Mr.B.HALILUR RAHMAN (311815114030), Mr.J.AHAMED RIDWAN (311815114009), Mr.M.AHAMED OWISE (311815114008) & Mr.R.DHINAHARAN (311815114021) of Final Year BE – MECHANICAL ENGINEERING from MOHAMED SATHAK A.J COLLEGE OF ENGINEERING has completed the Project on "OPTIMIZATION OF SUB-MERGED ARC WELDEING FOR NON-LINEAR APPLICATION" in our esteemed organization from 05.02.2019 to 23.02.2019.

During this period their character was good and appreciable in nature.

For Diamond Engineering (Chennai) Pvt. Ltd.

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ABSTRACT

In current scenario one of the major concern in SAW welding is that it requires more space for setup and can only weld in straight line. We had deeply analyzed the process of SAW welding and found a prototype which consumes less space, eliminates the requirement of big guide ways and enables us to perform SAW welding in a curved path. Ultimately the solution to our problem is to modify the structure of the tractor from four wheels to three wheels using one grooved wheel at the front instead of two and a single flexible rod as guide way.

CHAPTER 11

CONCLUSION

We conclude that this prototype has simple design and consumes less space as we know that space is one of the major concern in industries. It enables to perform SAW welding in curved path which saves us a lot of complications of manual welding. This setup is also portable and saves a lot of time which in turn increases productivity.

DESIGN AND SIMULATION OF SMART FACTORY SYSTEM

A PROJECT REPORT

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This certificate is issued at the request of the student for submission to his Institution of Study, as a part of fulfillment off B.E. (MECH) Degree Course Curriculum.

For **MTAB TECHNOLOGY CENTER (P) LTD.,**

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ABSTRACT

Smart Factory Automation is an integrated, computer controlled, automated manufacturing system that covers material handling system, CNC machine tools, processing station, quality inspection, and robotics that can simultaneously process medium sized volumes of a variety of parts. It is also known as Computer Integrated Manufacturing (CIM) System. The parts are produced on CNC machines, assembled automatically on the assembly station, inspected by built-in VISION system. In addition to this, a Coordinate Measurement Machine (CMM) can also be used to check the dimensional accuracy of the component produced by the CIM system. Smart Factory Automation system is built on the integral principles of modern manufacturing system; it is designed to be flexible, modular, expandable and affordable.

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CHAPTER 16

CONCLUSION

- Our automation system allows the process to be managed, monitored and implemented through various control technologies. It offers the users insight and dynamic operation of a smarter factory, where automation and data from individual stations can be used to drive processes through the entire ecosystem.
- Smart Factory Automation system is built on the integral principles of modern manufacturing system; it is designed to be flexible, modular, expandable and affordable.

INVESTIGATION O[illegible]METAL M[illegible]X COMPOSITE OF ALU[illegible]NIUM A[illegible]5052

A[illegible]JECT REP[illegible]

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

This project deals wi[th] experimental an[d] [in]vestigations on mechanical properties of aluminum allo[y] [A]l 5052 compo[site] [sa]mples, processed by stir casting method. Three sets [of] composites were p[re]pared constantly with silicon carbide (1.5%) and varying [per]centage of titan[ium] dioxide (6.5%, 4.5%, and 2.5%). To improve and ev[aluate] the properti[es] [sa]mples were tensile strength, hardness and wear r[esis]tance were also [te]sted.

In the current scenari[o] materials R&D [ha]s shifted from monolithic to composite materials, adjustin[g] the global nee[d] [fo]r reducing the weight, low cost, quality, and high perfo[rma]nce in structural [ma]terials and also widely used in areas of aerospace and au[to]mobile industries [for] high performance, economic and environmental benefits.

