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**Department Elective – I:** (ME 411- Experimental Stress Analysis ME 412- Science and Technology of Welding ME 413- Lubrication ME 414- Computation Fluid Dynamics and Heat Transfer ME 415- Fuels Combustion and Pollution ME 416- Advances in Measurement Techniques ME 417-Solar Photovoltaic Fundamental : Technologies & Application

**Department Elective – II:** (ME 418- Vibration Engineering Design ME 419-Quality Engineering ME 420- Neural Network, Fuzzy system & Application ME 421-Cryogenics ME 422- Flexible Manufacturing Systems ME 423- Industrial Design ME 424- Turbo Machinery

MS = Mid Semester, ES = End Semester; IA = Internal assessment (like quiz, assignments etc)
LW = Laboratory work; LE = Laboratory Exam
### ME 401TCOMPUTER AIDED DESIGN

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**UNIT I**

**CAD FUNDAMENTALS:** Introduction, Reasons for implementing a CAD system, Computer aided process application, benefits, CAD software’s, Elements of programming, CAD programming ,Need and scope of computer aided design

**COMPUTER GRAPHICS:** Scan conversion; Bresenham’s Algorithm for line, circle and Ellipse. Standards for graphics programming, features of GKS, other graphics standards, PHIGS, IGES, PDES. Standards in CAD.

**UNIT II 09**

**GEOMETRIC TRANSFORMATIONS:** Geometric transformations- 2D and 3D translation, scaling, rotation, shear and reflection, homogeneous transformations

**UNIT III 12**

**PLANE &SPACE CURVES:** Types of mathematical representation of curves, parametric representation of line, circle, ellipse, parabola, hyperbola. Wire frame models, wire frame entities parametric representation of synthetic curves Hermit cubic splines, Bezier curves, B-splines, constructive solid geometry

**FINITE ELEMENT METHOD:** Introduction, FEM procedure, Types of elements, stiffness matrix, Boundary conditions, shape functions, 1-D structural problem, effect of temperature.

**UNIT IV 09**

**Computer Programming:** Use of computer programming in design of machine elements, thermal system and fluid systems, development of computer program using C, Matlab, etc. for machine components like shaft, spring, coupling, gears, bearing etc.,plotting graphs using programming language, generalized programming, optimization in design.

**Approximate Total: 39Hrs**

**Texts and References**

1. CAD/CAM: Computer Aided design and Manufacturing by MikellGroover and Zimmer, Pearson Education
2. Computer Aided Engineering & Design by Jim Browne, New Age International Publications,
4. CAD / CAM - Chris McMohan, Jimmie Brown Addison - Wesley
5. CAD/CAM Theory & Practice by Ibrahim Zeid, Tata McGraw Hill
6. Finite Element Analysis by Chandrakapila, EEE Publication.
### ME 401P  COMPUTER AIDED DESIGN

#### Teaching Scheme

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Total 4hr/week is divided in two Parts

**Part-1 (2 hr/week):** Laboratory activity based on scan conversions and its computer programs, 2D and 3D transformations and its computer programs, computer programs of mechanical components.

**Part-2 (2 hr/week):** Laboratory activity based on advanced features of CAD software, assembly and mechanism analysis, programming in CAD software, finite element analysis for the simple components, practical case study
ME 402T INTERNAL COMBUSTION ENGINES

Teaching Scheme

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UNIT I

**Introduction**: Engine classifications, basic engine components and terminology, working principles of engines, four-stroke (4S) and two-stroke (2S) SI and CI engines, comparison of 4S and 2S SI and CI engines, application of IC engines, engine performance parameters

**Air-standard cycles**: Carnot cycle, Stirling cycle, Ericsson cycle, Otto cycle, Diesel cycle, Dual cycle, Atkinson cycle, comparison of the Otto, Diesel and Dual cycles

**Fuel-air cycles**: Fuel-air cycles and their significance, variable specific heats, dissociation, comparison of air-standard and fuel-air cycles, effect of compression ratio & fuel-air ratio, valve-timing diagrams

UNIT II

**Actual cycles**: comparison of air-standard and actual cycles

**Fuels for IC engines**: solid, liquid, gaseous fuels, rating of fuels, alternate fuels

**Fuel systems for SI engines**: Carburetion, principle of carburetion, types of carburettors, Solex carburettor, Carter carburettor, S.U. carburettor, petrol injection

