CURRICULUM OF MECHANICAL ENGINEERING
RGUKT BASAR

III YEAR

II SEMESTER

Subject Code	Subject Name	L-T-P	C
ME3201	Machining and Machine Tools	4-0-0	4
ME3202	Applied Thermodynamics-I	4-0-0	4
ME3203	Design of Machine Elements-II	4-0-0	4
ME3204	Heat Transfer	4-0-0	4
CS3001	Object oriented programming through Java	4-0-0	4
HS3201	Soft Skills	2-0-0	1
ME3801	Heat Transfer Lab	0-0-3	2
CS3601	Object oriented programming through Java Lab	0-0-3	2
ME3902	Seminar-III	0-0-2	1
ME3000	Comprehensive Viva-I		1
	Total	22-0-8	27

CODE: ME3201 **MACHINING AND MACHINE TOOLS**

Externals: 60 Marks **L-T-P-C***

Internals: 40 Marks **4-0-0-4**

Objectives:

- To learn the tool material, geometry and mechanics of metal cutting for turning, drilling milling.
- To know the heat distribution, tool wear, tool life, various machining processes like lathe, milling, drilling, grinding etc.
- To learn various types of fixtures, conventional and unconventional machining

UNIT-I

Tool Geometry: Single point cutting tool-types of reference systems–ASA,ORS and NRS systems and their Inter-relationships. Mechanism of chip formation, shear plane model. types of chips, effect of cutting parameters Forces in chip formation-Cutting force analysis- Ernst and Merchant analysis-theory of Lee and Shaffer. Effect of various cutting parameters on cutting forces, Theory of strain and strain rate in metal cutting and Energy considerations.

UNIT-II

Tool Wear: Different causes-various forms of tool wear-measurement of tool wear. Tool life. Machinability-criterion for machinability-influence of variables affecting machinability. Measurement of Cutting Forces and Temperatures Tool Materials: Various tool materials, their properties and general guidelines for selection. Cutting Fluids: Functions, properties, types and selection. Economics of Metal Cutting: Various types of costs and their estimation. Determination of cutting speed for maximum production rate and minimum cost criteria.

UNIT – III

Introduction to machine tools: Lathe: Description, types, operations, accessories, attachments and machine time calculations. Introduction to Capstan and Turret Lathe and Automatic Machine. Drilling: Description,types of drilling machines,drilling operations,machine time Calculations

UNIT-IV

Milling: Description, types of milling machines, Mounting of milling cutters, types of milling operations, machining time calculation, types of indexing methods. Shaping, Planning and Slotting: Description, types of machines and operations, tool setting and quick return mechanisms. Machining time calculations.

UNIT V

Grinding machine –Theory of grinding – classification of grinding machine – cylindrical and surface grinding machine – Tool and cutter grinding machine – special types of grinding machines – Grinding wheel, Different types of abrasives – bonds, specification and selection of a grinding wheel

Principles of design of Jigs and fixtures and uses. Classification of Jigs & Fixtures – Principles of location and clamping – Types of clamping & work holding devices.

TEXT BOOKS :

1. Metal cutting and machine tools by P.N.Rao.

2. Workshop Technology by S.K.HAJRA CHOUDHURY

3. Ghosh and Mallik, Manufacturing Science, Affiliated East-West Press, New Delhi.

REFERENCES:

1. Machine Tools – C.Elanchezhian and M. Vijayan /Anuradha Agencies Publishers.

2. Manufacturing Technology-KalpakJian- Pearson

3. P.C.Sharma, Production Engineering, Dhanpat Rai & Sons, New Delhi.

CODE: ME3202 **APPLIED THERMODYNAMICS – I**

Externals: 60 Marks **L-T-P-C***

Internals: 40 Marks **4-0-0-4**

Course Educational Objectives:

- To understand the operating principles of air standard and actual cycles involved in power producing devices.
- To understand the working principles and performance characteristics of I.C engines and compressors
- To understand combustion process in S.I and C.I engines

UNIT – I

Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blowdown-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

UNIT-II

I.C. ENGINES : Classification - Working principles, Valve and Port Timing Diagrams, Air – Standard, air-fuel and actual cycles – Engine systems – Fuel, Carburetor, Fuel Injection System, Ignition, Cooling and Lubrication.

UNIT – III

Combustion in S.I. Engines : Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Type of Abnormal combustion, pre-ignition and knocking (explanation of) – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types.

Combustion in C.I. Engines : Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

UNIT IV

Testing and Performance : Parameters of performance – measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

COMPRESSORS – Classification –positive displacement and roto dynamic machinery – Power producing and power absorbing machines, fan, blower and compressor – positive displacement and dynamic types – reciprocating and rotary types.

Reciprocating : Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance, stage compression, undercooling, saving of work, minimum work condition for stage compression.

UNIT-V

Rotary (Positive displacement type) : Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.

