Bachelor of Technology - Mechanical Engineering

Syllabus - First Semester

INTRODUCTION TO COMPUTERS AND PROGRAMMING IN C

Course Code: MAE2105 **CreditUnits: 03**

Course Objective:
The objective of this course module is to acquaint the students with the basics of computers system, its components, data representation inside computer and to get them familiar with various important features of procedure oriented programming language i.e. C.

Course Contents:

Module I: Introduction
Introduction to computer, history, von-Neumann architecture, memory system (hierarchy, characteristics and types), H/W concepts (I/O Devices), S/W concepts (System S/W & Application S/W, utilities). Data Representation: Number systems, character representation codes, Binary, octal, hexadecimal and their interconversions. Binary arithmetic, floating point arithmetic, signed and unsigned numbers, Memory storage unit.

Module II: Programming in C
History of C, Introduction of C, Basic structure of C program, Concept of variables, constants and data types in C, Operators and expressions: Introduction, arithmetic, relational, Logical, Assignment, Increment and decrement operator, Conditional, bitwise operators, Expressions, Operator precedence and associativity. Managing Input and output Operation, formatting I/O.

Module III: Fundamental Features in C
C Statements, conditional executing using if, else, nesting of if, switch and break Concepts of loops, example of loops in C using for, while and do-while, continue and break. Storage types (automatic, register etc.), predefined processor, Command Line Argument.

Module IV: Arrays and Functions
One dimensional arrays and example of iterative programs using arrays, 2-D arrays Use in matrix computations.
Concept of Sub-programming, functions Example of user defined functions. Function prototype, Return values and their types, calling function, function argument, function with variable number of argument, recursion.

Module V: Advanced features in C
Pointers, relationship between arrays and pointers Argument passing using pointers, Array of pointers. Passing arrays as arguments.
Strings and C string library.
Structure and Union. Defining C structures, Giving values to members, Array of structure, Nested structure, passing strings as arguments.
File Handling.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:

- "ANSI C" by E Balagurusamy
- YashwantKanetkar, "Let us C", BPB Publications, 2nd Edition, 2001.
- Herbert Schildt, "C: The complete reference", Osbourne Mcgraw Hill, 4th Edition, 2002.
- V. Raja Raman, "Computer Programming in C", Prentice Hall of India, 1995.

References:

- ***Kernighan & Ritchie, "C Programming Language", The (Ansi C Version), PHI, 2nd Edition.***
- ***J. B Dixit, "Fundamentals of Computers and Programming in 'C'.***
- P.K. Sinha and Priti Sinha, "Computer Fundamentals", BPB publication.

PROGRAMMING IN C LAB

Course Code:MAE2110 **CreditUnits: 01**

Software Required: Turbo C

Course Contents:

- C program involving problems like finding the nth value of cosine series, Fibonacci series. Etc.
- C programs including user defined function calls
- C programs involving pointers, and solving various problems with the help of those.
- File handling

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Syllabus - Second Semester

OBJECT ORIENTED PROGRAMMING USING C++

Course Code:MAE2203 **CreditUnits: 03**

Course Objective:
The objective of this module is to introduce object oriented programming. To explore and implement the various features of OOP such as inheritance, polymorphism, Exceptional handling using programming language C++. After completing this course student can easily identify the basic difference between the programming approaches like procedural and object oriented.

Course Contents:
Module I: Introduction
Review of C, Difference between C and C++, Procedure Oriented and Object Oriented Approach. Basic Concepts: Objects, classes, Principals like Abstraction, Encapsulation, Inheritance and Polymorphism. Dynamic Binding, Message Passing. Characteristics of Object-Oriented Languages. Introduction to Object-Oriented Modeling techniques (Object, Functional and Dynamic Modeling).

Module II: Classes and Objects
Abstract data types, Object & classes, attributes, methods, C++ class declaration, Local Class and Global Class, State identity and behaviour of an object, Local Object and Global Object, Scope resolution operator, Friend Functions, Inline functions, Constructors and destructors, instantiation of objects, Types of Constructors, Static Class Data, Array of Objects, Constant member functions and Objects, Memory management Operators.

Module III: Inheritance
Inheritance, Types of Inheritance, access modes – public, private & protected, Abstract Classes, Ambiguity resolution using scope resolution operator and Virtual base class, Aggregation, composition vs classification hiérarchies, Overriding inheritance methods, Constructors in derived classes, Nesting of Classes.

Module IV: Polymorphism
Polymorphism, Type of Polymorphism – Compile time and runtime, Function Overloading, Operator Overloading (Unary and Binary) Polymorphism by parameter, Pointer to objects, this pointer, Virtual Functions, pure virtual functions.

Module V: Strings, Files and Exception Handling
Manipulating strings, Streams and files handling, formatted and Unformatted Input output. Exception handling, Generic Programming – function template, class Template Standard Template Library: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, The Container Classes, General Theory of Operation, Vectors.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

Text & References:
Text:
- A.R. Venugopal, Rajkumar, T. Ravishanker "Mastering C++", TMH, 1997
- R. Lafore, "Object Oriented Programming using C++", BPB Publications, 2004.
- "Object Oriented Programming with C++" By E. Balagurusamy.
- Schildt Herbert, "C++: The Complete Reference", Wiley DreamTech, 2005.

References:
- Parasons, "Object Oriented Programming with C++", BPB Publication, 1999.
- Steven C. Lawlor, "The Art of Programming Computer Science with C++", Vikas Publication, 2002.
- YashwantKanethkar, "Object Oriented Programming using C++", BPB, 2004

OBJECT ORIENTED PROGRAMMING USING C++ LAB

Course Code:MAE2206 **CreditUnits: 01**

Software Required: Turbo C++

Course Contents:

- Creation of objects in programs and solving problems through them.
- Different use of private, public member variables and functions and friend functions.
- Use of constructors and destructors.
- Operator overloading
- Use of inheritance in and accessing objects of different derived classes.
- Polymorphism and virtual functions (using pointers).
- File handling.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab

Syllabus - Third Semester

KIMEMATICS OF MACHINE

Course Code:MAE2301 **CreditUnits: 04**

Course Contents:

Module-I: Introduction
Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanism, Grubler's equation, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain
Velocity in Mechanisms
Velocity of point in mechanism, relative velocity method, Velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, Rubbing velocity at a pin joint, Instantaneous center method, Types & location of instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism

Module-II: Acceleration in Mechanisms
Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Crank and slotted lever mechanism, Klein's construction for Slider Crank mechanism and Four Bar mechanism, Analytical method for slider crank mechanism
Mechanisms with Lower Pairs
Pantograph, Exact straight line motion mechanisms-Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms–Grass-Hopper, Watt and Tchebicheff mechanisms, Analysis of Hooke's joint, Davis and Ackermann steering gear mechanisms.

Module-III: FRICTION
Laws of friction, Friction on inclined plane, Efficiency on inclined plane, Friction in journal bearing-friction circle, Pivots and collar friction-uniform pressure and uniform wear, Belt and pulley drive, Length of open and cross belt drive, Ratio of driving tensions for flat belt drive, centrifugal tension, condition for maximum power transmission, V belt drive
Brakes & Dynamometers
Shoe brake, Band brake, Band and Block brake, Absorption and transmission type dynamometers

Module-IV: CAMS
Cams and Followers - Classification & terminology, Cam profile by graphical methods with knife edge and radial roller follower for uniform velocity, simple harmonic and parabolic motion of followers, Analytical methods of cam design – tangent cam with roller follower and circular cams with flat faced follower

Module-V: Gears & Gear Trains
Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, Length of path of contact, contact ratio, interference & under cutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, Sun and planet gear.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Books and References:

- Theory of Machines - Thomas Bevan
- Theory of Machines and Mechanisms- Shigley
- Theory of Machines and Mechanisms-Ghosh & Mallik
- Theory of Machines and Mechanisms- Rao &Dukkipati
- Theory of Machines-S.S. Rattan
- Kinematics of Machines-Dr. Sadhu singh
- Mechanics of Machines – V. Ramamurti
- Theory of Machines – Khurmi& Gupta
- Theory of Machines – R. K. Bansal
- Theory of Machines – V. P. Singh
- Theory of Machines – Malhotra & Gupta

MATERIAL SCIENCE AND METALLURGY

Course Code:MAE2303 **CreditUnits: 03**

Course Objective:
Metallurgy and Materials deal with the structure and properties of all materials, which have engineering applications. Metallurgists and Materials Engineers are responsible for designing, producing, examining and testing materials as diverse as metallic engineering alloys, semiconductors and superconductors, ceramics, plastics and composites. This course will help students understand the properties of different types of materials and their applications.

Course Contents:

Module I
Atomic structure of metals crystal structure, crystal lattice of (i) Body centered cubic (ii) face centered cubic (iii) closed packed hexagonal, crystallographic notation of atomic planes, polymorphism and allotropy, solidification of crystallization (i) nuclear formation (crystal growth) (ii) crystal imperfection Elementary treatment of theories of plastic deformation, phenomenon of slip twinning, dislocation, identification of crystallographic possible slip planes and direction in FCC, BCC, C.P., recovery, re-crystallization, preferred orientation causes and effects on the property of metals.

Module II
Introduction to Engineering materials, their mechanical behaviour, testing and manufacturing properties of materials, physical properties of materials, classification of engineering materials.

Module III
General principles of phase transformation in alloys, phase rule and equilibrium diagrams, Equilibrium diagrams of Binary system in which the components form a mechanical mixture of crystals in the solid state and are completely mutually soluble in both liquid state. Equilibrium diagrams of a systems whose components have complete mutual solubility in the liquid state and limited solubility in the solid state in which the solid state solubility deceases with temperature. Equilibrium diagram of alloys whose components have complete mutual solubility in the liquid state and limited solubility in solid state (Alloy with a peritectic transformation) Equilibrium diagrams of a system whose components are subject to allotropic change. Iron carbon equilibrium diagram. Phase transformation in the iron carbon diagram (i) Formation of Austenite (ii) Transformation of austenite into pearlite (iii) Martensite transformation in steel, time temperature transformation curves.

Module IV
Principles and applications of heat treatment processes viz. annealing, normalizing hardening, tempering; harden ability & its measurement, surface hardening processes. Defects in heat treatment and their remedies; effects produced by alloying elements on the structures and properties of steel. Distribution of alloying elements (Si, Mn. Ni. Cr. Mo. TL. Al) in steel.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:

- V. Raghavan, "Material Science & Engineering", Prentice Hall India Ltd., 2001.

- Shackelford, J.F. and Muralidhara, M.K., Introduction to Material Science for Engineers (6/e), Pearson Education, 2007
- S.K. Hazra Chaudhuri, "Material Science & Processes", Indian Book Publishers, Calcutta, 1983.
- R.B. Gupta, "Material Science Processes", Satya Prakashan, New Delhi, 2000.

References:

- Degarmo E. Paul et.al, "Materials & Processes in Manufacture", Prentice Hall India, New Delhi, 2001.
- Raymond A Higgim., "Engineering Metallurgy Part 1", Prentice Hall India, New Delhi, 1998.
- L. Krishna Reddi, "Principles of Engineering Metallurgy", New Age Publication, New Delhi, 2001.
- Buduisky et al, "Engineering Materials & Properties", Prentice Hall India, New Delhi, 2004.
- Peter Haasten, "Physical Metallurgy", Cambridge Univ. Press, 1996.

APPLIED THERMODYNAMICS

Course Code:MAE2311 **CreditUnits: 03**

Course Objective:
Objective of this course is to impart in depth understanding of the principles of thermodynamics and heat transfer. This course also helps students understand the application of basic fluid mechanics, thermodynamic, and heat transfer principles and techniques, including the use of empirical data, to the analysis of representative fluid and thermal energy components and systems encountered in the practice of electrical, electronic, industrial, and related disciplines of engineering.

Course Contents:
Module I:Basic concepts
Thermodynamic system, intensive and extensive properties, cyclic process, Zeroth Law of Thermodynamics, Work and heat, Flow work

Module II: First Law of Thermodynamics
Mechanical equivalent of heat, internal energy, Analysis of non-flow system, flow process and control volume, steady flow, energy equation, flow processes

Module III: Second Law of Thermodynamics and Entropy
Heat Engine, heat pump, Kelvin Planck and Clausius statement of Second Law of Thermodynamics, Perpetual motion machine, Reversible cycle- Carnot Cycle, Clausius inequality, entropy, Principle of entropy increase, concepts of availability, irreversibility.

Module IV: Air-Cycles
Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Erricsson cycle, Brayton cycle; Reversed Carnot cycle.

Module V: Properties of Steam
Use of steam tables, wet steam, superheat steam, different processes of vapour, Mollier Diagram.

Module VI: Reciprocating Air compressors
Single stage compressor, Isothermal efficiency, adiabatic efficiency, clearance volume, volumetric efficiency, and multi-stage compression with intercooling.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
Text:
- P.K. Nag, "Engineering Thermodynamics", Tata McGraw Hill
- Incropera, "Engineering Thermodynamics", John Willy

References:
- Engel, T. and Reid, P., Thermodynamics, Statistical Thermodynamics & Kinetics, Pearson Education, 2006
- Cengel& Boles, "Thermodynamics", Tata McGraw Hill.
- Sonntag/Vanhylene, Fundamentals of Thermodynamics, Wiley
- Rahul Gupta, Engineering Thermodynamics, Asian Books P. Ltd.
- Y.V.C. Rao, Engineering Thermodynamics, Khanna Publications
- Onkar Singh, Applied Thermodynamics, New Age Publications.
- DhomkundwarKothandaraman, "A Cou

STRENGTH OF MATERIALS-I

Course Code:MAE2312 **CreditUnits: 04**

Course Objective:
The objective of this course is to make the students understand the concept of stress and strain in different types of structure/machine under different loading conditions. The course also covers the simple and compound stresses due to forces, stresses and deflection in beams due to bending, torsion in circular section, strain energy, different theories of failure, stress in thin cylinder thick cylinder and spheres due to external and internal pressure.