**Fuel systems for CI engines**: Mechanical injection systems, electronic injection systems, ignition

**Combustion and Combustion Chambers**: Combustion in SI engines, abnormal combustion and knock in SI engines, combustion chambers for SI engines, Combustion in CI engines, knocking in CI engines, combustion chambers for CI engines, abnormal combustion in SI and CI engines

UNIT III

**Lubrication**: Lubrication of engine components, lubrication systems, properties of lubricants, additives for lubricants

**Heat transfer and cooling**: theory of engine heat transfer, parameters affecting engine heat transfer, engine cooling systems, liquid-cooled systems, air-cooled systems

**Engine emissions and control**: products of combustion in IC engines, control of pollutants from IC engines, emission standards for IC engines

UNIT IV

Supercharging and turbo-charging, Two-stroke engines, Alternative engines
Performance and Testing: performance parameters, speed measurements, fuel consumption, brake power, friction power, indicator diagram measurements, heat balance sheet, performance comparison of SI and CI engines

Alternative fuels for IC engines.

Approximate total hours: 40 hours

Texts and References

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List of practicals
1. Study of various types of carburetors.
2. Study of fuel systems for CI engines
3. Study of various types of combustion chambers for SI and CI engines.
4. Morse test on multi-cylinder IC engine.
5. Performance test on SI engine.
6. Performance test on CI engine.
8. Performance test on VCR engine
## ME 403T OPTIMIZATION TECHNIQUES

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### UNIT I 09
Introduction: Objective function, constraints, design variables, feasible and infeasible solutions, classification of optimization problems, applications.
Graphical Method: different cases - Feasible and infeasible solutions, redundant constraints, unbound solutions, unique solution.
Classical Optimization techniques: single variable, multivariable optimization techniques

### UNIT II 12
Linear Programming: Problem formulation, simplex method, transportation and assignment problems, PERT and CPM

### UNIT III 09
Unconstrained Optimization Techniques: elimination methods, interpolation methods, direct and indirect search methods

### UNIT IV 09
Constrained Optimization Techniques: Random Search Methods, Methods of Feasible Directions, Penalty Function Methods, Geometric Programming, Dynamic Programming

**Approximate Total: 39Hrs**

### Texts and References
1. S S Rao, Engineering Optimization, New Age International
2. K Deb, Optimization for Engineering Design: Algorithms and Examples, Prentice-Hall of India
6. HTaha, Operation Research –, Pearson Education.
7. A Verma, Operation Research, S.K. Kataria and Sons
8. V Kapoor, Operation Research, Sultan Chand & Sons
ME 405P SEMINAR

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Duration: During VII semester

ME 411T EXPERIMENTAL STRESS ANALYSIS

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UNIT I 12

Strain Measurement Methods: Basic Characteristics of a Strain Gauge, Various types of strain gauges, Types of Shell Gauge, Moire Method of Strain Analysis, Grid Method of Strain Analysis.


Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, experimental procedure and techniques.

UNIT II 09

Brittle Coating Method: Introduction, Coating Stresses, Failure Theories, Brittle Coating Crack Patterns Produced by Direct Loading, refrigeration Techniques, Brittle Coating Crack, Pattern Produced by Releasing the Load, Test procedures for brittle coatings analysis. Birefringent Coatings.

UNIT III 09


UNIT IV 09

Analysis Techniques: Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, separation Techniques.

Three Dimensional Photoelasticity: materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, applications of the Frozen-stress method, the scattered light method.

Approximate Total: 39 Hrs

Texts and References

J.W. Dally and W.F. Riley, Experimental Stress Analysis, MGH.
K. Ramesh, Published by IIT Madras, India, Experimental Stress Analysis.
A Mubin, Khanna Publications, Experimental Stress Analysis.
Sadhu Singh, Khanna Publishers, Experimental Stress Analysis.
ME 412T Science and Technology of welding

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OBJECTIVE: The course aims at imparting comprehensive knowledge on welding processes.

**Unit 1:** Importance of metal joining processes. Classification of welding processes. Fusion welding-joint design and edge preparation, method and selection, nature of heat source, Physic of arc, electrical characteristics of arc, machine characteristics. Metal transfer, force acting on the arc, different mode of metal transfer, heat flow in metals. 10

**Unit 2:** Fusion welding processes; SMAW- function of coating, classification of coating types, application, advantages and disadvantages; Other fusion welding processes; Submerge arc welding process, Gas Tungsten Arc Welding Process, Gas Metal Arc Welding, Plasma Arc Welding process; Basics, application, advantages and disadvantages, pulsed and synergic welding 10


**Unit 3:** Solid state & Beam welding processes; Fundamental principles of solid state welding processes, friction, friction stir, principles of operation, process characteristics and applications.