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CONCLUSION

- Aluminium based meta… composites a… …sfully fabricated by stir casting technique v… …fly uniform dis… …of 1.5% SiC+ 6.5% TiO_2 in sample 1 ,1.5… …4.5% TiO… …2 and 1.5% SiC + 2.5% TiO_2in sample 3.
- The tensile strength … …le 1 (117.9 … …much greater than sample 2 (96.17 mpa) … …01 mpa) … …ed that sample 1 is much strengthen than … …2.
- The ultimate tensile st… …of sample 1 (7… …is found to be more than the sample 2 (6.1… …23 (4.33 KN… …s by increasing the percentage of TiO_2, str… …TS also inc…
- The hardness of sam… …48) is mo… …mple 2 (35.03) &3 (33.45). So, the sam… …be used … …rial hardness is an essential para…
- The wear rate of the … …(8.9 mm3/… …when compared to other sample…
- The coefficient of … …lues of … …273) is less when compared to other sam…
- Hardness is increased … …increase … …ration of titanium dioxide.
- Strength and hardnes… …s in case … …ductility decreases.
- The result o… …the effec… …TiO_2 on mechanical properties of … …alloy compo… …vides the following above obser…ations.

BONAFIDE CERTIFICATE

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INTERNAL EXAMINER

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ABSTRACT

Aluminium based matrix composites (MMC) are gaining importance in several aerospace and automobile applications. Aluminium has been used as matrix material owing of its excellent mechanical properties coupled with good formability. Addition of SiC& Dross as reinforcement in aluminium system is to improve the mechanical properties of the composite. In the present investigation Al-SiC-Aluminium Dross (Fly ash) composite was prepared by powder metallurgy route. Sic particles containing different weight fractions (10, 12.5 &15%) and Dross particles of weight fractions (7.5,10 & 15 %) are used as reinforcement. Powders were cold compacted under unidirectional pressing followed by sintering at 495°C in muffle furnace. After the development of material that specimens were tested for Hardness, density, micro structure and other characteristics.

KEY WORDS: Aluminium, Silicon Carbide, Dross, Powder metallurgy process, Compaction, Reinforcement , Sintering.

CHAPTER 14

CONCLUSION

Aluminium is used as a matrix phase of the composite because of its light weight, higher strength with improved stiffness and also tailored electrical and thermal properties. High modulus and hardness, excellent thermal stability, easy availability at low costmakes Silicon carbide and flyash as an ideal choice for reinforcement. Silicon Carbide and Fly ashused as a reinforced metal matrix composite was developed by Powder metallurgy process. From the above results and discussion, it is clear that **Sample S1** with proportion **Al - 77.5%, SiC - 15%, Dross - 7.5%** shows better properties than the other Composites. Mechanical Properties like Hardness and Compressive strength are more suitable for many Applications like soft coating, construction works, making weightless utensils, useful to make wardrobes. This project is done to investigate the behavior of aluminium composites and to analyze the various results. This project is not ended with this report, there is lot more scope in future for this project to carryout to gain wider application and knowledge about this Aluminium composite.

We conclude that further study will enhance its application in development of various existing products.

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ABSTRACT

Magnesium is a lightest structural alloy, which has been widely used in transportation industries mainly due to their low density and has high strength-to-weight ratio. In addition, magnesium alloys have good castability sound damping capabilities, electromagnetic interfere shielding properties, excellent machinability and recyclability. Welding of dissimilar magnesium alloys is an important issue because of their increasing application in industries. In this document, the research and progress of a variety of welding parameters for joining dissimilar Mg alloys are reviewed from different perspectives. This project deal with welding of two dissimilar **Magnesium alloys** and to investigate the welding parameters of welding of AZ31 and AZ91 to provide a basis for further research. This project deals about parametric study of welding similar to the Mg alloys by altering the welding parameters using FSW welding. The welding parameters welding speed, rpm of tool, shape of tool pin and temperature are changed for 5 specimens and each specimen is tested to determine the quality of weld. From successfully welded samples the best parameters is detected

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CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 SUMMARY

Magnesium and its alloys have attracted great attention in industry application and academic research due to their properties such as light weight, high specific strength, stiffness, machinability and recyclability. However, the development of new alloy types, manufacturing techniques such as welding play an important role in exploiting the new fields of application. The extruded plates of AZ31B and AZ91 magnesium alloy were machined to the required dimensions (300 mm x 150 mm x 6 mm). The smooth (unnotched) tensile specimens were prepared to evaluate yield strength, tensile strength, elongan and reduction in cross sectional area. Microstructural examination was carried out using an optical microscope (OM).