Course Contents:

Module I: Simple stresses and strains
Concept of stress and strain; Hooke's law, Young's modulus, Poisson ratio, stress at a point, stress and strains in bars subjected to axial loading. Modulus of elasticity, stress produced in compound bars subject to axial loading. Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound walls.

Module II: Compound stress and strains
The two dimensional system; stress at a point on a plane, principal stresses and principal planes; Mohr's circle of stress. Graphical and Analytical methods for stresses on oblique section of body. Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams.

Module III: Bending Stress
Theory of bending stresses in beams due to bending, assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel sections, composite / flitched beams, bending and shear stresses in composite beams.

Module IV: Torsion
Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts torsional rigidity, combined torsion and bending of circular shafts principal stress and maximum shear stresses under combined loading of bending and torsion, analysis of close-coiled-helical springs.

Module V: Thin cylinders and spheres
Derivation of formulae and calculation of hoop stress, longitudinal stress in a cylinder and sphere subjected to internal pressure.

Module VI: Columns and struts
Columns and failure of columns, Euler's formulas; Rankine-Gordon's formula, Johnson's empirical formula for axially loaded columns and their applications.

Module VII: Slope and deflection
Relationship between moment, slope and deflection, Mohr's theorem; Moment area method; method of integration; Macaulay's method: Use of all these methods to calculate slope and deflection for the following:
a) Cantilevers
b) Simply supported beams with or without overhang
c) Under concentrated loads, uniformly distributed loads or combination of concentrated and uniformly distributed loads

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:

- Jindal U.C., "Strength of Materials", Galgotia Publication, New Delhi, 1998.
- Ryder G.H., "Strength of Materials", Macmillan, Delhi, 2003.
- R.K. Bansal, "Strength of Materials", Laxmi Publication, New Delhi, 2001.

References:

- Sadhu Singh, "Strength of Materials", Khanna Publishers, New Delhi, 2000.
- Timoshenko S.P., "Elements of Strength of Materials", East-West affiliated, New Delhi, 2000.
- Hibbler R.C., "Mechanics of Materials", Prentice Hall, New Delhi, 1994.
- Popov Eger P., "Engg. Mechanics of solids", Prentice Hall, New Delhi, 1998.
- Fenner, Roger. T, "Mechanics of Solids", U.K. B.C. Publication, New Delhi, 1990.
- Srinath L.S. et.al. "Strength of Materials", McMillan, New Delhi,2001.

MACHINE DRAWING LAB

Course Code:MAE2306 **CreditUnits: 01**

Course Contents:

Free-Hand Sketching & Shaft Scale Drawing
Components like cotter joint, knuckle joint; rivets and riveted joints; couplings; flywheels, pulleys, bush bearings, Engine parts. Isometric views from Orthographic Projections of Machine Components.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Text & References:

- Pohit, G and Gosh, G., Machine Drawing with Auto CAD, Pearson Education, 2007
- PS Gill, Machine Drawing, S. Chand.
- ND Bhatt, Machine Drawing, Charotar publications
- N Sidheshwar, Machine Drawing , Tata McGraw Hill
- CL Tanta, Mechanical Drawing , "Dhanpat Rai"

KINEMATICS OF MACHINE LAB

Course Code:MAE2307 **CreditUnits: 01**

1. To study inversion of 3 R-IP Kinematics chain
2. To study inversions of 2R-2P Kinematics Chain
3. To carry out computer implementable kinematics analysis of 4 R mechanisms
4. To carry out computer implementable kinematics analysis of slider bar mechanism
5. To study gear box, clutch and differential gear
6. To find coefficient of friction for clutch plate
7. To determine gear ratio for an epicyclical gear train and verify it by analytical method
8. To study different types of Cam follower systems
9. To determine moment of inertia of the given object using of Trifler suspension.
10. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
11. To find coefficient of friction between belt and pulley.
12. To study various types of gears – Helical, cross helical, worm, bevel gear.
13. To study the different types of brakes and dynamometers.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

STRENGTH OF MATERIALSLAB-I

Course Code:MAE2313 **CreditUnits: 01**

List of Experiments:

1. Universal Testing Machine
2. Tensile Test (MS)
3. Double Shear Test (MS)
4. Compression Test (CI)
5. BrinellHardness No.
6. Izod Impact
7. Testing Machine
8. Rockwell Hardness Tester
9. Spring Stiffness (Spring Compression Testing machine)
10. Torsion testing machine

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

RENEWABLE ENERGY & ENERGY MANAGEMENT

Course Code:MAE2314 **CreditUnits: 03**

Course Objective:
Current Energy Scenario, Principles of renewable energy, fundamentals, scientific principles of renewable energy, technical implications, social implications.

Course Contents:

Module-I: Solar Energy
Solar radiation: Extraterrestrial solar radiation, components of radiation, geometry of earth and sun, geometry of collector and solar beam, measurements of solar radiations, Solar water heating system, solar air heaters, solar concentrators

Module-II: Energy from Oceans
Principles of Ocean thermal energy conversion, Principles of Geothermal energy conversion, suitable sites and criteria, Advantages and disadvantages.

Module-III: Energy from Wind
Basic principles of wind energy conversion; design of windmills; wind data and energy estimation site selection considerations.

Module-IV: Energy from Water
Classification of small hydro power (SHP) stations; description of basic civil works design considerations turbines and generators for SHP; advantages and limitations.

Module-V: Energy from Earth
Origin and nature of geothermal energy; classification of geothermal resources: schematic of geothermal power plants

Module-VI: Energy Management
The relevance of energy management profession, general principles of energy management and energy management planning.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

References

- 'Renewable energy resources: John W Tidwell and Anthony D Weir.
- Renewable energy engineering and technology-edited by V. V.N. Kishore
- 'Non-conventional sources of energy'. G.D. Rai. Khanna Publishers,2000.
- 'Solar energy utilization' G.D. Rai Khanna Publishers 2000.
- 'Renewable and novel energy sources' S.L.Sah. M.I. Publications, 1995.
- 'Energy Technology'. S.Rao and B.B. Parulekar. Khanna Publishers, 1999

ERGONOMICS

Course Code:MAE2315 **CreditUnits: 03**

Course Objective: To explain the general principles those governthe interaction of humans and their working environment for improving worker performance and safety.

Module-I: INTRODUCTION Brief history of human factors Engineering/Ergonomics, Interdisciplinary nature, Principles of Human factors Engineering, Biostatic and Biodynamic Mechanics,Human Machine Systems – interfaces.

Module-II: HUMAN PERFORMANCE Factors influencing performance, Information receiving and processing, Information theory and its application, Human response and errors, Signal detection theory,Posture and Body Mechanics: Muscle Functioning, Spine, Musculoskeletal problems in Sitting and Standing.

Module-III: PHYSIOLOGICAL ASPECTS OF HUMAN AT WORK Metabolism, Physiological factors involved in muscular activity, Measurement of energy expenditure, Quantitative work load analysis , Physical work capacity and its evaluation , Physiological fatigue, Work and rest schedules, Physical fitness tests.

Module-IV: WORK PLACE DESIGN Problems of body size, Anthropometry measures, Work posture, Work space layout and work station design , Design of displays, controls and VDT work stations, Hand tool design, Illumination.

Module-V: OCCUPATIONAL HEALTH AND SAFETY Industrial accidents, Personnel Protective devices, Safety Management practices, Effect of Environment – heat, cold & noise, NIOSH regulations and Factories Act, Legal and Safety Aspects.

OUTCOMES: The Student should apply ergonomic principles to design workplaces for the improvement of human performance and implement latest occupational health and safety to the work place.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

TEXT BOOKS:

- Bridger, R.S., "Introduction to Ergonomics", McGraw Hill, 1995.
- Martin Helander, "A guide to Ergonomics of Manufacturing", TMH, 2006.

REFERENCES:

- Mecormik, T.J., "Human Factors Engineering", TMH, 1990.
- John Grimaldi, "Safety Management", A.I.B.S., 5th Edition, Hazard Control Technology 2003
- Philips, Chandler A, "Human Factors Engineering", John Wiley and Sons, Inc. 2000
- M. S. Sanders and Ernest J. McCormick, "Human Factors Engineering and Design", McGraw-Hill Inc.
- E. Grad jean, "Fitting Task to the Man" Taylor and Francis.
- The Factories Act, 1948.

SOLAR ENERGY

Course Code:MAE2316 **CreditUnits: 03**

Course Objectives

The course provides introduction to solar energy based systems.The course also provides the understanding of generation of power from solar insolation and power generation through solar photovoltaics and solar thermal etc. The components of power generation via solar photovoltaics and solar thermal routes and their performance characteristics will also be covered.

Course Contents

Module-I: Introduction

Current Energy Scenario, Principles of renewable energy, fundamentals, scientific principles of renewable energy, technical implications, social implications.

Module-II: Solar Radiations

Solar radiation: Extra-terrestrial solar radiation, components of radiation, geometry of earth and sun, geometry of collector and solar beam, measurements of solar radiations, Solar water heating system, solar air heaters, solar concentrators

Module-III: Solar Energy

Solar thermal power and it's conversion, Solar collectors, Flat plate collector, Performance analysis of flat plate collector,

Module-IV: Solar concentrating collectors,

Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing.

Module-V: Solar Thermal Energy Storage

Solar thermal energy storage, Different systems, Solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, Solar pumping, Solar cooking, Greenhouses, Solar power plants.

Module-VI: Solar Photovoltaic Systems

Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- 'Renewable energy resources: John W Tidwell and Anthony D Weir.
- Renewable energy engineering and technology-edited by V. V.N. Kishore
- 'Non-conventional sources of energy'. G.D. Rai. Khanna Publishers,2000.
- 'Solar energy utilization' G.D. Rai Khanna Publishers 2000.
- 'Renewable and novel energy sources' S.L.Sah. M.I. Publications, 1995.
- 'Energy Technology'. S.Rao and B.B. Parulekar. Khanna Publishers, 1999
- Solar Photovoltaics, Chentan Singh Solanki, PHI Publications, 2009

Syllabus - Fourth Semester

DYNAMICS OF MACHINES

Course Code:MAE2401 **CreditUnits: 04**

Course Contents:

Module I

Static Force Analysis: Static force analysis of planer mechanisms, Free body diagrams, dynamic force analysis including inertia and frictional forces of planer mechanisms

Inertia forces: D-Alembert's Principle, Velocity and acceleration of piston, Torque exerted on the crank shaft when friction and inertia of moving parts are neglected, Forces on the reciprocating parts of an engine considering friction and inertia of moving parts, Turning moment on crank shaft, Dynamically equivalent system, Torque exerted on the crank shaft, considering the weight of the connecting rod.

Module-II

Balancing of rotating masses: Balancing of single rotating mass, Balancing of several masses rotating in the same plane, Balancing of several masses rotating in different planes.

Balancing of reciprocating masses: Balancing of reciprocating engine, Partial balancing of primary force, Partial balancing of locomotives, Variation of tractive force, swaying couple, hammer blow, coupled locomotive, primary balance of multi-cylinder inline engine, Secondary balance of multi-cylinder in line engines, Method of direct and reverse cranks, V-engines balancing.

Module-III

Governors: Types of Governor, Watt Governor, Porter governor, Proell Governor, Hartnell Governor, Wilson-Hartnell governor, Sensitivity, Stability, Isochronism, Hunting, Governor Effort and Power, controlling force

Module-IV

Gyroscopic effect and Gyroscope: Spinning and precession, gyroscopic couple, Effect of gyroscopic couple on the stability of automotive vehicles: Stability of four wheelers, Stability of two wheelers, Gyroscopic effects on ships and aero planes.

Module-V

Vibration: Vibration analysis of SDOF systems, natural, damped, forced vibrations, base-excited vibrations, transmissibility ratio

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- PL Ballaney, Theory of Machines,
- Hams Crone and Roggers, Theory of Machines
- Shigley, Theory of Machines
- J. Lal, Theory of Machines
- SS Rattan, Theory of Machines
- Ghosh and Mallick, Mechanisms and Machines, EWP publication.
- R.S. Khurmi, Theory of Machine, S. Chand.

THEORY OF METAL FORMING

Course Code:MAE2403 **CreditUnits: 03**

Course Objective:
The objective of this course is to introduce the fundamentals of basic manufacturing processes (solidification process, heat treatment, deformation processes, material removal processes, and joining processes). The students are expected to be able to select, analyze and design basic manufacturing processes for product development.

Course Contents:
Module I: Introduction
Review of tensile test, True stress and true strain, Yielding criteria for ductile metals, Yield locus, Plastic stress-strain relations-Levymises equation, prandtl-Reuss equations.

Module II: Plastic deformation
Crystal Geometry, Lattice defects, Deformation by slip, Shear Stress required to cause slip in a perfect Crystal, Deformation by twinning, Fracture, Types of Fracture, Creep Failure.

Module III: Introduction to metal working
Classification of metal working processes-Cold working, Hot working, Effect of variables on metal working processes, Methods of Analysis of metal working processes.

Module IV: Forging
Classification of Forging Processes, Forging equipment, Open die forging, Closed die forging, Load calculation in Plane strain forging, Forging defects.

Module V: Rolling
Rolling Mills, Hot rolling, Cold rolling, Forces and Geometrical Relationships in Rolling, Rolling load & torque, rolling defects.

Module VI: Extrusion
Methods of Extrusion, Hot Extrusion, Cold Extrusion, Analysis of Extrusion processes, Effect of Variables on Extrusion pressure, Extrusion defects.

Module VII: Sheet metal forming
Forming Methods, Forming Operations-Shearing, Blanking, Bending, Stretch Forming, Deep Drawing, Stresses developed in Deep Drawing, Defects in Formed Parts.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
- Mechanical Metallurgy by George E. Dieter: Mc Graw-Hill Book Company
- Metal working by Surinder Kumar, Dhanpat Rai & Sons

MANUFACTURING PROCESSES

Course Code:MAE2411 **CreditUnits: 03**

Course Objective:
This is a new developmental graduate course for students interested in learning how to design, analyze and build specialty manufacturing process machines. It anticipated that this course would become part of the new manufacturing emphasis area in mechanical engineering.