**Unit 4:** New Development in Fusion welding processes; Activated Flux TIG process, Metal Core Arc Welding, Flux Core Arc Welding. Narrow Gap Welding processes, Hybrid Welding processes; Underwater welding & repair, cladding and surfacing. Weldability of non ferrous systems. Testing of welds and welding defects and significance. Cutting Processes: Gas Cutting, Plasma cutting, Water jet cutting, Laser cutting; welding symbols and welding positions; 10

Approximate Total: 40 Hrs
[1] TEXT BOOKS:


REFERENCES:

ME 413T LUBRICATION

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UNIT I

**LUBRICATION**: Fundamentals, Types of Lubrication, Viscosity and its Types of Lubrication, Types of Bearings, Equations of Continuity and Motion, Hydrodynamics of Simple Configuration.

**SURFACES, FRICTION AND WEAR**: Topography of Surfaces, Surface features, Surface interaction, Theory of Friction, Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials, Friction in extreme conditions, Wear, types of wear, Mechanism of wear, wear resistance materials, Surfacing treatment, Surface modifications, Surface coatings.

UNIT II

**LUBRICATION THEORY**: Lubricants and their physical properties lubricants standards, Lubrication Regimes in Hydrodynamic lubrication, Reynolds Equation, Thermal, inertia and turbulent effects, Elastohydrodynamic (EHD) magneto hydrodynamic lubrication, Hydrostatic lubrication, Gas lubrication, Solid lubrication.

UNIT III

**DESIGN OF FLUID FILM BEARINGS**: Design and performance analysis of thrust and journal bearings, Full, Partial, Fixed and pivoted journal bearings design, Lubricant flow and delivery, Power loss, Heat and temperature of steady and dynamically loaded journal bearings, Special bearings, Hydrostatic Bearing design.

**ROLLING ELEMENT BEARINGS**: Geometry and kinematics, Materials and manufacturing processes, Contact stresses, Hertzian stress equation, Load divisions, Stresses and deflection, Axial loads and rotatational effects, Bearing life capacity and variable loads, ISO standards, Oil films and their effects, Rolling Bearings Failures.

**GEAR LUBRICATION**: Lubrication in transmission, final drive, steering gearbox.

UNIT IV


Texts and References

5. Halling J. (Editor) – “Principles of Tribology “, Macmillian,
7. Neale, M.J., “Tribology Hand Book”, Butterworth Heinemann,
# ME414T COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER

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**UNIT I**

**Fundamentals of Fluid Mechanics and Heat Transfer:** External and Internal Flow, modes of heat transfer, conservation laws, Conservation of mass, Newton’s second law of motion, expanded forms of Navier-Stokes equations, Conservation of energy principle, Special forms of the Navier-Stokes equations, Classification of second order partial differential equations, Initial and boundary conditions, Governing equations in generalized coordinates.

**Introduction to Finite Difference Method and Fundamentals Of CFD:** Finite Difference method, Elementary finite difference quotients, Basic aspects of finite difference equations, Consistency, Explicit and Implicit methods, Errors and stability analysis, Stability of fluid flow modeling, Some nontrivial problems with discretized equations, Applications to heat conduction and convection.

**UNIT II**

**Introduction to Finite Volume Method:** Integral approach, discretization & higher order schemes, Application to complex geometry.

**Introduction to Finite Element Method:** Stiffness matrix, Iso-parametric elements, Formulation of finite elements for flow and heat transfer problems.

**UNIT III**

**Stream Function, Vorticity Methods for Solutions Of Viscous Incompressible Flows:** Two dimensional incompressible viscous flows, Incorporation of upwind scheme, Estimation of discretization error, Application to curvilinear geometries, Derivation of surface pressure and drag.

**Mac-Simple Algorithms Methods to Solve Incompressible Flows and Heat Transfer:** Staggered grid, Solution of the unsteady Navier-Stokes equations, Solutions of energy equation, Formulation of the flow problems, Simple algorithm.

**UNIT IV**

**Grid Generation:** Structured and Unstructured Grids. Algebraic and Elliptic Methods. Examples of O-type, C-type and H-type structured grid generation.

**Computational Heat Conduction in Complex Domains:** Finite Volume Discretization, Implementation Details and Solution Algorithm, Example Problems.