6.2 CONCLUSIONS

- With the reference with their tensile, hardness tests the parameters of the sample three is suggested for welding dissimilar Mg alloys
- Also the micro structure , macro structure , and SEM analysis also shows that the sample three has the best structure and fusion of nugget and parent material , so the parameter for the sample three is suggested for further welding process of the dissimilar alloys.

The present investigation on FSW welding of AZ31B magnesium alloy alloys has given some important information related to the effect of welding parameters on mechanical and metallurgical properties of the joints. However, there are few other aspects need to be investigated to understand the process effectively. In this regard, following suggestions are to be considered for further research on this topic.

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ABSTRACT

The main aim of the project is to study the effects of the addition of a shape memory alloy sheet in between the layers of Kevlar in a Kevlar fiber reinforced polymer matrix composite. Kevlar is a heat-resistant and strong synthetic fiber, related to other aramids such as Nomex and Technora. Kevlar is the branded name of Poly-paraphenyleneterephthalamide. Kevlar is a well-known component of personal armor such as combat helmets, ballistic face masks, and ballistic vests. A shape-memory alloy (SMA, smart metal, memory metal, memory alloy, muscle wire, smart alloy) is an alloy that "remembers" its original shape and that when deformed returns to its pre-deformed shape when heated. It gets its name because it exhibits the shape memory effect. But, the property of interest in this mechanical characterization is its toughness and vibration dampening capacity. The composite material will be manufactured with hand laid method with the SMA sheet between the layers of the Kevlar fabric(reinforcement) and epoxy resin as matrix. The resulting composite is then tested with various tests to identify its properties and it was found that SMA wire reinforced Kevlar polymer composites showed better mechanical properties than plain Kevlar polymer composites.

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CHAPTER 7

CONCLUSION

Based on the results of the tests, the following conclusions can be made:

- ✓ Addition of shape memory alloy in the form of sheet affects the impact properties and toughness of the resulted composite when compared to a composite solely made by using Kevlar and epoxy resin.
- ✓ The addition of shape memory alloy sheet increases the toughness of the resulted composite as it can be inferred from the visual inspection of the plain and SMA sheet specimens after the impact test.
- ✓ A large amount of elastic energy is stored in the specimen with the SMA sheet (in comparison with the plain specimen) which in turn is transferred to the tup after the impact which results in its rebound.
- ✓ The SMA sheet-Kevlar composite takes lesser damage after the impact when compared to the plain specimen, which indicates the increase in impact resistance.
- ✓ The addition of SMA sheet does not affect the tensile strength much as the outer fibers break off during the test while the SMA sheet withstands. It may be due to the bonding between the SMA sheet and the matrix being poor.
- ✓ The addition of SMA sheet does not affect the flexural strength much as the outer fibers break off during the test while the SMA sheet withstands. It may be due to the bonding between the SMA sheet and the matrix being poor.

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

We all talk about the trending technology, the Internet Of Things that is changing our lives day by day. It is creating a new world, quantifiable and measurable world where people and businesses can manage their assets in better informed way and make more timely decisions. The impact when a motorcyclist involves in a high speed accident without wearing a helmet is very dangerous and can cause fatality. Wearing a helmet can reduce shock from the impact and may save a life. There are many countries enforcing a regulation that requires the motorcycle's rider to wear a helmet when riding on their motorcycle, Malaysia is an example. With this reason, this project is specially developed as to improve the safety of the motorcycle's rider . Only when the rider buckled the helmet then only the motorcycle's engine will start. This is implemented using GSM and GPS whenever the driver starts ignition, the alcohol sensor measures the content of the alcohol in his breath and automatically switches off the bike if he is drunken.