Course Contents:

Module I: Introduction to Machine Tools
Classification of machine tools, kinds of motion in machine tool operations, definition of cutting speed, feed and depth of cut.

Module II: Lathe
Classification and various parts of Lathe, specification, Description of important mechanism viz. apron, tail stock, head stock, work holding, devices and operations, e.g. taper, turning, eccentric turning and screw-cutting, Geometry of a single point cutting tool. Calculation of machining time, Capstan and turret lathe

Module III:Drilling Machine
Geometry and nomenclature of a twist drill, specification and classification of drilling machines, cutting speed, feed, depth of cut and calculation machining time in drilling, tool holding devices, different types of operations performed on a drilling machine.

Module IV:Milling Machine
Classification, up milling and down milling, dividing Head, different types of operations – simple, compound and differential indexing, slab milling, spiral milling, slot milling, T-slot milling and end milling.

Module V:Shaper, Slotter& Planner
Principal part of a shaper, classification, Quick Return mechanism, table feed mechanism of a shaper, Operations, e.g. horizontal, vertical and inclined shaping, difference between a shaper, planer and slotter, cutting speed, feed, and depth of cut and calculation of machining time in shaping.

Module VI:Grinding Machines
Construction and specification of a grinding wheel, wheel turning and dressing, Grinding machines surface, cylindrical and center less grinding.

Module VII:Special Machines
Horizontal and vertical boring machines, Gear Geometry, Gear generation and hobbing; Lapping, honing and super finishing processes.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
Text:

- P.N. Rao, "Manufacturing Technology: Metal Cutting & Machine Tools", Tata McGraw Hill, Delhi, 2004.
- B.S. Raghuwanshi, "Workshop Technology", Vol.2, Dhanpat Rai & Sons, 2003.
- HazraChandhari S.K., "Elements of Workshop Technology", Vol.2, Media Promoters, 2003.

References:

- P.C. Sharma, “A Text Book of Production. Engineering”, S. Chand, New Delhi, 2004.
- Bawa H.S., “Workshop Technology”, Vol.2, Tata McGraw Hill, 2004.
- Juneja&Shekhon, “Fundamental of Metal Cutting”, New Age Publications
- S.F. KrarStevan F. and Check A.F., “Technology of M/C Tools”, McGraw Hill Book Co., 1986.
- Kibbe Richard et al, “M/c Tool practices”, Prentice HallIndia, 2003.
- Bangalore HMT, “Production Technology”, Tata McGraw Hill, 1980.
- R.K. Jain, “Production Technology”, Khanna Publishers
- Gerling Heinrich, “All about Machine Tools”, New Age Publication, 2003.

STRENGTH OF MATERIALS-II

Course Code:MAE2412 **CreditUnits: 04**

Course Contents:

Module-I: Energy Methods: Definitions, expressions for strain energy stored in a body whenload is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy ofbeams in bending, beam deflections, strain energy of shafts in twisting, energymethods in determining spring deflection, Castigliano's& Maxwell's theorems.Numericals.

Module-II: Theories of Elastic Failure: Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

Module-III: Springs: Stresses and Deflection of springs by energy method, helical springsunder axial load and under axial twist axial load and twisting moment actingsimultaneously both for open and closed coiled springs, leafsprings.

Module-IV: Thin Pressure Vessels: Hoop & Longitudinal stresses & strains incylindrical& spherical vessels & their derivations under internal pressure.

Module-V: Thick Pressure Vessels: Derivation of Lame's equations, radial & hoop stresses and strains in thick andcompound cylinders shells subjected to internal fluid pressure. Numericals.

Module-VI: Rotating Rings & Discs: Stresses in uniform rotating rings & discs, rotating discsof uniform strength, stresses in rotating cylinders, hollow cylinders &solidscylinders. Numericals.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text Books:

1. Strength of Materials – G.H.Ryder, Third Edition in SI Units 1969 Macmillan, India.
2. Mechanics of Materials – (Metric Edition): Ferdinand P. Beer and E. Russel Johnston,Jr.Second Edition, McGraw Hill.
3. Strength of Material- Sadhu Singh- Khanna Publisher.

Reference Books:

1. Book of Solid Mechanics – Kazmi, Tata McGraw Hill
2. Strength of Materials – D.S. Bedi - S. Chand & Co. Ltd.
3. Advanced Mechanics of Solids and Structures – N. Krishan Raju and D.R.Gururaje-Narosa Publishing House.

Web Links:

1. http://nptel.ac.in/courses/112101095/
2. https://www.youtube.com/watch?v=jZRomCtVLHU
3. https://www.youtube.com/watch?v=1Ycn81U72G0

FLUID MECHANICS

Course Code:MAE2413 **CreditUnits: 04**

Course Objective:
The objective of Fluid Mechanics subject is that students should understand the, properties of fluids, pressure measurement devices, hydraulic forces on surfaces, bouncy and flotation in fluids, kinematics and static behaviour of fluids, dimension and model analysis, laminar and turbulent flow, flow through pipes and orifices, boundary layer theory.

Course Contents:

Module I: Fluid Properties and Fluid Statics
Newtonian and Non-Newtonian Fluids; Viscosity; Incompressible and compressible fluids, compressibility. Forces on plane surfaces, forces on curved surfaces, buoyant forces, and stability of floating bodies, metacentre and metacentre height.

Module II: Kinematics of Fluid Motion
Steady and unsteady flow; uniform and non-uniform flow; Laminar and turbulent flow; streamline, path line and streak line; continuity equation, irrotational and rotational flow, velocity potential and stream function, vortex flow, free and forced vortex.

Module III: Dynamics of Fluid Flow
Euler's equation of motion and its integration to yield Bernoulli's equation, its practical applications – Pilot tube, Venturi meter; steady flow momentum equation, force exerted on a pipe bend.

Module IV: Dimensional Analysis and Principles of Similarity
Buckingham π-Theorem and its applications, Geometric, Kinematics and Dynamic similarity; Dimensionless numbers-Reynolds, Froude, Euler, Mach, Weber Number and their significance.

Module V: Laminar and Turbulent Flow
Reynold's experiment, critical velocity, steady laminar flow through a circular tube, flow between parallel plates. Transition from laminar to turbulent flow, courses of turbulence, velocity distribution law near a solid boundary, velocity distribution in rough pipes, Hazen – Williams's formula.

Module VI: Analysis of Pipe Flow
Energy losses, minor losses in pipe lines, concept of equivalent length, flow between two reservoirs, and multiple pipe systems – in series and parallel, siphon.

Module VII: Flow Measurements
Measurement of flow using Venturi meter, orifice meter, Pitot tube, measurement of flow in open channels – rectangular, triangular, trapezoidal weir, Cipoeletti weir.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:

- R.K. Bansal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publications (P) Ltd., 2002.
- Gupta, S. C., Fluid Mechanics and Hydraulic Machines, Pearson Education, 2007
- D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", S.K. Kataria & Sons, 2000.

References:

- F. M. White, Introduction to Fluid Mechanics, McGraw Hill
- I.H. Shames, “Mechanics of Fluids”, Tata McGraw Hill
- Douglas, J. F., Gasiorek, J.M. and Swaffield, J., Fluid Mechanics, Pearson Education, 4/e, 2006
- V.L. Streeter and E.B. Wylie, “Fluid Mechanics”, Tata McGraw Hill
- Massey B S, Mechanics of Fluids, Van Nostrand Reinhold Co

DYNAMICS OF MACHINES LAB

Course Code:MAE2405 **CreditUnits: 01**

List of Experiments:

1. To study gyroscopic effects through models
2. To determine gyroscopic couple on Motorized Gyroscope.
3. To determine and verify the whirling speed of a shaft-disc system
4. To determine the damping factor for a given horizontal vibration set up
5. To perform experiment on Watt and Porter Governors to prepare performance characteristic Curves, and to find stability & sensitivity.
6. To perform experiment on Proell Governor to prepare performance characteristic curves, and to find stability & sensitivity.
7. To perform experiment on Hartnell Governor to prepare performance characteristic Curves, and to find stability & sensitivity.
8. To perform the experiment for static balancing on static balancing machine.
9. To perform the experiment for dynamic balancing on dynamic balancing machine.
10. To determine mass moment of inertia of a flywheel.
11. To perform wheel balancing
12. To plot pressure distribution curves on a journal bearing

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

MANUFACTURING PROCESSES LAB

Course Code:MAE2414 **CreditUnits: 01**

Course Contents:

1. Operations on the Lathe Machine.
2. Operations on the Shaper Machine.
3. Operations on the Planner Machine.
4. Operations on the Drilling Machine.
5. Operations on the Grinding Machine.
6. Operations on the Milling Machine.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

FLUID MECHANICS LAB

Course Code:MAE2415 **CreditUnits: 01**

FLUID MECHANICS LAB

1.Verification of Bernoulli's Theorem

2.Experiment using Venturimeter

3.Determination of coefficient of Discharge C_d, C_c, $C_!$ Using

4.Circular/triangular/rectangular orifice

5.To find major head losses in a pipe line

6.To find minor head losses in a pipe line (sudden expansion/contraction/bend)

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

NUMERICAL ANALYSIS AND PROGRAMMING

Course Code:MAE2408 **CreditUnits: 02**

Course Objective:
This course deals with the techniques of numerical analysis, which gives the solution to applied problem when ordinary analytical method fails. Emphasis is given on computer programming also so that the given techniques can be used in design of engineering and scientific problems.

Course Contents:

Module I: Solution of Algebraic and Transcendental Equation
Error in a series approximation, Bisection Method, Iteration method, Method of false position, Newton-Raphson method
Solutions of Simultaneous equation
Gauss elimination method, Jacobi iteration method, Gauss Seidal method

Module II: Interpolation
Finite Differences, Difference tables
Polynomial Interpolation**:** Newton's forward and backward formula
Central Difference Formulae: Gauss forward and backward formula.
Interpolation with unequal intervals: Lagrange's Interpolation, Newton Divided difference formula

Module III: Numerical Integration and Differentiation
Introduction, Numerical differentiation Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rules.

Module IV: Solution of differential Equations
Euler's Method, Runga-Kutta Methods.

Module V: Statistical Computation
Frequency chart, Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves etc, Data fitting with Cubic splines.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
Text:
- Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education
- Gerald &Whealey, "Applied Numerical Analyses", AW
- Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Int.
- Grewal B S, "Numerical methods in Engineering and Science", Khanna Publishers, Delhi

References:
- T Veerarajan, T Ramachandran, "Theory and Problems in Numerical Methods, TMH
- PradipNiyogi, "Numerical Analysis and Algorithms", TMH
- Francis Scheld, " Numerical Analysis", TMH
- Sastry S. S, "Introductory Methods of Numerical Analysis", Pearson Education.
- Gupta C.B., Vijay Gupta, "Introduction to Statistical Methods", Vikas Publishing.
- Goyal, M, "Computer Based Numerical and Statistical Techniques", Firewall Media, New Delhi.

NUMERICAL ANALYSIS & PROGRAMMING LAB

Course Code:MAE2409 **CreditUnits: 01**

Software Required: Turbo C/C++

Course Contents:

Assignments will be provided for the following:

1. Analysis of various numerical and statistical techniques

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

GAS TURBINES

Course Code:MAE2416 **CreditUnits: 03**

Course Objective: To explain the theory of a simple ideal gas turbine cycle and the methods which help in the improvement of the efficiency and net work output.

Course Contents:

Module-I: Introduction
Air standard cycles, assumptions of air standard cycles, general aspects of gas turbine, classification of gas turbine, gas turbine vs. reciprocating IC engines, gas turbine vs. steam turbines

Module-II: Types of Gas Turbines
Constant pressure combustion gas turbines, open cycle gas turbine, closed cycle gas turbine, closed cycle gas turbine plant vs. open cycle gas turbine plant, constant volume combustion gas turbines, advantages and disadvantages

Module-III: Simple gas turbine cycles
Theory of a simple ideal gas turbine cycle, efficiency of air standard gas turbine cycle, variation of efficiency with pressure ratio, optimum pressure ratio, maximum pressure ratio, isentropic efficiency of compressor and turbine

Module-IV: Methods improving thermal efficiency of gas turbine plant
Regenerative gas turbine cycle, reheat gas turbine cycle, gas turbine cycle with intercooling, gas turbine cycle with reheat and regeneration,Real gas turbine cycles

Module-V: Pollution from gas turbine emissions
Gas turbine combustion chamber, types of combustion chambers, description of a typical combustion chamber, performance of combustion chamber, pollution aspects, automotive gas turbines

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text Books:

- Internal Combustion Engines –V. Ganesan, Pub.-Tata McGraw-Hill.
- Gas Turbines - V. Ganesan, Pub. - Tata McGraw Hill.
- Engineering fundamental of the I.C.Engine – Willard W. Pulkrabek Pub.-PHI,India
- Internal combustion Engines – R.K.Rajput, Laxmi Publications

Reference Books:

- Internal Combustion Engines & Air pollution- Obert E.F, Pub.-Hopper & Row Pub., New York
- Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, New York
- Fundamentals of Internal Combustion Engines-H.N. Gupta, PHI, New Delhi

ELECTRICAL MACHINE

Course Code:MAE2417 **CreditUnits: 02**

Course Objective:
Electrical Machines provides the backbone for successful and uninterrupted smooth functioning of any industry. Knowledge of this subject in any engineering branch is vital in process industry. The course covers the machines e.g. Motors & generators characteristics and classifications related to mechanical & automation as well as recent development engineering applications. Successful completion of this course will be very helpful for the students who wish to join challenging industry.

Course Contents:

Module I
Introduction to Subject, Some important fundamentals, Electrical Power generation, Utilization & distribution facts & figures. Simple Loop Generator, D C Machines, Construction Features, Principle of Operation.

Module II
DC Generator Analysis & DC Motor, Classification & Characteristics & Analysis. Speed Torque Characteristics, Speed control of D C Motor. Application of D C Motor. Starters.