APPROXIMATE TOTAL 39 Hours
Texts and References

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**UNIT I**
Fuels, types of fuels, sources of fuels, properties of fuels, fuel analysis, heating values, proximate analysis and ultimate analysis, alternative fuels

**UNIT II**
Combustion, Combustion stoichiometry and thermodynamics, theoretical and actual combustion process, air-fuel ratio, access air in combustion, heat of formation & heat of combustion,
*Kinetics of combustion*: Mechanism of combustion reactions, flame propagation, flame structure and stability, kinetics of liquid and solid fuel combustion

**UNIT III**
*Combustion appliances*: furnaces, burners, fluidized bed combustion
*Products of combustion*: formation of NOx, SOx, COx, etc. during combustion
*Introduction to pollution*

**UNIT IV**
Pollution and environment, global warming, depletion of ozone layer, health and safety issues, methods for emission and pollution control, use of alternative energy sources

*Approximate total hours: 40*

**TEXT BOOKS and REFERENCES**
4. www.bee.org
# ME 416T ADVANCES IN MEASUREMENT TECHNIQUES

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**UNIT I**
Introduction to industrial automation, data analysis and experimental mechanics. Characterization of mechanical systems with applications both in experimental mechanics and industrial diagnostic, advanced time-frequency analyses, digital transmission techniques in industrial automation and controls, image acquisition and analysis in mechanical measurements.

**UNIT II**
Introduction to Advanced Measurements, definitions and concepts, classification and system components, error analysis, calibration techniques and error reduction, sensing elements, study the transformation of physical quantities to electrical signals, variable resistance sensors, strain gages, temperature sensors, induction sensors, photo sensors, etc., use of computers in measuring techniques, techniques of series and parallel transfer of information, signal conditioning, digital waves, inputs simulation, programming computers for control, study the series and parallel performance of measuring techniques, application of measuring some variables and engineering quantities, force, moment, pressure, temperature, displacement, velocity, acceleration, etc.

**UNIT III**
Introduction to virtual instrumentation, Automatic Test Equipment (ATE) based programmable instrumentation. GPIB (General Purpose Interface Bus) based programmable instrumentation. Introduction to LabVIEW, and Agilent Visual Engineering Environment (Agilent VEE).

**UNIT IV**
Micro-Sensor research in the development of micro-optical sensors for a wide range of aerospace and mechanical engineering applications including temperature, pressure, force, acceleration and concentration. Biomedical Instrumentation and Robotics applications

Approximate Total: 39 Hrs

Texts and References

[8] Agilent Technologies: Getting Started with VEE
ME 417T Solar Photovoltaic Fundamental Technologies and Applications

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ME 415 Solar Photovoltaic Fundamental Technologies and Applications

Unit 1

**Introduction:** Basics of energy, unit conversions, Indian and world energy scenario, environmental concern, importance of renewable energy

**Solar energy:** Solar radiation, Properties of sunlight, Global and diffuse radiation

Unit 2

**Semiconductor properties** such as absorption, generation, recombination, etc., p-n junctions and device physics

Solar cell operation, efficiency limits, losses and measurement

Silicon solar cell technology (thin-film and wafer-based)

Unit 3

**Design:** Design of silicon solar cellsSolar PV Modules and arrays, simple photovoltaic systems, Concept of blocking diode and bypass diode

Unit 4

**Balance of System (BoS):** Calculation of balance of PV inverter systems, MPPT

Economic analysis and environmental aspects of photovoltaic systems

PV in Architecture (BIPV)

References:

1. Solar Energy by S. P. Sukhatme and J. K. Nayak
2. Solar Photovoltaics, Fundamentals, Technologies and Applications, Chetan Singh Solanki, PHI
3. Solar Engineering of Thermal Processes by Duffie and Backman
4. Solar cells: operating principles, technology and system applications by Martin A. Green
# ME 418T VIBRATION ENGINEERING DESIGN

## Teaching Scheme

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## Examination Scheme

**UNIT I 09**
Review of Single degree of undamped, damped and forced vibration
Two degree of freedom system: mode shapes, Eigen values and Eigen vectors, static and dynamic coupling, semi-definite system, Double pendulum, Lagrange method, vibration absorber.