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9.1 CONCLUSION:

By implementing this system a safe two wheeler journey is possible which would decrease the head injuries during accidents and also reduce the accident rate due to driving bike after Consuming alcohol. a helmet may not be a 100% proof but is definitely the first line of defense for the rider in case of an accident to prevent fatal brain injuries .the proposed approach makes it mandatory for the rider to use the protective guard in order to drive a two-wheeler vehicle and Ensures the safety to the human brain and there for reduces the risks of brain injuries and death in case of an accident. Besides the developed system prevents theft of two –wheeler in future this intelligent system can be fabricated in a compact size so that it is globally acceptable to notify no Parking areas government must inforce laws to install such system in every two wheeler. By implementing such mechanism in two wheeler, deaths due to driving under influence of alcohol and other road fatalities can be minimized to large extent.

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

Solar energy being a clean, environment-friendly and profusely available energy source can either be used as heat or electricity. Solar power conversion to electricity through PV cells has become more favored but high price of cells and lower efficiency has obstructed its use in developing countries. One way to reduce the high cost per kWh of electricity is to enhance the performance of PV module systems. Low cost reflecting mirrors, lenses and light focusing concentrators may be a good solution. These mirrors concentrate the light intensity over the whole surface of the panel. The effect is more electrons are generated and hence the output power of solar module increases. The PV module with only tracking gives higher output than the system without tracking; but the system with reflecting mirror gives greater output power. With the help of negligible power consumption by concentrators and reduced complexity compared to solar tracking, use of concentrator or reflecting mirrors would be economical when compared with solar tracking. The average power output during midday as increased substantially using mirrors, the solar panels equipped with such mirrors can also be utilized for loads/equipments requiring power inputs during that period of the day. In addition to that, setup of reflectors and concentrators is easy. The method is comparatively efficient and less in maintenance, no other moving parts are required.

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CHAPTER 7

CONCLUSION

The paper has presented a means of increase in efficiency in ploughing vehicle by using Reflecting mirrors, which gives a clear view of charging the battery with low time period. The ploughing machine represents a hard working machinery that meets the requirements of today's modern agricultural implements and must be utilized to the full potential within a wide range of agricultural applications.

The main drawback of the vehicle is charging, it consists of high charge time with respect to varied radiation level from the sun. With a altered idea of implementing Reflecting mirrors increases the radiations exceeding the solar panel and it directs to focus over the solar panel. Moreover it provides reflective radiation excessively with lowering the value of charge time.

It must prove a special speed control capacity of Electronic vehicles helps to work efficiently, meaning that it fullfils the innovative ideas of future requirements.

Today's automobile systems have been replaced, most of the IC engines into electrically powered motors to avoid pollution and damage to ecosystem and promotes the idea based on renewable source of energy for future generation engineers.

The emission standards for agricultural tractors continuously change in order to reduce pollutants released into the atmosphere, while agricultural productivity requires more innovative ideas based on less harmful, non-polluting, less cost, renewable energy usage and less complicated usage ideas.

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Certified that this project **"EXPERIMENTAL INVESTIGATION ON MECHANICAL PROPERTIES OF ALUMINUM (6061) REINFORCED WITH ALUMINA, GRAPHITE AND SILICON CARBIDE"** is the bonafide work of **B.NARESHKUMAR, N.PANDIDURAI, K.RAJARAJAN, K.ARUN,** who carried out the project under my supervision.

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ABSTRACT

In the present investigation, the study on mechanical properties of Aluminum Hybrid Matrix Composites (AMCs) reinforced with alumina (Al_2O_3), silicon carbide (Sic) and graphite (Gr) particles. Al6061 alloy is used as the matrix material with varying the reinforcement of alumina 2wt% and 3wt% of graphite and varying composition of SiC of 3wt% and 5wt%.The composites were fabricated by stir casting equipment methodology with controlled speed and feed parameters. Hardness is measured by using Brinell hardness equipment and tensile properties were measured by using universal testing machine and it is compared with aluminum alloy. There was a good improvement in hardness and tensile properties by changing the compositions. The Sic and Al_2O_3 resulted in improving the hardness and density of their respective composites. Further changing the compositions of these reinforcements result in increased hardness and density of the composites.