Module III
A C Machines, 3 phase IM, Revolving Magnetic field theory, IM as a transformer, Equivalent Circuit. 3 phase Synchronous Machines, Synchronous Motor, Synchronous Generator, EquivalentCkt.

Module IV
Single phase Induction Motor, Double Revolving Field theory, Different types of 3 phase IM. Characteristics & typical Applications. Fractional Kilo Watt Hour Motor, Stepper Motor, Hysterisis Motor, A C Series Motors, Universal Motors.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:
- I J Nagrath & D P Kothari. "Electrical Machines". TMH
- Irvin Kosow, "Electrical Machines & Transformers", PHI.

References:
- B L Theraja "Electrical Engineering".

ELECTRICAL MACHINE LAB

Course Code: MAE2418 **Credit Units: 01**

Course Contents:

S. NO.	NAME OF THE EXPERIMENTS
1.	Speed Control of DC Shunt Motor
2.	To obtain magnetization characteristics of 1) Separately excited DC Generator 2) Shunt Generator
3.	To obtain the load characteristics 1) DC Shunt Motor 2) Cumulative Compound generator
4.	To conduct Swinburne Test on a DC. Shunt Motor and hence obtain its efficiency at full load.
5.	To perform No Load Test and blocked rotor test on a three phase Induction motor and hence determine its equivalent circuit parameters.
6.	To perform load test on a three phase Induction Motor and obtain its various performance characteristics.
7.	Retardation Test on a three phase induction motor and calculate its moment of inertia.
8.	To perform No Load and Blocked Rotor Test on a single phase Induction motor and hence determine its equivalent circuit parameters.
9.	To perform open circuit and short circuit test on a three phase alternator and hence determine its voltage regulation by synchronous Impedance Method.
10.	To obtain V curves of a three phase synchronous motor at no load.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Syllabus - Fifth Semester

MACHINE DESIGN-I

Course Code:MAE2501 **CreditUnits: 03**

Course Objective:
The objective of this course is to help students apply concepts learned in the mechanics, structure, material and manufacturing courses. This course offers working knowledge in the use of proper failure theories under steady and variable loading, design of mechanical elements, such as shaft, coupling, power screws, and detachable, permanent and welded connections.

Course Contents:

Module I:Variable stresses in Machine Parts
Fatigue and Endurance Limit, Factor of Safety for Fatigue Loading, Stress concentration, Notch sensitivity, Gerber Method, Goodman Method and Soderberg Method for combination of stresses.

Module II: Power Screws
Types of screw threads, Torque required to raise and lower the load, Efficiency of square threaded screw, overhauling and self locking screw, stresses in power screw, design of screw jeck.

Module III: Cotter and Knuckle Joints
Types of cotter joints, design of socket and spigot joint, design of sleeve and cotter joint, design of jib and cotter joint, Design procedure of Knuckle joint.

Module IV: Riveted and Welded Joint
Types of Riveted joint, Lap joint , Butt Joint, Caulking and Fullering, Failure of Riveted joint, Strength of Riveted joint, Efficiency of Riveted joint. Advantages and Disadvantages of welded joint over Riveted joint, Strength of Fillet joint, strength of Butt joints.

Module V: Keys and Couplings
Types of Keys, Splines, Strength of Sunk Key, types of shaft coupling, Sleeve and muff coupling, Flange coupling, Flexible coupling, Oldham coupling, Universal coupling.

Module VI: Drives
Types of Belt drives, Flat Belt drives, Velocity ratio, Sleep, Creep of Belt, Length of open Belt, length of cross belt, power transmission by belt, Maximum tesion in the belt. Types of V belt and Pulleys, advantages and disadvantages of V belt over Flat Belt, Ratio of Driving tensions for V belt, Rope drives. Chain drives, advantages and disadvantages of Chain drives.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
- J.E. Shigley, Mechanical Engineering Design.
- Sadhu Singh, Machine Design
- R.S. Khurmi& J.K. Gupta, Machine design
- D.K. Aggarwal & P.C. Sharma, Machine Design

HEAT&MASS TRANSFER

Course Code:MAE2502 **CreditUnits: 04**

Course Objective:
The main objective of the course to understand the behaviour of thermal systems. To illustrate the development of the governing differential, algebraic and finite difference equations associated with thermal systems. To introduce the possible methods of solution to the governing equation. To investigate the influences of boundary and initial conditions and system parameters on the resulting steady or transient response of the system. To provide the basic tools those are used in thermal system design. To expose students to heat transfer applications in industry.

Course Contents:

Module I
One-dimensional steady-state conduction through homogeneous and composite plane walls, cylinders and spheres, critical thickness of insulation; heat transfer from fins of uniform cross section.

Module II
Concept of hydrodynamic and thermal boundary layers, momentum and energy equation for boundary layers on a flat plate application of dimensional analysis to free and force convection; important dimensionless number.

Module III
Thermal radiation; Kirchoff's law; Planck's distribution law, Wien's displacement law; Stefan-Boltzmann's relation, Configuration factors; radiant interchange between black and grey surfaces; radiation shielding solar radiation.

Module IV
Combined heat transfer analysis; overall heat transfer co-efficient; types of heat exchangers; LMTD methods of heat exchanger design; simple heat exchanger calculations.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- Incropera, F.P. and DeWitt, D.P. (2002). Fundamentals of Heat and Mass Transfer, John Willy & Sons, New York, NY.
- Nag, P.K. (2002). Heat and Mass Transfer, TMH.
- John R.Howell&Richrd O Buckius, Fundamentals of Engg. Thermodynamics, McGraw Hill International.
- Holman, J.P. (1997). Heat Transfer, 9th edition, McGraw-Hill.
- Mills, A.F. (1999). Basic Heat and Mass Transfer. Prentice-Hall.
- Thirumaleshwar, M. (2006). Fundamentals of Heat and Mass Transfer, Pearson education.
- Ghoshdastidar, P.S. (2004). Heat Transfer. Oxford University Press.
- Arora, Domkundwar, S. and Domkundwar, A. (1988). A Course in Heat & Mass Transfer, Dhanpat Rai & Co.

METROLOGY

Course Code:MAE2551 **CreditUnits: 03**

Course Objective:
The main objective of this course is to give the student: a basic understanding of the physical loss governing metrology and tolerance design. Gain and appreciation for the capabilities and applications of metrology through hands own experiences.

Course Contents:

Module I: Principles of measurement
Definition of Metrology, difference between precision and accuracy. Sources of errors: Controllable and Random Errors, Effects of Environment and Temperature, Effects of support, alignment errors.
Length Standards: Line standards, end standards and wavelength standards, transfer from line standards to end standards. Numerical based on line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges.
Limits, fits and tolerances: Various definitions, different types of fits and methods to provide these fits. Numerical to calculate the limits, fits and tolerances, ISO system of limits and fits; Gauges and its types, limit gauges – plug and ring gauges. Gauge Design – Taylor's Principle, wear allowance on gauges.

Module II: Comparators
Principles and working of Mechanical, Electrical, Optical and Pneumatic Comparators.
Angular Measurement: Sine Bar – different types of sine bars, use of sine bars in conjunction with slip gauges, Use of angle gauges, spirit level, errors in use of sine bars. Numericals. Principle and working of autocollimator.

Module III: Straightness and flatness
Definition of Straightness and Flatness error. Numericals based on determination of straightness error of straight edge with the help of spirit level and auto collimator
Screw Thread Measurement: Errors in threads, Measurement of elements of screw threads –major diameter, minor diameter, pitch, flank angle and effective diameter (Two and three wire methods). Effect of errors in pitch and flank angles
Gear Measurement: Measurement of tooth thickness – Gear tooth vernier caliper, Constant chord method, base tangent method and derivation of mathematical formulae for each method. Parkinson Gear Tester.

Module IV
Machine Tool Alignment: Machine tool tests and alignment tests on lathe. Alignment tests on milling machine. Alignment tests on a radial drilling machine, Interferometry.
Surface texture: Introduction, types of irregularities, Elements of surface
Texture, Measurement of surface finish, Examination of surface Roughness.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
Text:
- R.K. Jain, "Engineering Metrology", Khanna Publishers, Delhi
- I.C. Gupta, "Engineering Metrology", Dhanpat Rai Publications, Delhi

References:
- F.W. Galyer& C.R. Shotbolt, "Metrology for Engineers", ELBS edition.

MACHINE DESIGN LAB-I

Course Code:MAE2504 **CreditUnits: 01**

Course Contents:

Design of:
(i) Cotter Joint
(ii) Knuckle Joint
(iii) Pipe Joint
(iv) Screw Jack
(v) Rigid and Flexible coupling
(vi) Spur Gear Train

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

METROLOGY LAB

Course Code:MAE2505 **CreditUnits: 01**

Course Contents:

Name of Experiments:

1 Set up a dimension by slip gauges (example 36.936; 14.727…..) Measure this set up by micrometer (least count 0.01) several times and read dimensions. Find statistical mean and record the expected variation between the actual dimension and dimension measured by micrometer.
2 To check the roundness of a circular bar with the help of dial gauge.
3 Mill a component to dimension (23, 57.6,…). Set up a comparator by slip gauge set to this dimension. Check component deviation by the comparator and record the deviation. Measure several times and obtain the mean value.
4 Check the bore in a component by a bore-indicator. Set the bore indicator by micrometer and measure the deviation in the bore. Measure several times and obtain the mean value at three positions along the length of the bore.
5 Set – up a sine bar for measuring the angle of an inclined surface (of a bracket, milling cutter arbor with 7/24 taper, ….). Measure the angle several times and record the mean value. Use height gauge wherever necessary.
6 Check angular dimension of a dovetail guide way by measuring across rollers.
Check the included angle of a V – block (90º, 60º, …) / or a machined groove by measuring over a roller using height gauge and parallel blocks/slip gauges.
7 Measure the straightness of a surface (surface plate; guide way of machine tool) by using straight edge and dial gauge and dial gauge stand. Set up straight edge on jacks such that dial reading at each end coincide. Move the dial stand along the straight edge. Record readings at 50 mm interval and draw a plot. Obtain maximum deviation which is the straightness.
8 Measure straightness using a spirit level. Place spirit level at an initial position and note level reading. Move the level on a straight line and take readings at 50 mm intervals. Plot the difference from the original reading and obtain the straightness value.
9 Draw a trapezoidal and any other profile in AutoCAD to 1:1 scale. On a steel plate make the profile by fitting and filing. Set up the drawing on profile projector. Check the component and note deviations. Correct the profile and recheck. Make the profile as close to the required one.
10 To machine a given surface and study its roughness characteristics
11 To measure the geometry of a screw using profile projector
12 To study the cutting tool geometry using tool makers microscope

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

HEAT & MASS TRANSFER LAB

Course Code:MAE2507 **CreditUnits: 01**

Experiments to be Performed (Minimum 10 Numbers)

1. To Determine Thermal Conductivity of Insulating Powders.
2. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
3. To Measure the thermal Conductivity of Liquid.
4. To determine the transfer Rate and Temperature Distribution for a Pin Fin.
5. To Measure the Emissivity of the Test plate Surface.
6. To Determine Stefan Boltzmann Constant of Radiation Heat Transfer.
7. To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection.
8. Determination of Heat Transfer Coefficient in Drop Wise and Film Wise condensation.
9. To Determine Critical Heat Flux in Saturated Pool Boiling.
10. To Study Performance of Simple Heat Pipes.
11. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
12. To Find the Heat transfer Coefficient in Forced Convection in a tube.
13. To determine the total thermal conductivity and thermal resistance of the given compound resistance in
series.
14. To find out the thermal conductivity of given slab material.
15. To determine the individual thermal conductivity of different lagging in a lagged pipe.
16. To study the rates of heat transfer for different materials and geometries
17. To understand the importance and validity of engineering assumptions through the lumped heat capacity
method.
18. Testing and performance of different heat insulators.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

SUMMER INTERNSHIP EVALUATION-I

Course Code:MAE2535 **CreditUnits: 03**

Objective:

There are certain phases of every Intern's professional development that cannot be effectively taught in the academic environment. These facets can only be learned through direct, on-the-job experience working with successful professionals and experts in the field. The internship program can best be described as an attempt to institutionalize efforts to bridge the gap between the professional world and the academic institutions. Entire effort in internship is in terms of extending the program of education and evaluation beyond the classroom of a university or institution. The educational process in the internship course seeks out and focuses attention on many latent attributes, which do not surface in the normal classroom situations. These attributes are intellectual ability, professional judgment and decision-making ability, inter-disciplinary approach, skills for data handling, ability in written and oral presentation, sense of responsibility etc.

Guidelines

In order to achieve these objectives:

- **Each student will be allotted a supervisor** for proper guidance.
- **Student will first submit details of company, external guide, project title to coordinator/supervisor as per given schedule.**
- For internal assessment purpose, students will submit an industry feedback and a progress report.
- Student will maintain a file (**Internship File/Project Report**) which he/she will submit after completion of internship. **Further, coordinator will provide NTCC project guidelines and sample to help in preparation of file.** The Internship File aims to encourage students to keep a personal record of their learning and achievement throughout the Programme. It can be used as the basis for lifelong learning and for job applications. Items can be drawn from activities completed in the course modules and from the workplace to demonstrate learning and personal development. The File will assess the student's analytical skills and ability to present supportive evidence, whilst demonstrating understanding of their organization, its needs and their own personal contribution to the organization.

The **layout guidelines** for the Project Report

1. File should be in the following specification

- A4 size paper
- Spiral Binding
- **Font**

For normal text Font Type and Size must be- Times New Roman, 12 pt. The minimum font size of materials within a table or a figure can be 10 point.

- **Margins**

A margin of 3.75 cm (1½ inch) is to be given on the binding edge while on the other sides it is to be 2.5 cm (1 inch). The text of the report, including headings, figures, tables, and notes, but excluding page numbers, must be accommodated within the page area.

- **Line Spacing**

The line spacing in the main text must be between one-and-a-half (1.5). Single line spacing should be given for figure captions, table titles, figure legends, and footnotes. Equations, tables, figures, and quotations should be set off from the main text with adequate space (not less than the normal line spacing adopted for the main text). Two consecutive paragraphs should be separated by a spacing which must be larger than the line spacing adopted for the text.