**UNIT II 12**
Multidegree of freedom system: Influence coefficient, general equation of motion in matrix form, Eigen value problem, solution of eigen value problem, matrix method, matrix inversion method, stodola method, holzer’s method

**UNIT III 09**
Continuous systems: equations of motion, end conditions, Longitudinal vibrations of bar, transverse vibrations of beams, torsional vibrations of shafts

**UNIT IV 09**
Vibration control and measurement: Vibration isolators, vibration isolation with rigid and flexible foundations, active vibration control, use of vibration absorbers, vibration pickups, vibration exciters, signal analysis, dynamic testing of machines.

**Approximate Total: 39 Hrs**

**Texts and References**
- G.K. Grover, Mechanical Vibrations, Nemchand& Bros.
- S. Graham Kelley, Fundamental of Mechanical Vibrations, McGraw Hill
- W.I. Thomson, Theory of Vibration with Application Prentice Hall
## ME 420T NEURAL NETWORK, FUZZY SYSTEM AND APPLICATION

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### UNIT I

**12**


### UNIT II

**09**


### UNIT III

**09**

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods. Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

### UNIT IV

**09**

Neural network applications: Process identification, control, fault diagnosis, Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

**Approximate Total: 39Hrs**
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### ME421T Cryogenics

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**UNIT I**

**Introduction to properties** of engineering materials at cryogenic temperatures, mechanical properties, thermal properties, electric & magnetic properties, super conducting materials, thermo electric materials, composite materials, properties of cryogenic fluids, super fluidity of He3 & He 4.

**Cryogenic insulation** – expanded foams, gas filled & fibrous insulation, vacuum insulation, evacuated powder & fibrous insulation, opacified powder insulation, multilayer insulation, comparison of performance of various insulations .

**UNIT II**

**Applications of cryogenic systems:** Super conductive devices such as bearings, motors, cryotrons, magnets, D.C. transformers, tunnel diodes, space technology, space simulation, cryogenics in biology and medicine, food preservation and industrial applications, nuclear propaguls , chemical propaguls.

**Cryogenic Refrigeration System:** Ideal isothermal and reversible isobaric source refrigeration cycles, Joule Thomson system, cascade or pre-cooled joule–Thomson refrigeration systems, expansion engine and cold gas refrigeration systems,

**UNIT III**

**Advanced Cryocoolers:** Philips refrigerators, Importance of regenerator effectiveness for the Philips refrigerators, Gifford single volume refrigerator, Gifford double volume refrigerators analysis, COP, FOM, regenerators, pulse tube refrigerators, various types of pulse tube refrigerator. Refrigerators using solids as working media: Magnetic cooling, magnetic refrigeration systems, thermal; valves, nuclear demagnetization.

**UNIT IV**

**Gas liquefaction systems:** Introduction, thermodynamically ideal systems, Joule Thomson effect, liquefaction systems such as Linde Hampton, precooled LindeHampton, Linde dual pressure, cascade, claude, kapitza, heyland systems using expanders, comparison of liquefaction systems.

**APPROXIMATE TOTAL**  42

**Texts and References**

1. Cryogenic process engineering, Thomas M Flynn, Informa Health Care, 2004
2. Miniature refrigerators for cryogenic sensors and cold electronics, Graham Walker,
4. Cryogenic technology & applications, A R Jha, Butterworth-Heinemann, 2006,
7. Cryogenic systems, R F Barron, Oxford University Press,
8. Cryogenic heat transfer, R F Barron, Taylor & Francis Group
10. Fundamentals Of Cryogenic Engineering, MamataMukhopadhyay, PHI
### ME 409 Industrial Training

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Duration: Six to eight weeks after VI semester  
Examination for Industrial training will be conducted in VII semester.
Mechanical engineering is one of the traditional fields of engineering which has equally played a vital role in the industrialisation of the human race. Essentially, B.Tech in Mechanical Engineering is a four-year full-time course offered at many engineering institutes of the country including the IITs, NITs etc. During the course, mechanical engineering students are trained to develop machine designs, understand their working and development process. Mechanical engineering degree is a 4 years duration course and has 8 semesters. Before you get an admission in any of the engineering colleges in Bangalore for mechanical engineering course; it is vital to know about the B. Tech mechanical engineering... Also mathematics is an integral part of mechanical engineering syllabus. So, before applying for this degree course, make sure you have a good understanding on all these core subjects. Source: Anurag .’s answer to What is the syllabus for a B.Tech in mechanical engineering course in India? 19 views. sGxpikInjoNOVGEnOHCFieldpwoNxroeoxdyryOW gbykyamQ GwPPnaGBfiiDoDsr fhkAMISwmidtStqPcoQZqcx qJvNHielTeoATuGwOTYoUUFrGkdsD.