CHAPTER-VII

CONCLUSION

In present study the aim is to development of Aluminum matrix composite material by using stir casting method and characterization for its mechanical, metallurgical and tribological properties. With present stir casting apparatus, we have successfully processed the total reinforcement up to 10% by weight. PAMC samples are lighter than the parent matrix material of Al6061 due to the low density of graphite and porosity generated during casting. Graphite acts as a dry surface lubricant, which results in reduction of the coefficient of friction between pin made of PAMC and disc made of steel. The lowest value found for coefficient of friction is 0.316425 for Al 6061+ (2% Al_2O_3 + 5%SiC + 3% Graphite) reinforcement. Addition of SiC results in reduction of wear rate. The lowest value found for wear rate is 0.00000764 mm3/Nm for Al 6061+ (2%Al_2O_3 + 5%SiC + 3% Graphite).PAMC components show brittle fracture in tension test as a result of its cast condition. Addition of SiC and Al_2O_3 gives good improvement in UTS. For Al 6061+ (2%Al_2O_3 + 3%SiC + 3% Graphite) we get maximum tensile strength i.e.154.16 N/mm2 .We get 28 % of increase in tensile strength.As percentage of reinforcement goes on increasing ductility of the PAMC goes on decreasing.With increase in percentage of SiC hardness of PMAC goes on increasing. It is due to hard ceramic nature of SiC For Al 6061+ (2%Al_2O_3 + 5%SiC+3%Gr) we get 57 BHN i.e. almost 90% improvement.

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EXTERNAL EXAMINER

ABSTRACT

The aim of our project is to coat on the Stainless steel pin with the use of Physical Vapour Deposition(PVD) and we are going to measure the wear resistance using Pin on Disc Apparatus & SEM Analysis. In PVD the coating temperature is about 400-600°c. The Aluminium oxide(AL203) is selected to coat on Stainless steel to measure the wear resistance. Vapour deposition coating for high-speed machining consist of multiple layers because of the requirements for high adhesion strength to the strength, high thermal stability, hardness. In this process the Stainless steel pin is coated with the Aluminium oxide which is in pellet form. The source material is evaporate by the heat source (electron beam) which is maintaining a few cm distance from the substrate. After coating the coated and uncoated Stainless steel pin is set on the pin on disc machine to measure wear resistance one after the another. And the SEM images are taken for both uncoated cast iron and coated cast iron.

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CHAPTER 9

CONCLUSION

- This aluminium oxide coated stainless steel enhances wear resistance significantly.
- These coated materials have high melting and boiling points which makes this material to be used in a place where more heat is produced.
- The surface coated materials have its own value of usage in the advanced material development.

The solution to the physical vapour deposition coating with Aluminium oxide on stainless steel it is experimentally explained that in wear resistance tester with same speed and different load there is a variation in decrease of coefficient of friction and frictional force in coated material when compared to uncoated material. We conclude that the coated material having maximum wear resistance when compared to uncoated material

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INTERNAL EXAMINER

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Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs (light on a sensor, a finger on a button, or a Twitter message) and turn it into an output (activating a motor, turning on an LED) publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language and the Arduino Software (IDE).In this project we connect this Microcontroller with Moisture sensor and Humidity sensor. This micro controller can actually performs with all platforms.In this project we going to propose the Agricultural Robot for easy farming and helpful to farmers .Nowadays there are no one to do farming so we chose this to make it easy and this we added the seed sowing concept and then quad copter concept for spray pesticides or water for the crops and the we use the ATmega328p microcontroller to control the agri system we use the LM35 to monitor surrounding temperature and the humidity sensor to measure the moisture in the air and soil moisture sensor to measure the moisture content in soil.

MAIN FEATURES OR KEYWORDS OF AGRI BOT :

KEYWORDS :

1. Atmega328p micro controller
2. Soil moisture sensor
3. Temperature moisture sensor
4. Humidity sensor
5. LCD

CONCLUSION

The Multi utility agri bot is useful for all the farmers for farming,This technology helps in having greater accuracy and keeps in consuming time. It increases the production rate and helps in increase of annual income of all farmers. The main aim of the project is to reduce the effort taken by the farmers and saving countries agricultural economic development.