- **Tables and Figures**

Each sketch, drawing, graph and photograph should have a figure number and title below the figure etc. Numbering should be sequential, chapter wise. For instance, if there are 24 figures chapter 3 spread over all of its sections the figure numbers run from Figure 3.1 through Figure 3.24. In figures experimental data should typically be represented by centered symbols, and theoretical data by continuous curves.

Each table should have a table number and caption above the table. Numbering should be sequential, chapter wise, as in the case of Figure numbers. For instance, if there are 18 tables in chapter 3 the table numbers run from Figure 3.1 through Figure 3.18.

Make sure that figures and tables are complete in other respects such as legends, references (if any) and coordinate labels with units. Each figure and table must be explicitly referred to in the text and located where its first reference occurs, preferably after the reference.

- **Drawings**

All engineering drawings must conform to relevant Standards and should include a title block. If drawings are large they should be included at the back of the report in a separate pocket. In case drawings are made using CAD packages, a CD ROM should be included which contains all the files and details of the packages used.

- **Equations**

The numbering of equations should be sequential, chapter wise. Numbered equations must be explicitly referred to in the text.

2. Report Size: The maximum number of pages of the Report should be preferably between 50-80 pages.

3. Report Layout: The report should contain the following components
Front Page
Declaration
Student Certificate (University)
Certificate (Company)
Acknowledgement
Abstract
Contents
List of Figures
List of Tables
Company Profile (optional)
Chapters
Appendices(optional)
References / Bibliography

The above components are described below:
1. **The Title Page**-- Format will be given by coordinator/supervisor.
2. **Declaration by the Students-**This is page number (i), the beginning of the small case Roman numeral page numbers. The student has to give a declaration to the effect that the data used for the work, the work depicted in the report, and the written material contained in the report are not copied from others and that due permission has been taken from, and due credit has been given to, the sources whenever they are used.
3. Certificate-This is page number (ii). It is given by the Institute. The certificate will be signed by the Faculty Supervisor(s) before the viva-voce after verifying the format and by the Head of the Department after review with the Supervisor(s).
4. Company Certificate: This is a certificate, which the company gives to the students.

5. Contents-This is page number (iii). The table of Contents should be titled just Contents (not Table of Contents). Try to fit it into one or two pages.
6. Acknowledgement-This is page number (iv). Keep this brief and avoid using informal language. This page must be signed by the candidate.
7. Abstract and **Keywords-**This is page number (v). The abstract (preferably one page) should contain the context/relevance of the problem at hand, a description of what was done and a gist of the significant observations/results.
The keywords (maximum 6) are a hint that what is contained in the report.
8. Company Profile: A Company Profile corresponds to a file with company-specific data. Company data can be stored there and included in a booking when needed.
9. **Chapters**—Introduction, Literature Review/Background Study etc. as given by coordinator/supervisor.
10. **References / Bibliography** --This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

ASSESSMENT OF THE INTERNSHIP FILE

Continuous Internal Assessment consists of topic relevance, progress report and industry feedback on company letterhead. Final Assessment includes viva, presentation, execution and report marks.

Examination Scheme:

Components	**IF**	**PR**	**R**	**E**	**V**	**FP**
Weightage (%)	20	20	15	15	15	15

V – Viva, IF – Industry Feedback, FP – Final Presentation, R – Report, PR-Progress Report, E-Execution

OPTIMIZATION TECHNIQUES

Course Code:MAE2508 **CreditUnits: 03**

Course Contents:

Introduction& history of optimization, Clasification& application of optimization technique. Classical optimization techniques for unconstrained optimization. Karush-Kuhn-Tucker conditions. Sensitivity analysis for linear programming problems. Non-linear programming. Penalty function methods. Sequential linear programming. Feasible direction methods. Quadratic programming. Geometric programming. Integer programming.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Books:-

- Engineering Optimization: Theory and Practice By Singiresu S. Rao , John Wiley Publication
- Optimization Concepts and Applications in Engineering by Ashok D. Belegundu, Tirupathi R. Chandrupatla, Cambridge University Press, 2011
- Theory and Techniques of Optimization for Practicing Engineers by Raymond L. Zahradnik , Barnes & Noble, 1971

OPERATIONS RESEARCH

Course Code:MAE2511 **CreditUnits: 03**

Course Objective:
In a rapidly changing environment an understanding is sought which will facilitate the choice and the implementation of more effective solutions, which, typically, may involve complex interactions among people, materials and money. Organizations may seek a very wide range of operational improvements - for example, greater efficiency, better customer service, higher quality or lower cost. Whatever the business, engineering aim, Operation Research can offer the flexibility and adaptability to provide objective help. This course introduces students to the principles of operational research.

Course Contents:

Module I: Linear Programming
Formulation of problem. Graphical and simplex method for maximization and minimization. Duality theory and sensitivity analysis

Module II:Transportation Models
Stepping stone algorithm, MODI method and Vogel's Approximation Method (VAM) for selfing balanced, unbalanced transportation problems and problems of degeneracy and maximization.

Module III:Assignment Models
Assignment model for maximization and traveling salesman problems, Industrial Problems

Module IV:Queuing Theory
Basic structured, Terminology, classification. Birth and death process. Sequencing: Processing in jobs through machines with the same processing order. Processing of 2 jobs through machines with each having different processing order.

Module V:Network Models
Introduction to PERT and CPM. Fundamental concept of Network models and construction of network diagrams. PERT activity, time estimate. Critical path and project time duration. Probability of completing the project on or before specified time. Float of a activity.

Module VI:Games Theory
Zero Sum two person competitive games, Minimax and maximini principle Arithmetic, algebraic, matrix algebra method,. Solution by dominance, sub game, Graphical and linear programming method.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
- HM Wagner, Principles of Operations Research, Prentice Hall
- Heizer, J. & Render B., Operations Management, Pearson Education (8/e), 2006
- PK Gupta and DS Hira, Operations Research, S. Chand & Co.
- Taha, Introduction to Operation Research
- F.S. Hiller and G.I. Libermann, Introduction to Operation Research, Holden Ray.

ADVANCED THERMODYNAMICS

Course Code:MAE2512 **CreditUnits: 03**

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

Course Contents:

Module-I: Preliminaries and the Zeroth-Law of Thermodynamics
Basic Concepts: Macroscopic and Microscopic Approaches, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property – Intensive and Extensive, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasi-static, Reversible and Irreversible Processes, Working Substance. Concept of Thermodynamic Work and Heat, Equality of Temperature, Zeroth Law of Thermodynamic and its utility, Problems.

Module-II: First-Law of Thermodynamics
First Law of Thermodynamics: Energy and its Forms, Energy and 1^{st} law of Thermodynamics, Internal Energy and Enthalpy, PMMFK, Steady flow energy equation, 1^{st} Law Applied to Non- flow process, Steady Flow Process and Transient Flow Process, Throttling Process and Free Expansion Process. Problems.

Module-III: Second Law of Thermodynamics
Second Law of Thermodynamics: Limitations of First Law, Thermal Reservoir, Heat Source and Heat Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and their Equivalence, PMMSK. Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump, Carnot Theorem and its Corollaries, Thermodynamic Temperature Scale. Entropy, Clausius Inequality, Principle of Entropy Increase, Temperature Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of Thermodynamics. Problems.

Module-IV: Availability & Irreversibility
Availability and Irreversibility: High and Low Grade Energy, Availability and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Dead state of a system, Availability of a Non-Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb's Functions,Irreversibility

Module-V: Thermodynamic Properties of Pure Substances
Pure Substance: Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling, Saturated and Superheat Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots During Steam Formation, Properties of Dry, Wet and Superheated Steam, Property Changes During Steam Processes, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam. Problems.

Module-VI: Gas Vapor Mixtures
Ideal and Real Gases: Concept of an Ideal Gas, Basic Gas Laws, Characteristic Gas Equation, Avogadro's law and Universal Gas Constant, P-V-T surface of an Ideal Gas. Vander Waal's Equation of state, Mixture of Gases, Mass, Mole and Volume Fraction

Module-VII: Thermodynamic Relations
Thermodynamic Relations: Maxwell Relations, Clapeyron Equation, Relations for changes in Enthalpy and Internal Energy & Entropy, Specific Heat Capacity Relations, Joule Thomson coefficient & inversion curve.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text Books:

- **Thermodynamics: an Engineering Approach**, Y.A.Cengal and M.A.Boles, McGraw Hill (Fifth edition).
- Engineering Thermodynamics – Jones and Dugan, PHI, New Delhi.
- Fundamentals of Engineering Thermodynamics – E. Radhakrishnan, PHI, NewDelhi.

Reference Books:

- Theory and Problems of Thermodynamics – Y. V.C. Rao, Wiley Eastern Ltd., New Delhi.
- Engineering Thermodynamics – C P Arora, Tata McGraw Hill
- Basics of Mechanical Engineering – Vineet Jain, Dhanpat Rai Publication
- Engineering Thermodynamics – P K Nag, Tata McGraw Hill

Syllabus - Sixth Semester

MACHINE DESIGN-II

Course Code:MAE2602 **CreditUnits: 03**

Course Objective:
The course aims at developing concepts as to how to analyze mechanical systems and select proper machine elements (bearing, gears, belts, chains). It prepares the students how to design machine element by specifying their type, geometry, material and how to integrate these elements to build a mechanical systems.

Course Contents:

Module I:Mechanical Drives
Selection of transmission, helical, bevel and worm gears, belt and chain drives.

Module II:Friction Clutches & Brakes
Common friction materials, shoe, band, cone and disc brake their characteristics and design, friction clutches.

Module III:Bearings and Lubrication
Types of sliding bearing, materials, type of lubrication, design of sliding bearing, selection and application of rolling bearing, seals.

Module IV
Design of spring, helical spring, Leaf spring

Module V: Engine parts
Piston, connecting rod and crankshaft.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
Text:
- Maleeve Hartman and O.P. Grover, "Machine Design", CBS Publication & Publishers.
- V.B Bhandari, "Machine Design", Tata McGraw Hill.
- P.C. Sharma and D.K Aggarwal., "Machine Design", S.K. Kataria & Sons.

References:
- Mahadevan, "Design Data Book", CBS Publication & Publisher

FLUID MACHINES

Course Code:MAE2611 **CreditUnits: 03**

Course Objective:
Fluid power systems cover generation, transmission, and control applications of power by using pressurized fluids. This course imparts the knowledge of different fluid power systems (pneumatic and hydraulic) which are used in industries and hydropower plants.

Course Contents:

Module I:Introduction
Euler's equations for turbo machines; impulse and reaction forces due to fluid systems on stationery and moving system of vanes; jet propulsion.

Module II:WaterTurbines
Classification: Pelton, Francis, Propeller and Kaplan turbines; velocity triangles; efficiency; draft tubes, governing.

Module III: Pumps
Centrifugal pumps, velocity triangles, efficiency, turbine pumps, axial and mixed flow pumps.

Module IV: Performance of Fluid Machines
Similarity laws applied to rotodynamic machines; specific speed, unit quantities; characteristic curves; use of models; cavitations and attendant problems in turbo machines; selection of turbines hydroelectric plants.

Module V: HydraulicPower Transmission
Transmission of hydraulic power through pipe lines; water hammer; precautions against water hammer in turbine and pump installations: hydraulic ram.

Module VI: PowerHydraulics
Positive pumps: gear, vane, screw, pump, variable delivery valves: flow control, pressure control, direction control, solenoid operated valve, hydraulic circuits, fluid coupling and torque converter.
Pneumatic Power: Basic principles, comparison of pneumatic and hydraulic Systems.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
Text:

- Gupta, S. C., Fluid Mechanics and Hydraulic Machines, Pearson Education, 2007
- R.K. Bansal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publications (P) Ltd., 2002.

References:

- Dr. D.S. Kumar, "Fluid Mechanics & Fluid Power Engineering", S.K. Kataria& Sons,2001
- D.R. Malhotra & N.K. Malhotra, "The Fluid Mech. & Hydraulics", Satya Prakashan, 2001
- V.P. Gupta, Alam Singh, Manish Gupta, "Fluid Mechanics, Fluid Mechanics & Hydraulics", CBS Publishers; 1999.

INTERNAL COMBUSTION ENGINES

Course Code:MAE2612 **CreditUnits: 03**

Course Objective:
This course provides an in-depth knowledge of the functioning of IC Engine & Gas Turbine, and also deals with the combustion techniques used for various fuels. This course finds immense application in automobile industry and gas-operated power plants.

Course Contents:

Module I: Fundamentals
Development of IC engine, Classification, Working Cycles, Indicator diagram, comparison of SI Engine and CI Engine, two stroke and four-stroke engine, Valve timing diagram of SI and CI engine.

Module II: Air Standard Cycle
Assumptions in air standard cycle & fuel-air cycle, fuel-air cycle calculations, factors influencing fuel-air cycle, effects of variable specific heats, dissociation.

Module III: Fuel and Combustion
Combustion of SI engine, ignition limits, normal combustion, abnormal combustion, effect of engine Variable in ignition lag, spark advance and factors affecting ignition timing, pre-ignition, theory, and factors affecting detonation, PN, HUCR. Combustion in CI engine, fundamentals ofcombustion process in Diesel engine, delay period, diesel knock, and cold starting of CI engine. IC engine Fuel, combustion equations, theoretical air and excess air, stoichiometric air fuel ratio, desirable Properties of good IC engine fuels knock rating of SI engine fuel.

Module IV: Performance & Testing
Testing and performance of IC engine, performance parameters, basic measurement, engine Performance curve, fuel consumption, load outputs, engine power, heat balance.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:
- Ganesan, V. Internal Combustion Engine, Tata McGraw-Hill.
- Mathur, M.L. and Sharma, R.P. Internal Combustion Engine. Dhanpat Rai Publication
- Vladimir Leonidas Maleev. Internal-combustion Engines, Theory and Design. McGraw-Hill.

References:
- Lester Clyde Lichty, Robert Leroy Streeter. Internal Combustion Engines, McGraw-Hill
- Wallace Ludwig Lind. Internal-combustion Engines: Their Principles and Applications to Automobile, Aircraft, Ginn.
- Edward Frederic Obert, Burgess Hill Jennings, Internal Combustion Engines: Analysis and Practice
- Joseph Albert Polson. Internal Combustion Engines, Chapman & Hall, limited
- Rolla Clinton Carpenter, Herman Diederichs. Internal Combustion Engines, Their Theory Construction and Operation. Van Nostrand companies
- John Benjamin Heywood. Internal Combustion Engine Fundamentals. McGraw-Hill

MACHINE DESIGN LAB-II

Course Code:MAE2604 **CreditUnits: 01**

Course Contents:
Design and drawing based upon the course Machine Design II such as automotive transmission, brakes, clutches connecting rod, I.C. engine piston, connecting rod, hydraulic rivet, mechanical hoist etc.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

FLUID MACHINES LAB

Course Code:MAE2613 **CreditUnits: 01**

Course Contents:

Name of Experiments:

1. To conduct a test on Centrifugal Pump and plot its characteristics
2. To Plot the characteristics of Pelton turbine.
3. To conducts an experiment on Francis turbine.
4. To study the effect of a draft tube on reaction turbines.
5. To find the friction factor for flow through pipes
6. To study the hydraulic controls rig.
7. To conduct an experiment for verifying model laws.
8. To study the cavitations phenomenon in turbines.
9. Study of hydraulic couplings and torque converters.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

INTERNAL COMBUSTION ENGINES LAB

Course Code:MAE2614 **CreditUnits: 01**

LIST OF EXPERIMENTS

S.No.	Name of the Experiment
1.	To study the constructional details & working principles of two-stroke petrol/ four-stroke petrol Engine.
2.	To study the constructional details & working principles of two-stroke Diesel / four-stroke Diesel Engine.
3.	Analysis of exhausts gases from single-cylinder/ multi- cylinder/ petrol engine by Orsat apparatus.
4.	To prepare heat balance sheet on multi-cylinder diesel engine / petrol engine.
5.	To find the indicated horse power (IHP) on multi-cylinder diesel engine / petrol engine by Morse test.
6.	To prepare variable speed performance test of a multi- cylinder /single-cylinder petrol engine / diesel engine and prepare the curve (i) bhp, ihp, fhpVs Speed (ii) Volumetric efficiency & indicated specific fuel consumption VsSpeed.
7.	To find fhp of multi cylinder diesel engine / petrol engine by Willian's Line Method &MotoringMethod.
8.	To perform constant speed performance test on a single- cylinder/ multi-cylinder diesel engine & draw curves of (i) bhp Vs fuel rate, air rate and A/F and (ii) bhp Vs mep, mechanical efficiency &s.f.c.
9.	To study and determine the effect of A/F ratio on the performance of the two stroke, single – cylinder petrol engine.
10.	To study and draw the valve timing diagram four stroke, single – cylinder diesel engine.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

VIBRATION ENGINEERING

Course Code:MAE2615 **CreditUnits: 02**

Course Contents

Module-I: Scope of Vibration: Important terminology and classification, Degrees of freedom, Harmonic motion, vectorialrepresentation, complex number representation, addition, Derivation of equation of motion for one dimensionallongitudinal, transverse and torsional vibrations without damping using Newton's second law, D' Alembert'sprinciple and Principle of conservation of energy, Compound pendulum and centre of percussion, Dampedvibrations of single degree of freedom systems, Viscous damping, underdamped, critically damped andoverdamped systems, Logarithmic decrement, Vibration characteristics of Coulomb damped and Hystereticdamped systems.

Module-II: Forced Vibrations of Single Degree of Freedom Systems: Forced vibration with constant harmonicexcitation, Steady state and transient parts, Frequency response curves and phase angle plot, Forced vibrationdue to excitation of support.

Module-III: Vibration Isolation and Transmissibility: Force transmissibility, Motion transmissibility, Forced vibration with rotating and reciprocating unbalance, Materials used in vibration isolation.

Module-IV: System with Two Degrees of Freedom: principle mode of vibration, Mode shapes, Undamped forcedvibrations of two degrees of freedom system with harmonic excitation, Vibration Absorber, Undamped dynamicvibration absorber and centrifugal pendulum absorber

Module-V: Many Degrees of Freedom Systems: exact analysis.
Many Degrees of Freedom Systems: approximate methods, Rayleigh's, Dunkerley's, Stodola's and Holzer's methods, Vibrations of continuous systems, Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft.

Examination Scheme:

Components	**A**	**CT**	**S/V/Q**	**HA**	**EE**
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

List of Recommended Books

- Mechanical Vibrations, Rao S.S., Pearson Education.
- Mechanical Vibrations and Noise Engineering, Ambekar A.G., Prentice Hall India.
- Mechanical Vibrations, Grover G.K., Nem Chand and Brothers.
- Theory of Vibrations with Applicaion, Thomson and Dahleh, Pearson Education.
- Elements of Vibration Analysis, Leonard Meirovitch, Tata McGraw-Hill, New Delhi.
- Principles of Vibration, Benson H.Tongue, Oxford Publcation

VIBRATION ENGINEERING LAB

Course Code:MAE2616 **CreditUnits: 01**

List of Experiments

To perform any 8 of the following experiments:

1. To find the viscosity of the given fluid using the concept of vibrations.
2. To determine the co-efficient of friction between two materials using the method vibrations and also draw a graph between the co-efficient of friction and the speed of the rollers.
3. Investigation of the node and anti-node position for the cantilever.
4. Investigation of the node and anti-node position for simply supported beam.
5. Investigation of the node and anti-node position for a fixed end beam.
6. Determine experimentally the load on a beam with different end conditions and compare it with actual load and discuss the results.
7. Test the given structure for its vibrational stability.
8. Determine experimentally the spring stiffness and dampers required structure to a specific degree from the given vibrating body and test it experimentally.
9. To determine experimentally the whirling speed of shaft for a given system.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

COMPUTER INTEGRATED MANUFACTURING SYSTEM

Course Code:MAE2608 **CreditUnits: 02**

Course Contents

Module-I:
Evolving manufacturing environment, New competitive challenges, Evolving Role of Information Technology

Module-II:
CIM Systems: Flexibility, Integration and Automation Opportunities, Automation of information and manufacturing systems, Automation strategies, Towards Flexible Automation,

Module-III:
Islands of automation, Evolution Towards CIM systems, Computer based integration between various functions- manufacturing, sales, design, materials etc

Module-IV:
Flexible Manufacturing Systems (FMS) as mini CIM,Computer Integrated Production Management, ERP, Group technology,

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

COMPUTER INTEGRATED MANUFACTURING SYSTEMS LAB

Course Code:MAE2617 **CreditUnits: 01**

Course Objectives

The objective of this course is to

1. To equip the students about the computer integration in manufacturing.
2. To provide sound knowledge of CIMS, FMS, GT and ERP.

List of experiments

1. To study Computer Integrated Manufacturing System(CIMS) and its importance in manufacturing environment.
2. To study a CIM model of any industry.
3. Introduction to CAD software's.
4. Introduction to CAM software's.
5. To study Computer aided process planning (CAPP) with suitable example.
6. To describe Computer aided quality control.
7. To study Flexible manufacturing system (FMS).
8. To study flexibility in FMS and its measurements.
9. To study Group Technology(GT)with suitable example.
10. To study part family forming using different method in GT.
11. Do an exercise of Part Coding onGroup Technology.
12. Study of Enterprise resource planning (ERP) and its applications.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Text & References:

Text:

- Mikell P. Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", 2nd Edition, Pentice Hall, 2001.
- Rao, Kundra& Tiwari, "Computer aided Manufacturing" Tata McGraw Hill, 2007.
- Numerical Control: by Koren, Khanna Publisher.

References:

- Mikell P. Groover, Emory W. Zimmers, "CAD/CAM", Pearson Education, 2006.
- P.N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 2006

COMPUTER AIDED DESIGNING

Course Code:MAE2618 **CreditUnits: 02**

Course Objective:
The objective of this course is to impart students an in-depth exposure to methods in geometric modeling and its applications in CAD/CAM. This course introduces integrated approach to CAD including: Overview of CAD, numerical techniques for CAD, Computer graphics and design, Principle and management of design data base system, finite element analysis and CAD, Design optimization. Along with the theoretical presentations, commercial CAD software are also introduced and applied to create Engineering components and assemblies.

Course Contents:

Module I
Introduction to CAD. Design process, Introduction to solid modeling and aided design of some elements/ components, hardware requirements, concurrent engineering.

Module II
Elementary Computer Graphics. Transformations, Mappings, Projections – orthographic, isometric, perspective.

Module III
Representation of surfaces. Plane surfaces, Ruled surfaces, Surfaces of revolution, Sweep surfaces, Bezier surface, Bicubic surface patch, Approximation B – spline surface, composite surfaces.

Module IV: Solid Modeling
Set theory, Graph theory, Regularized Boolean operations, B-rep modeling, Sweep representations, Spatial occupancy enumeration.

Module V: Advanced CAD
Mechanical assembly, Geometric property formulation- curve length, surface are calculations, volume calculation, centriod calculation, Tolerances representations, Animation, Simulation, Strategic factors in product design, Robust design for product, Introduction to Finite element modeling and analysis.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
Text:
- Ibrahim Zeid, "CAD/CAM Theory and Practice", Tata McGraw-Hill Publishing Company Limited, 6th Edition 1998.
- David F. Rogers and J. Alan Adams, "Mathematical Elements for Computer GraPrentice Hall Indiacs", Tata McGraw-Hill, 2nd Edition 2002.

References:
- Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw-Hill Publishing Company Limited,

COMPUTER AIDED DESIGNING LAB

Course Code:MAE2619 **CreditUnits: 01**

Course Contents:

List of Experiments:

1. Analysis and design using ANSYS/Pro-E software for:
2. Flange Coupling.
3. Design Shaft.
4. Design for Key.
5. Design for Spur Gear.
6. Design for Helical Gear.
7. Parts of Thin Cylinder Pressure Vessels.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva

Syllabus - Seventh Semester

COMPUTER AIDED MANUFACTURING

Course Code:MAE2701 **CreditUnits: 03**

Course Objective:
The aim of the course is to impart the students the basic and essential concepts in using Computer Assisted Manufacturing (CAM) and Computer Numerical Control (CNC) machines. Students will learn the basic concepts of manufacturing planning and control. They will be offered hands on experience in using CAM software to design, simulate and write CNC programs.

Course Contents:

Module I
Introduction to Numerical control. Programmed automation. Nomenclature, type and features of NC machines tools. Axes designation. Point to point, straight and continuous control systems.

Module II
Machining centre and Turning centre, Automatic tool changer, Machine Tool beds and automated pallet changers**.**

Module III
Machine Control Unit, Actuation Systems, open and close loop systems, transducers for NC Systems, revolves, encoders and inductosyn.

Module IV
Manual Part Programming: Processes planning, G&M codes. Interpolation Cycles. Tool compensation, Subroutines, Introduction to Computer Aided Part Programming.

Module V
Tooling and tool presetting. Computer Aided inspection - Contact Inspection (Coordinate Measuring Machine) &Non Contact Inspection.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
Text:
- Mikell P. Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", 2nd Edition, Pentice Hall, 2001.
- Rao, Kundra& Tiwari, "Computer aided Manufacturing" Tata McGraw Hill, 2007.
- Numerical Control: by Koren, Khanna Publisher.

References:
- Mikell P. Groover, Emory W. Zimmers, "CAD/CAM", Pearson Education, 2006.
- P.N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 2006.

AUTOMOTIVE ENGINEERING

Course Code:MAE2707 **CreditUnits: 03**

Course Objective:
This course emphasizes on constructional details of automotive vehicles which includes – Basic structure, engine, transmission systems, suspension systems, steering system, braking systems and wheels&tyres..

Course Contents:

Module I
Introduction, Components of an automobile, basic engine terminology, engine cycles, working of an IC engine. Basic engine design considerations, constructional details of C.I. and S.I. engines. crank shafts, connecting rod, piston, values, cams, manifolds, air cleaners, mufflers, radiators, and oil filters.

Module II: Transmission System
Description and working of manually operated gearboxes like sliding mesh, constant mesh, synchromesh and epicycle; hydraulic torque convertor and its construction working and performance, sem-automatic and fully automatic transmission, Hydramatic transmission, analysis of differentials, live axles, construction working and requirements of overdrive.

Module III:Steering System
Introduction, Front axle, wheel alignment, Steering geometry, steering mechanisms, Ackerman steering, center point steering, power steering.

Module IV: Suspension
Objective, requirement, function, types Shock absorbers, Independent suspension, Stabilizer, air suspension, Hydroelastic suspension, Hydragas interconnected suspension.

Module V
Principle, braking requirements, brake efficiency, fading of brakes, types of brakes, bleeding of brakes, brake fluid.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
Text:
- Kirpal Singh, "Automobile Engg.", Vol. I & II, Standard Publishers, 2004
- N.K. Giri, "Automotive Mechanics", Khanna Publishers
- Narang G.B.S., "Automobile Engg.", Khanna Publishers
- Srinivasan, "Automotive Engines", Tata McGraw Hill
- K.K. Jain & R.B. Asthana, "Automobile Engineering", Tata McGraw Hill

References:
- James D. Halderman and Chase D. Mitchell Jr., Automotive Engines- Theory and Servicing, Pearson Education, 2007
- Joseph Haitner, "Automotive Mechanics", C.B.S. Publications

COMPUTER AIDED MANUFACTURING LAB

Course Code:MAE2703 **CreditUnits: 01**

Course Contents:

Name of Experiments:

1. Make a sketch of CNC lathe showing major assemblies and indicate the CNC axes with designations. Make a sketch of the conventional lathe and, if it is considered as a CNC lathe, show the axes with designations.

2. Make a Kinematics diagram of CNC Lathe showing all machine sub-assemblies. Indicate bearing arrangements, ball screw arrangements with sizes, wherever available.