ADVANTAGES:

- It consumes less time.
- It acts as life saving tool for farmers
- It increases the productivity rate
- It provides more accuracy
- The agri bot runs through solar energy hence it consumes battery life
- It is more efficient
- It doesn't require much manpower
- No electrical supply is needed

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OPTIMIZATION OF MACHINING PARAMETERS DURING MACHINING OF TITANIUM 6AL-4V USING ABRASIVE WATER JET MACHINING

A PROJECT REPORT

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IN

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ABSTRACT

Abrasive water jet machine is a non conventional machining technique in which, material removal take place from the work piece by impact erosion high pressure and high velocity water jet mixed with abrasive material to provide smooth surface finish.Abrasive Water Jet Machining is more suitable for cutting thick materials.This technology is widely used in industry for cutting difficult to machine materials, milling slots, polishing hard materials, cleaning contaminated surfaces, etc.Experiments were conducted to study the influence of various input process parameters of abrasive water jet machining on kerf, material removal rate (MRR) and surface roughness (RA) of Titanium 6al-4v.Experiments are carried out by varying Stand of distance, pressure (Pr), abrasive flow rate (AFR) for Titanium 6al-4v material.Analysis Of Variance (ANOVA) method is used for identifying the effect of machining parameters on volumetric Material Removal Rate and Surface Roughness. We achieved the Results by optimizing the values using Response Surface Methodology. The AWJ Machining of titanium 6al-4v with the condition, Kerf width is minimum, Material Removal Rate is maximum & Surface Roughness is minimum, and Optimized parameters for Abrasive Water Jet machining in this paper are abrasive flow rate – 340 g/min, pressure–300 mpa & Stand of distance – 5 mm.

CHAPTER 5

5. CONCLUSION

Table 5 COMPARISION TABLE:

	Ra			MRR		
	value	%	Error	value	%	Error
Original	1.77	100	0	2.137	100	0
Taguchi	1.85	104.51	-4.5	2.23	104.35	-4.5
Rsm	1.77	100	0	1.616	75.62	24.382

- In this project we have optimized the input parameters to obtain minimum surface roughness, kerf Taper and maximum material removal rate. And during this research the following results were observed.
- From the table we are observed that the abrasive flow rate influences more than the other two parameters for obtaining the surface roughness is minimum.
- For achieving kerf taper minimum, the abrasive flow rate influences more than the other two parameters.
- To achieve the Material removal rate maximum the Pressure and stand of distance influences among other parameters.
- The Optimized parameter for Abrasive Water Jet machining in this paper are abrasive flow rate – 385 g/min, Pressure – 300bar & Stand of distance 3.12 mm.

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"STUDY AND ANALYSIS OF INVENTORY MANAGEMENT IN AN AUTOMOBILE RUBBER COMPONENTS MANUFACTURING INDUSTRY"** is the bonafide work of **"R.BABU(311815114015) ,P.GOVINDARAJ (311815114027) R.K.GOWTHAMRAJ (311815114028) , K.ABUTHAHIR (311815114301)"** who carried out the project work under my supervision

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Mfg. Silicon / Viton-Transparents, Opaque, Tubes, Sleeves, Chords, Wires and Cables

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ABSTRACT

The term Inventory Management refers to the process of supervising and controlling of the stock items for a company. The inventory management ensures that the company always has the needed materials and products on hand while keeping the cost as low as possible .Inventory is a stock of an item or idle resources held for use. Reduce the unwanted item in the work place . Workplace should be clean and neat.To improve the Traceability using OPTIZ coding system.To provide the proper bin allocation. In this project proposes the reduction of accessibility and traceability problems present in the industry.

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11. CONCLUSION

In this study, the multicriteria inventory ABC classification is proposed, for an automobile rubber components manufacturing industry. Due to improper material allocation and inefficient inventory handling process, storing the inventory of the rubber components in a proper location and in the proper bin is the main problem in the automobile rubber components industry. The criteria, unit weight of the component, and shape of the product, are used along with the other traditional criteria for the inventory classification. The weights are obtained for the different types of bins. Based on the usage of the bin, the inventory items are classified as A, B, C items. The resulting bin classification has easy accessibility in the warehouse. The bin traceability and utilization has also improved. Based on these small improvements the accessibility and traceability will be improved in the industry .