3. Repeat (1) on CNC machining centre and conventional milling machine.

4. Repeat (2) for CNC machining centre.

5. Study the CNC lathe. Prepare a block diagram of controls. Identify location and type of transducers and indicate on an outline of the machine. Describe how they function.

6. Repeat (5) on machining centre.

7. Study the work holding and tool holding devices in the CNC lathe and machining centre and draw up their specifications and capacities.

8. Prepare part programs for 2 specified components for CNC lathe by manual part programming. First write the machining technology in full; then prepare part program and then enter in the machine.
   Test the program in dry run and by tool path graphic simulation.
   Machine the component.

9. Do the above work for machining centre.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

AUTOMOTIVE ENGINEERING LAB

Course Code:MAE2708 **CreditUnits: 01**

Course Contents:

List of Experiments:

1. Drawing Valve Timing Diagram
2. Determination of Firing Order of engine
3. Specification of engine
4. Study of different parts of engine
5. Study of Clutch
6. Study of Hydraulic Brake System
7. Study of Carburetor
8. Study of various parts of Auxiliary systems
9. Study of Wheel
10. Study of emission system
11. Study of steering system

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva

SUMMER INTERNSHIP EVALUATION-II

Course Code:MAE2735 **CreditUnits: 03**

Objective:
There are certain phases of every Intern's professional development that cannot be effectively taught in the academic environment. These facets can only be learned through direct, on-the-job experience working with successful professionals and experts in the field. The internship program can best be described as an attempt to institutionalize efforts to bridge the gap between the professional world and the academic institutions. Entire effort in internship is in terms of extending the program of education and evaluation beyond the classroom of a university or institution. The educational process in the internship course seeks out and focuses attention on many latent attributes, which do not surface in the normal classroom situations. These attributes are intellectual ability, professional judgment and decision-making ability, inter-disciplinary approach, skills for data handling, ability in written and oral presentation, sense of responsibility etc.

Guidelines
In order to achieve these objectives:

- **Each student will be allotted a supervisor** for proper guidance.
- **Student will first submit details of company, external guide, project title to coordinator/supervisor as per given schedule.**
- For internal assessment purpose, students will submit an industry feedback and a progress report.
- Student will maintain a file (**Internship File/Project Report**) which he/she will submit after completion of internship. **Further, coordinator will provide NTCC project guidelines and sample to help in preparation of file.** The Internship File aims to encourage students to keep a personal record of their learning and achievement throughout the Programme. It can be used as the basis for lifelong learning and for job applications. Items can be drawn from activities completed in the course modules and from the workplace to demonstrate learning and personal development. The File will assess the student's analytical skills and ability to present supportive evidence, whilst demonstrating understanding of their organization, its needs and their own personal contribution to the organization.

The **layout guidelines** for the Project Report
1. File should be in the following specification

- A4 size paper
- Spiral Binding
- **Font**

For normal text Font Type and Size must be- Times New Roman, 12 pt. The minimum font size of materials within a table or a figure can be 10 point.

- **Margins**

A margin of 3.75 cm (1½ inch) is to be given on the binding edge while on the other sides it is to be 2.5 cm (1 inch). The text of the report, including headings, figures, tables, and notes, but excluding page numbers, must be accommodated within the page area.

- **Line Spacing**

The line spacing in the main text must be between one-and-a-half (1.5). Single line spacing should be given for figure captions, table titles, figure legends, and footnotes. Equations, tables, figures, and quotations should be set off from the main text with adequate space (not less than the normal line spacing adopted for the main text). Two consecutive paragraphs should be separated by a spacing which must be larger than the line spacing adopted for the text.

- **Tables and Figures**

Each sketch, drawing, graph and photograph should have a figure number and title below the figure etc. Numbering should be sequential, chapter wise. For instance, if there are 24 figures chapter 3 spread over all of its sections the figure numbers run from Figure 3.1 through Figure 3.24. In figures

experimental data should typically be represented by centered symbols, and theoretical data by continuous curves.

Each table should have a table number and caption above the table. Numbering should be sequential, chapter wise, as in the case of Figure numbers. For instance, if there are 18 tables in chapter 3 the table numbers run from Figure 3.1 through Figure 3.18.

Make sure that figures and tables are complete in other respects such as legends, references (if any) and coordinate labels with units. Each figure and table must be explicitly referred to in the text and located where its first reference occurs, preferably after the reference.

- **Drawings**

All engineering drawings must conform to relevant Standards and should include a title block. If drawings are large they should be included at the back of the report in a separate pocket. In case drawings are made using CAD packages, a CD ROM should be included which contains all the files and details of the packages used.

- **Equations**

The numbering of equations should be sequential, chapter wise. Numbered equations must be explicitly referred to in the text.

2. Report Size: The maximum number of pages of the Report should be preferably between 50-80 pages.

3. Report Layout: The report should contain the following components

Front Page
Declaration
Student Certificate (University)
Certificate (Company)
Acknowledgement
Abstract
Contents
List of Figures
List of Tables
Company Profile (optional)
Chapters
Appendices(optional)
References / Bibliography

The above components are described below:

1. **The Title Page**-- Format will be given by coordinator/supervisor.

2. **Declaration by the Students-**This is page number (i), the beginning of the small case Roman numeral page numbers. The student has to give a declaration to the effect that the data used for the work, the work depicted in the report, and the written material contained in the report are not copied from others and that due permission has been taken from, and due credit has been given to, the sources whenever they are used.

3. Certificate-This is page number (ii). It is given by the Institute. The certificate will be signed by the Faculty Supervisor(s) before the viva-voce after verifying the format and by the Head of the Department after review with the Supervisor(s).

4. Company Certificate: This is a certificate, which the company gives to the students.

5. Contents-This is page number (iii). The table of Contents should be titled just Contents (not Table of Contents). Try to fit it into one or two pages.

6. Acknowledgement-This is page number (iv). Keep this brief and avoid using informal language. This page must be signed by the candidate.

7. Abstract and **Keywords-**This is page number (v). The abstract (preferably one page) should contain the context/relevance of the problem at hand, a description of what was done and a gist of the significant observations/results.

The keywords (maximum 6) are a hint that what is contained in the report.

8. Company Profile: A Company Profile corresponds to a file with company-specific data. Company data can be stored there and included in a booking when needed.

9. **Chapters**—Introduction, Literature Review/Background Study etc. as given by coordinator/supervisor.

10. **References / Bibliography** --This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals

preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

ASSESSMENT OF THE INTERNSHIP FILE

Continuous Internal Assessment consists of topic relevance, progress report and industry feedback on company letterhead. Final Assessment includes viva, presentation, execution and report marks.

Examination Scheme:

Components	**IF**	**PR**	**R**	**E**	**V**	**FP**
Weightage	20	20	15	15	15	15

V – Viva, IF – Industry Feedback, FP – Final Presentation, R – Report, PR-Progress Report, E-Execution

INDEPENDENT STUDY

Course Code:MAE2712 **CreditUnits: 02**

This is an elective, self-directed course to investigate aemergingareasof IT and Computer Science like Mobile Operating System, Cloud Computing, or from Current Research Areas etc. The primary goal of the course is to provide students with research exploration of a specific topic of interest to the individual student under the advisement of an instructor who will monitor and critique the student's progress.

Independent study provides students with the opportunity to work one-on-one with a Faculty on a particular topic. The student and faculty should discuss the aims and content of the study and present the proposal to Head of Department. The independent study proposal should include the study's title, theme, readings, work to be submitted, and syllabus. Faculty and student should meet for a minimum number of 2 hours per week. Student will give a seminar after completion of study.

TERM PAPER

Course Code:MAE2731 **CreditUnits: 02**

A term (or research) paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned. The progress of the paper will be monitored regularly by the faculty. At the end of the semester the detailed paper on the topic will be submitted to the faculty assigned. The evaluation will be done by Board of examiners comprising of the faculties.

Guidelines for Term Paper

The procedure for writing a term paper may consist of the following steps:

1. Choosing a subject
2. Finding sources of materials
3. Collecting the notes
4. Outlining the paper
5. Writing the first draft
6. Editing & preparing the final paper

1. Choosing a Subject

The subject chosen should not be too general.

2. Finding Sources of Materials

a) The material sources should be not more than 10 years old unless the nature of the paper is such that it involves examining older writings from a historical point of view.
b) Begin by making a list of subject-headings under which you might expect the subject to be listed.
c) The sources could be books and magazine articles, news stories, periodicals, scientific journals etc.

3. Collecting the Notes

Skim through sources, locating the useful material, then make good notes of it, including quotes and information for footnotes.

a) Get facts, not just opinions. Compare the facts with author's conclusion.
b) In research studies, notice the methods and procedures, results & conclusions.
c) Check cross references.

4. Outlining the Paper

a) Review notes to find main sub-divisions of the subject.
b) Sort the collected material again under each main division to find sub-sections for outline so that it begins to look more coherent and takes on a definite structure. If it does not, try going back and sorting again for main divisions, to see if another general pattern is possible.

5. Writing the First Draft

Write the paper around the outline, being sure that you indicate in the first part of the paper what its purpose is. You may follow the following:

a) statement of purpose
b) main body of the paper
c) statement of summary and conclusion

Avoid short, bumpy sentences and long straggling sentences with more than one main idea.

6. Editing &Preparing the Final Paper

a) Before writing a term paper, you should ensure you have a question which you attempt to answer in your paper. This question should be kept in mind throughout the paper. Include only information/ details/ analyses of relevance to the question at hand. Sometimes, the relevance of a particular section may be clear to you but not to your readers. To avoid this, ensure you briefly explain the relevance of every section.
b) Read the paper to ensure that the language is not awkward, and that it "flows" properly.
c) Check for proper spelling, phrasing and sentence construction.
d) Check for proper form on footnotes, quotes, and punctuation.
e) Check to see that quotations serve one of the following purposes:
   (i) Show evidence of what an author has said.
   (ii) Avoid misrepresentation through restatement.
   (iii) Save unnecessary writing when ideas have been well expressed by the original author.
f) Check for proper form on tables and graphs. Be certain that any table or graph is self-explanatory.

Term papers should be composed of the following sections:

1) Title page
2) Table of contents
3) Introduction
4) Review
5) Discussion&Conclusion
6) Bibliography
7) Appendix

Generally, the introduction, discussion, conclusion and bibliography part should account for a third of the paper and the review part should be two thirds of the paper.

Discussion

The discussion section either follows the results or may alternatively be integrated in the results section. The section should consist of a discussion of the results of the study focusing on the question posed in the research paper.

Conclusion

The conclusion is often thought of as the easiest part of the paper but should by no means be disregarded. There are a number of key components which should not be omitted. These include:

a) summary of question posed
b) summary of findings
c) summary of main limitations of the study at hand
d) details of possibilities for related future research

Bibliography

From the very beginning of a research project, you should be careful to note all details of articles gathered. The bibliography should contain ALL references included in the paper. References not included in the text in any form should NOT be included in the bibliography. The key to a good bibliography is consistency. Choose a particular convention and stick to this.

Bibliographical Conventions:

Monographs

Crystal, D. (2001), Language and the internet, Cambridge: Cambridge University Press

Edited Volumes

Gass, S/Neu, J. (eds.) (1996), Speech acts across cultures, Challenges to communication in a second language, Berlin/ NY: Mouton de Gruyter.

[(eds.) is used when there is more than one editor; and (ed.) where there is only one editor. In German the abbreviation used is (Hrsg.) for Herausgeber].

Edited Articles

Schmidt, R./Shimura, A./Wang, Z./Jeong, H. (1996), Suggestions to buy: Television commercials from the U.S., Japan, China, and Korea. In: Gass, S./Neu, J. (eds.) (1996), Speech acts across cultures. Challenges to communication in a second language, Berlin/ NY: Mouton de Gruyter: 285-316.

Journal Articles

McQuarrie, E.F./Mick, D.G. (1992), On resonance: A critical pluralistic inquiry into advertising rhetoric. Journal of consumer research 19, 180-197.

Electronic book

Chandler, D. (1994), Semiotics for beginners [HTML document]. Retrieved on [5.10.01] from the World Wide Web, http://www.aber.ac.uk/media/Documents/S4B/.

Electronic Journal Articles

Watts, S. (2000) Teaching talk: Should students learn 'real German'? [HTML document], German as a Foreign Language Journal [online] 1, Retrieved [12.09.00] from the World Wide Web, http://www.gfl-journal.com/

Other Websites

Verterhus, S.A. (n.y.), Anglicisms in German car advertising. The problem of gender assignment [HTML document], Retrieved on [13.10.01] from the World Wide Web, http://olaf.hiof.no/~sverrev/eng.html

Unpublished Papers

Takahashi, S./DuFon, M.A. (1989), Cross-linguistic influence in indirectness: The case of English directives performed by native Japanese speakers. Unpublished paper, Department of English as a Second Language, University of Hawai'i at Manoa, Honolulu

Unpublished Thesis/ Dissertations

Möhl, S. (1996), Alltagssituationen im interkulturellen Vergleich: Realisierung von Kritik und Ablehnung im Deutschen und Englischen. Unpublished MA thesis, University of Hamburg
Walsh, R. (1995), Language development and the year abroad: A study of oral grammatical accuracy amongst adult learners of German as a foreign language. Unpublished PhD dissertation, University College Dublin

Appendix
The appendix should be used for data collected (e.g. questionnaires, transcripts, etc.) and for tables and graphs not included in the main text due to their subsidiary nature or to space constraints in the main text.

Examination Scheme:

Dissertation:	75
Viva voce	25
Total:	**100**

PROJECT

Course Code:MAE2732 **CreditUnits: 02**

Methodology

Topics of project are to be based on the latest trends, verifying engineering concepts /principals and should involve elementary research work. The projects may involve design, fabrications, testing, computer modeling, and analysis of any engineering problem. On completion of the practical training the students are to present a report covering various aspects learnt by them and give a presentation on same.

Guidelines for Project File

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

Project File

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period where the researcher is not working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The project file is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the file should be comprehensive and includes:

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated objectives;
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen and may be useful to document for future reference.