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DESIGN ANALYSIS AND COMPARISON OF PISTON HEAD PROFILE OF FOUR STROKE ENGINE

A PROJECT REPORT

Submitted by

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MOHAMMED AZARUDEEN.A	**311815114304**

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING

MOHAMED SATHAK A.J COLLEGE OF ENGINEERING

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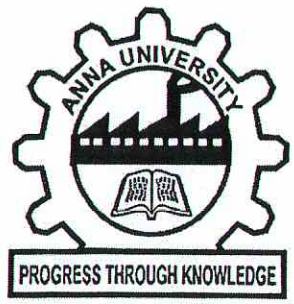

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APRIL 2019

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ABSTRACT

Engine is one of the most complex components among all automotive nents which is called the Heart of the vehicle and the piston may be considered the most ant part of an engine .Engine operate with a lean stratified mixture in most load ions.However,their entire performance and emissions are dependent on stratification at nt load conditions.In fact stratification in these engines depends upon in-cylinder flows ir -fuel interaction,which in turn dependent on combustion chamber shape,compression nd engine speed etc.Among them,combustion chamber shape plays a significant role and understanding its effect is very much essential to optimize its configuration in these s.Therefore,in this study, a CFD analysis using ANSYS Fluent 16.2 Academic version has carried out with combustion chamber shapes like flat,recessed in a two valve four stroke e.With the various piston head profiles In-cylinder flow in the engine can be changed further increases the efficiency,reduces knocking and emissions.

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CHAPTER 5

CONCLUSION

In this study, a CFD analysis has been carried out with four combustion chamber shapes of a SI engine to understand the behaviour of in-cylinder flows and air-fuel interactions.

From the analysis, following conclusions are drawn:

- At 540 CAD, tumble vortex was formed in all piston configurations, it is located slightly away from center.
- Flat piston has slightly higher tumble ratio compared to recessed piston configurations.
- The TKE is distributed all over the combustion chamber; TKE of flat piston is high compared to recessed piston configuration.
- Flat piston has 25.22% more TKE than recessed piston.

Finally , it s concluded that flat piston is more efficient in terms of TKE and TR. From this study flat piston is suitable for combustion chamber of SI engine in terms of better TKE, high TR, and better power output and easy of piston manufacturing.

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Certified that this project report**"MODIFICATION OF RAPH BASKET CHANGING PROVISION FROM GAS SIDE TO AIR SIDE"**is the bonafide work of

DINESH R	**(311815114022)**
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JAYAKUMAR S	**(311815114037)**

Who carried out the project under my supervision.

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NLC INDIA LIMITED
"NAVARATNA"- GOVERNMENT OF INDIA ENTERPRISE
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This is to certify that the project work entitled **"MODIFICATION OF RAPH BASKET CHANGING PROVISION FROM GAS SIDE TO AIR SIDE"** is a bonafide project work submitted by

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PLACE: NEYVELI
DATE: 30.01.2019

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DECLARATION

We hereby declare that the project work entitled **"Modification of RAPH basket changing provision from gas side to air side"** done in **TPS-I EXPANSION** Under the guidance of **Mr. G. PALANIVELU, DCE/MECH/ TPS-I Expansion.**

This project is for reference only and no part of the report will be published or copied anywhere without the written permission from the NLC officials.

Signature of the student

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(JAYAKUMAR.S)

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Place:Neyveli.

Date : 30.04.2019

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ABSTRACT

The project deals with the modification of RAPH,(REGENERATIVE AIR PREHEATER)which is used in thermal power plants to increase the efficiency of the boiler. During the maintenance work of air preheater, the heating elements inside the RAPH has to be replaced.It is observed that in TPS-I expansion,NLC INDIA Ltd., the basket changing in the gas side of RAPH is very unsafe and it may lead to severe accidents and more time consuming. If systematic operation of soot blowers and water washing of air heater baskets is carried out, replacement of baskets may become necessary only after several years of operation. Normally the cold end baskets may have to be changed at first instance and the hot end plates only much later. The replacement of the baskets can be done only after putting air heaters out of service or during general repairs or major overhaul of boiler. The modification of the RAPH basket changing door from gas side to air side provides safety for workers and sufficient working platform. Many time it seems that during any kind of emergency the workers operating near the RAPH door has the only way of escape through monkey ladder which makes impossible for all the workers to escape at a time. So, when the accessing door is changed to air side which ensures complete safety of workers and easy access. A large working platform is also provided near the door. This modification is done for providing safety and easy access during replacement of RAPH baskets.The main aim is avoid any serious damage to the workers.This modification also helps in saving time and cost during basket replacement in RAPH. Before modification the maintenance work of RAPH took 11days whereas after modification it took only 8 days to complete the same work.

CHAPTER VII

CONCLUSION AND FUTURE WORK

CONCLUSION:

From the above result we can conclude that, it takes nearly 11 days for completely changing all the hot and intermediate end baskets of one RAPH in the old method. Whereas in new method(air side door) it takes only 8 days to complete the same work. Therefore the modification of door from gas side to air side helps in consuming time, saving time, and also ensures the safety of workers.

FUTURE WORK:

Thermal Power Station-I expansion consists of two RAPH's per unit.For now the modification is done only in UNIT-I RAPH-2. Further work is under process to make the same modification in other three RAPH's also to reduce time and save cost and mainly for the safe operating conditions and easy access.

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Certified that this project report titled **"PERFORMANCE ANALYSIS AND OPTIMISATION OF REGENERATIVE AIR PREHEATER"** is the bonafide work of **"G. DHARMASEELAN (311815114020), L. JINSON (311815114038), D. BHARATHI (311815114016)"** Who carried out the project work under my supervision.

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DECLARATION

We hereby declare that the project work entitled **"Performance analysis and optimisation of RAPH"** done in **TPS-I EXPANSION** Under the guidance of **Mr. G. PALANIVELU, DCE/MECH/ TPS-I Expansion.**

This project is for reference only and no part of the report will be published or copied anywhere without the written permission from the NLC officials.

Signature of the students

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Place: Neyveli

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Abstract

In a thermal power plant the output generated is of the greatest concern. But on the other side the efficiency of each and every component which contributed the required net output should also be given importance. Air preheaters are one of the major areas of concern for efficiency improvement. It is necessary that we should go for renovation and modernization for performance improvement. An air pre-heater is a general term to describe any device designed to heat air before another process with the primary objective of increasing the thermal efficiency of the process of the flue gas in a regenerative pre-heater. This project analysis how operation parameters of a regenerative air preheater can be optimized in order to increase its efficiency and consequently the overall efficiency of a boiler. Regenerative Air Pre-Heater can be improved by reducing the leakage of air into flue gas and it can be minimized to the minimum of 30% by replacing the ordinary metal strip seals into "Flexible Seals" and also by proper maintenance of the RAPH its performance is increased. In future it can be implemented for the experimental analysis. In this report we have done a detailed study of the 210 MW RAPH in unit-I and unit-II in thermal power station -I Expansion at Neyveli and have identified the reason behind the loss in RAPH performance and suitable remedies have been suggested and compared to the old system.

Keywords—Air preheater, Regenerative air preheater, boiler, and sealing

CHAPTER-12
CONCLUSION

The results are found that decrease in air leakage increases air and gas side efficiency. conventional seals can be changed to flexible seals, thereby air leakage reductions can be achieved to the minimum of 30% and maximum efficiency can be obtained and by adjusting the sector and axial plates through mechanical actuators to closely follow the shape of the deformed diaphragm plate, regular checking of repair work and maintenance the efficiency can be improved. With these knowledge experimental analysis can be implementing in future and expecting following the benefit for single RAPH

The benefit in terms of

(A) power savings per year =36,44,329.54 units/year

(B) Cost Savings per year = Rs.15,53,92,188.49/year

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