Layout Guidelines for the Project File

- A4 size Paper
- Font: Arial (10 points) or Times New Roman (12 points)
- Line spacing: 1.5
- Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

Assessment of the Project File

Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfill the following assessment objectives:

- Range of research methods used to gain information
- Execution of research
- Data analysis (Analyse Quantitative/ Qualitative information)
- Quality Control
- Conclusions

Assessment Scheme:

Continuous Evaluation:
40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/ mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:
60% (Based on the documentation in the file, final report layout, analysis and results, achievement of objectives, presentation/ viva)

Syllabus - Eighth Semester

REFRIGERATION AND AIR CONDITIONING

Course Code:MAE2801 **CreditUnits: 03**

Course Objective:
The aim of this course is to provide the students with the understanding of the basic principles of Refrigeration and Air Conditioning such that they could build simple mathematical models representing the conditioned space and its components used to control environmental conditions. The application of thermodynamics, heat transfer, and fluid mechanics includes an understanding of refrigerants and refrigeration systems, psychometrics, human comfort and air quality, calculation of heating and cooling loads, and heat and mass transfer processes and associated R & AC components and systems.

Course Contents:

Module I:Refrigeration
Air refrigeration systems, air cycle refrigeration of aircraft, various compression refrigeration cycles, basic components of the plant.

Module II
Properties and choice of refrigerants, Eco-friendly refrigerants multiple compression and evaporation system, cascading.

Module III
Vapour absorption cycle, electrolux system steam jet refrigeration, vortex tube, application of refrigeration systems cascading, vapour absorption cycle

Module IV: Air-conditioning
Psychometric processes, applied psychometric, comfort air-conditioning, ventilation requirements, cooling and dehumidification system, estimation of cooling and heating loads, air handling, air distribution, duct design, industrial air conditioning.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
- CP Arora, Refrigeration and Conditioning, Tata McGraw Hill
- Manohar Prasad, Refrigeration and Conditioning , Wiley Eastern Limited
- Jordan and Priester, Refrigeration and Conditioning, Prentice Hall of India
- WF Stoecker, Refrigeration and Conditioning, McGraw Hill.

REFRIGERATION AND AIR-CONDITIONING LAB

Course Code:MAE2802 **CreditUnits: 01**

Course Contents:

List of Experiments:

1. Study of refrigeration testing.
2. Study of Air-Conditioning testing.
3. To calculate the COP of Refrigerator.
4. Study of effect of superheating.
5. To calculate the efficiency of Compressor.
6. To calculate total Heat Load for Air-Conditioning unit.
7. To calculate the COP of Heat Pump.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

PROJECT-DISSERTATION

Course Code:MAE2837 **CreditUnits: 08**

Methodology

Topics of project are to be based on the latest trends, verifying engineering concepts /principals and should involve elementary research work. The projects may involve design, fabrications, testing, computer modeling, and analysis of any engineering problem. On completion of the practical training the students are to present a report covering various aspects learnt by them and give a presentation on same.

Guidelines for Project File and Project Report

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

Project File

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period where the researcher is not working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The Project File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated objectives;
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen and may be useful to document for future reference.

Project Report

The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the lay out of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

- **Title or Cover Page**
  The title page should contain Project Title; Student's Name; Programme; Year and Semester and Name of the Faculty Guide.
- **Acknowledgement(s)**
  Acknowledgment to any advisory or financial assistance received in the course of work may be given. It is incomplete without student's signature.
- **Abstract**
  A good"Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.
- **Table of Contents**
  Titles and subtitles are to correspond exactly with those in the text.

- **Introduction**

  Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.
- **Materials and Methods**

  This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any. It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.
- **Results and Discussion**

  Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

  Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in "point" form.

  While presenting the results, write at length about the the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather, it should lead to generalization of data on the chosen sample.

  Results and its discussion should be supporting/contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporing or contradicting the present case of research.
- **Conclusion(s) & Recommendations**

  A conclusion should be the final section in which the outcome of the work is mentioned briefly.

  Check that your work answers the following questions:
  - Did the research project meet its aims (check back to introduction for stated aims)?
  - What are the main findings of the research?
  - Are there any recommendations?
  - Do you have any conclusion on the research process itself?
- **Implications for Future Research**

  This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.
- **Appendices**

  The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.
- **References**

  References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

  Examples

  For research article

  Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic*Escherichia coli* O157: H7. *ClinMicrobiol Infect*, **8** (suppl 1): 116–117.

  For book

  Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

Layout Guidelines for the Project File & Project Report

- A4 size Paper
- Font: Arial (10 points) or Times New Roman (12 points)
- Line spacing: 1.5
- Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

Assessment of the Project File and the Project Report

Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfill the following assessment objectives:

- Range of Research Methods used to oASEin information
- Execution of Research
- Data Analyses (Analyse Quantitative/ Qualitative information)
- Quality Control
- Conclusions

Assessment Scheme:

Continuous Evaluation:

40% (Based on punctuality, regularity of work, adherence to plan and methodology,refinements/ mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:

60% (Based on the Documentation in the file, Final report layout, analysis andresults, achievement of objectives, presentation/ viva)

ARTIFICIAL INTELLIGENCE AND ROBOTICS

Course Code:MAE2805 **CreditUnits: 02**

Course Objective:
To develop semantic-based and context-aware systems to acquire, organise, process, share and use the knowledge embedded in multimedia content. Research will aim to maximise automation of the complete knowledge lifecycle and achieve semantic interoperability between Web resources and services. The field of Robotics is a multi disciplinary as robots are amazingly complex system comprising mechanical, electrical, electronic H/W and S/W and issues germane to all these.

Course Contents:

Module I: Scope of AI
Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques- search knowledge, abstraction.
Problem solving
State space search; Production systems, search space control: depth-first, breadth-first search, heuristic search - Hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis

Module II: Knowledge Representation
Predicate Logic: Unification, modus ponens, resolution, dependency directed backtracking. Rule based Systems: Forward reasoning: conflict resolution, backward reasoning: use of no backtracks.
Structured Knowledge Representation: Semantic Nets: slots, exceptions and default frames, conceptual dependency, scripts.
Expert Systems
Need and justification for expert systems, knowledge acquisition, Case studies: MYCIN, RI.
Learning: Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets.

Module III: Manipulator kinematics
Kinematics: Introduction, solvability, algebraic solution by reduction to polynomial, standard frames, repeatability and accuracy, computational considerations.

Module IV: Manipulator dynamics
Introduction, acceleration of rigid body, mass distribution, Newton's equation, Euler's equation, Iterative Newton-Euler dynamic formulation, closed dynamic equation, Lagrangian formulation of manipulator dynamics, dynamic simulation, computational consideration.

Module V: Trajectory Generation
Introduction, general considerations in path description and generation, joint space schemes, Cartesian space schemes, Path generation in runtime, Planning path using dynamic model.

Module VI: Linear control of manipulators
Introduction, feedback and closed loop control, second order linear systems, control of second-order systems, Trajectory following control, modeling and control of a single joint, sensor and vision system.
Robot Programming languages & systems: Introduction, the three level of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:

- E. Rich and K. Knight, "Artificial intelligence", TMH, 2nd ed., 1992.
- N.J. Nilsson, "Principles of AI", Narosa Publ. House, 1990.
- John J. Craig, "Introduction to Robotics", Addison Wesley publication
- Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, "Robotic Engineering – An integrated approach", PHI Publication
- Tsuneo Yoshikawa, "Foundations of Robotics", PHI Publication

References:

- D.W. Patterson, "Introduction to AI and Expert Systems", PHI, 1992.
- Peter Jackson, "Introduction to Expert Systems", AWP, M.A., 1992.
- R.J. Schalkoff, "Artificial Intelligence - an Engineering Approach", McGraw Hill Int. Ed., Singapore, 1992.
- M. Sasikumar, S. Ramani, "Rule Based Expert Systems", Narosa Publishing House, 1994.

ARTIFICIAL INTELLIGENCE AND ROBOTICS LAB

Course Code:MAE2808 **CreditUnits: 01**

Course Contents:

Name of Experiments:

1. Robot Arm (Model 1055)

2. Write a prolog program to define a relations knowledge base as follows : Assume the following in the kbase :
   Male (person), female (person), husband (person, person0, wife(person, person), father (person, person), mother (person, person). Define the predicates for
   Parent
   Brother
   Sister
   Grandfather
   Ancestor

3. Write a prolog program to simulate a non deterministic finite automation (NFA)

4. A computer system accepts a user's name and password which are stored as facts in the kbase. Validate this information through a predicate login. If not valid, display a suitable message.

5. Write prolog predicates to perform list manipulation as follows :
   List membership relation
   Length of a list
   Concatenate 2 list to produce a third list
   Reverse a list
   Subset of a list
   Appending an element to a list
   Summing the element of a list

6. Write a prolog program to implement Depth first search algorithm.

7. Write a prolog program to simulate the Towers of Hanoi problem.

8. There is a gold treasure hidden inside a cave. The cave is a maze of galleries connecting different rooms in which there are dangerous beings like monsters and robbers. The gold treasure is all in one room. Determine a route by which a person can get to the treasure and escape with it unhurt. Enclosed is a photocopy of the cave lay out. Write the corresponding prolog program.

9. Write a prolog program to simulate the xor logic circuit. In this program make use of the predicate definitions for AND, NOT and OR gate.

10. A hungry monkey finds himself in a room in which a bunch of bananas is hanging from the ceiling. The monkey cannot reach the bananas. In the room there is a chair and a stick. The ceiling is just the right height so that a monkey standing on a chair could knock the bananas down with the stick. The monkey knows how to move around, carry other things around, reach for the bananas and wave a stick in the air. Write prolog predicate that define the monkey's legal moves, the different legal states and enable the monkey to got to the bananas.

11. In the block world problem, assure a sequence of 3 blocks a, b, c on a table. Write prolog predicates to define valid states in the blocks world domain and also to define valid legal moves in the system.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva

COMPUTATIONAL FLUID DYNAMICS

Course Code:MAE2809 **CreditUnits: 02**

Course Contents:

Module-I: Introduction
Introduction to CFD, description about CFD, History and early view points on CFD, Fluid Mechanics Preliminaries, Mathematical preliminaries, Reynold's transport theorem, Equations of mass, momentum and energy conservation in integral and difference forms.

Module-II: Discritization methods
Basics of discretization in CFD, Finite difference formulation with introduction to - Consistency, Stability and Order of accuracy. Understanding discretization techniques using Linear Convection Equation.

Module-III: Finite volume method
Finite volume formulation, Finite volume state update formulae in 1D and 2D, Higher order procedures. Spatial Discretization Convective and diffusive fluxes Euler backward/forward time integration Chracteristics and Eigenvalues

Module-IV: Heat conduction problem
Solution of One dimensional heat conduction through a pin fin by F.D.M solution of two dimensional heat conductional in a plate by F.D.M. Control volume formulation of the heat conduction problem and its solution.

Module-V: Turbulence Modeling
Introduction to turbulence, Reynold's averaged Navier-Stokes equations and closure problem, Prandtl's mixing length theory and eddy viscosity , Turbulence models - k-epsilon model, k-omega model.

Module-VI: Fluid flow problem
Practical aspects of CFD, Grid generation: Introduction to structured, unstructured, Cartesian meshes: A case study on CFD technology readiness for an industrial application.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Books recommended;

- Computational fluid dynamics by John.d.Anderson, Jr
- Introduction to Computational fluid dynamics by Anil .W. Date
- Numerical heat transfer and fluid flow by suhas. V. patankar
- An Introduction to Computational Fluid Dynamics by H.K. Versteeg and W. Malalasekera
- Computational Fluid Dynamics by Klaus A. Hoffmann, Steve T. Chiang

COMPUTATIONAL FLUID DYNAMICSLAB

Course Code:MAE2810 **CreditUnits: 01**

1. To perform the experiment on Geometry import, Geometry clean up, Building computational domain, Edge meshing,Surface meshing, Quality check for surface mesh, Volume meshing, Quality check for volume mesh, setting boundary conditions, Volume Mesh export.
2. Inviscid unstructured mesh generation for NACA 0012 airfoil
3. 3 Viscous unstructured mesh generation for NACA 0012 airfoil
4. Inviscid unstructured mesh generation for a convergent divergent nozzle
5. Viscous unstructured mesh generation for a convergent divergent nozzle
6. To make and validate a computer programme for the one dimensional pin fin steady state heat conduction.
7. To make and validate a computer programme for the fully developed laminar flow in circular pipe.
8. To make and validate a computer programme for the plate in two dimensions in steady state conduction.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva

POWER PLANT PRACTICES

Course Code:MAE2811 **CreditUnits: 03**

Course Objective:
The objective of this course is that the students come to know different ways of producing energy such as thermal energy from gas and steam, hydraulic energy nuclear energy, non conventional source of energy from wind, solar and tidal. And their different uses in productive works.

Course Contents:
Module I: Steam Generator Plant
Fuel handling systems, Indian coals, combustion of coal in furnaces; fluidized bed combustion; High pressure heavy duty boilers, Super critical and once through boilers influence of operating conditions on layout of evaporator, superheated, reheated and economizer; dust collectors; ash disposal, fans and draft systems.

Module II: Turbine Plane
Layout of turbine plant room, corrosion in condensers and boilers, feed water treatment; feed heating and de aeration system; cooling water systems and cooling towers.

Module III: Control
Important instruments on steam generator and turbine; drum water level control, combustion control and super heat temperature control; testing of power plants and heat balance.

Module IV: Other Power Plant
General layout of I.C. Engines and turbine power plants, types, gas turbine plants, fields of application, Nuclear power plants, power reactors and nuclear steam turbines; handling of nuclear waste and safety measures, peak load power generation methods.

Module V: Economics
Planning for power generation in India, super thermal power plants, estimation of cost of power generation; choice of plant site.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att:Attendance

Text & References:
Text:
- Arora &Domkundwar, "A course in Power Plant Engineering", Dhanpat Rai & Sons

References:
- Black Veatch, "Power Plant Engineering", CBS Publisher