Dynamic Compressors : Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

Axial Flow Compressors : Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency-pressure rise calculations – Polytropic efficiency.

TEXT BOOKS:

1. I.C. Engines / V. Ganesan- TMH
2. Thermal Engineering / Rajput / Lakshmi Publications.

REFERENCES:

1. IC Engines – Mathur & Sharma – Dhanpath Rai & Sons.
2. Engineering fundamentals of IC Engines – Pulkrabek, Pearson, PHI
3. Thermal Engineering, Rudramoorthy - TMH
4. Thermodynamics & Heat Engines, B. Yadav, Central Book Depot., Allahabad
5. I.C. Engines, Heywood, McGrawHIll.
6. Thermal Engineering – R.S. Khurmi & J.K.Gupta –S.Chand
7. Thermal engineering data book-B.Srinivasulu Reddy, JK International Pub.

CODE: ME3203 **DESIGN OF MACHINE ELEMENTS – II**

Externals: 60 Marks **L-T-P-C***

Internals: 40 Marks **4-0-0-4**

Objectives:

- To learn design criteria of machine components, selection of materials and manufacturing process.
- To learn application of principles to design helical coiled and leaf springs, gears, curved beams, sliding contact and rolling element bearings, chain drives, IC engine components and fly wheels.

Unit-I

Mechanical springs: Introduction. Different types of springs. Materials used for springs.
Helical Springs: Whal factor, calculation of stress, Deflection and energy stored in spring. Design for static and fluctuating loads.
Leaf Springs: Stress and Deflection. Nipping of Leaf springs. Design for static and fluctuating loads.

Unit-II

Gears: Introduction of gear drives, different types of gears, Materials used for gears. Standards for gears and specifications.
Spur Gear Design: Lewis equation, Beam strength of gear tooth and static design. Wear load and design for Wear. Dynamic loads on gear tooth. Design of Helical, Bevel and Worm gears, concepts of Design for manufacturability.

Unit-III

Bearings: Introduction. Materials used for Bearings. Classification of bearings and mounting of bearings.
Design of sliding contact bearings: Properties and types of Lubricants, Design of Hydrostatic and Hydrodynamic sliding contact bearings.
Design of Rolling Contact Bearings: Different types of rolling element bearings and their constructional details, static load carrying capacity. Dynamic load carrying capacity. Load-life relationship, selection of bearing life. Design for cyclic loads and speeds. Design of Ball and Roller bearings.

Unit-IV

I.C. Engine parts: Introduction. Materials used. Design of piston, connecting rod and crank for I.C. Engines.
Fly wheels: Introduction. Design of solid disk type and rimmed fly wheels.

Unit-V

Design of curved beams: Introduction stresses in curved beams, expression for radius of curvature of neutral axis for rectangular, circular, trapezoidal and T-sections. Design of crane Hook, C-clamp.

Design of chain drives: Power rating of roller chains. Strength of roller chains.

Suggested Reading

1. Bhandari V.B. *Machine Design*, Tata Mc Graw Hill Publications, 1994.
2. J.E. Shigley , C.R. Misckhe, *Mechanical Engineering Design*, Tata Mc Graw Hill Publication, 2003.
3. P. Kannaiah, *Machine Design*, Science-Tech Publications, 2003.
4. M.F. Spotts, *Design of Machine Elements*, Prentice Hall, 1964.
5. Robert L. Norton, *Machine Design: An Integrated Approach*,2/e PearsonEducation, 2000

CODE: ME3204 **HEAT TRANSFER**

Externals: 60 Marks **L-T-P-C***

Internals: 40 Marks **4-0-0-4**

Objectives:

- To understand the basic concepts of heat transfer.
- To study the concepts of conduction, convection, radiation and heat exchangers applicable for commercial and industrial use.
- To study and solve problems on different modes of heat transfer which are related to thermal power plants, refrigeration and air conditioning.

UNIT – I

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –General applications of heat transfer.

Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates.

UNIT – II

Simplification and forms of the field equation – steady, unsteady and periodic heat transfer – boundary and Initial conditions.

One Dimensional Steady State Heat Conduction: in Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – Critical radius/thickness of insulation-with Variable Thermal conductivity –with internal heat sources or Heat generation. Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to errors in Temperature measurement.

One Dimensional Transient Heat Conduction: in Systems with negligible internal resistance – Significance of Biot and Fourier Numbers - Chart solutions of transient conduction systems- Problems on semi-infinite body.

UNIT – III

Convective Heat Transfer: Dimensional analysis–Buckingham π Theorem and its application for developing semi – empirical non- dimensional correlations for convective heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations.

Forced convection: External Flows: Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer for flow over-Flat plates, Cylinders and spheres..

Internal Flows: Division of internal flow through Concepts of Hydrodynamic and Thermal Entry Lengths – Use of empirical relations for convective heat transfer in Horizontal Pipe Flow, annular flow.

Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate – Use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation.

UNIT IV

Heat Transfer with Phase Change: Boiling: Pool boiling – Regimes, determination of heat transfer coefficient in Nucleate boiling, Critical Heat flux and Film boiling.

Condensation: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

Heat Exchangers:

Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT V

Radiation Heat Transfer

Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities– laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between gray bodies – radiation shields– electrical analogy for radiation networks.

TEXT BOOKS:

1. Fundamentals of Engg. Heat and Mass Transfer / R.C. Sachdeva / New Age International
2. Fundamentals of Heat and Mass Transfer/M.Thirumaleswar/Pearson Edu.

REFERENCE BOOKS:

1. Heat Transfer – P.K.Nag/ TMH
2. Heat Transfer / Holman .J.P/TMH
3. Heat and Mass Transfer –Cengel- McGraw Hill.
4. Heat and Mass Transfer – R.K. Rajput – S.Chand & Company Ltd.
5. Heat and Mass Transfer-Kondandaraman
6. Fundamentals of Heat Transfer - Incropera & Dewitt /John Wiley Pub.
7. Thermal Engineering Data Book /B.S.Reddy and K.H.Reddy Rev. Edition/I.K.International

CS3001 OBJECTED ORIENTED PROGRAMMING THROUGH JAVA

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **4-0-0-4**

Objectives:

- To be able to differentiate between structures oriented programming and object oriented programming.
- To be able to use object oriented programming language like Java and associated libraries to develop object oriented programs.
- To Able to understand and apply various object oriented features like inheritance, data abstraction, encapsulation and polymorphism to solve various computing problems using Java language.
- To be able to apply concepts of operator overloading, constructors and destructors.
- To be able to apply exception handling and use built-in classes

UNIT-1:

Introduction to OOPS: Paradigms of Programming Languages, Basic concepts of Object Oriented Programming, Differences between Procedure Oriented Programming and Object Oriented Programming, Objects and Classes, Data abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic binding, Message communication, Benefits of OOP , Application of OOPs.

Java : History, Java features, Java Environment, JDK, API.

Introduction to Java : Types of java program, Creating and Executing a Java program, Java Tokens, Keywords, Character set, Identifiers, Literals, Separator, Java Virtual Machine (JVM), Command Line Arguments, Comments in Java program.

UNIT -2:

Elements: Constants, Variables, Data types, Scope of variables, Type casting, Operators: Arithmetic, Logical, Bit wise operator, Increment and Decrement, Relational, Assignment, Conditional, Special operator, Expressions – Evaluation of Expressions

Decision making and Branching: Simple if statement, if, else statement, Nesting if, else, else if Ladder, switch statement, Decision making and Looping: While loop, do, While loop, for loop, break, labelled loop, continue Statement.-, Simple programs

Arrays: One Dimensional Array, Creating an array, Array processing, Multidimensional Array, Vectors, Wrapper classes, Simple programs

UNIT-3:

Strings: String Array, String Methods, String Buffer Class, Simple programs

Class and objects: Defining a class, Methods, Creating objects, Accessing class members, Constructors, Method overloading, Static members, Nesting of Methods, this keyword, Command line input, Simple programs

Inheritance: Defining a subclass, Deriving a sub class, Single Inheritance, Multilevel Inheritance, Hierarchical Inheritance, Overriding methods, Final variables and methods, Final classes, Finalizer methods, Abstract methods and classes, Visibility Control: Public access, Private access, friend, protected. Interfaces: Multiple Inheritance, Defining interface, Extending interface, Implementing Interface, Accessing interface variables, Simple programs

UNIT- 4:

Packages: Java API Packages, System Packages, Naming Conventions, Creating & Accessing a Package, Adding Class to a Package, Hiding Classes, Programs

Applets: Introduction, Applet Life cycle, Creating & Executing an Applet, Applet tags in HTML, Parameter tag, Aligning the display, Graphics Class: Drawing and filling lines, Rectangles, Polygon, Circles, Arcs, Line Graphs, Drawing Bar charts, Programs

AWT Components and Even Handlers: Abstract window tool kit, Event Handlers, Event Listeners, AWT Controls and Event Handling: Labels, TextComponent, ActionEvent, Buttons, CheckBoxes, ItemEvent, Choice, Scrollbars, Layout Managers- Input Events, Menus, Programs

UNIT-5:

Exception Handling: Limitations of Error handling, Advantages of Exception Handling, Types of Errors, Basics of Exception Handling, try blocks, throwing an exception, catching an exception, finally statement

Multithreading: Creating Threads, Life of a Thread, Defining & Running Thread, Thread Methods, Thread Priority, Synchronization, Implementing runnable interface, Thread Scheduling.

I/O Streams: File, Streams, Advantages, The stream classes, Byte streams, Character streams.

JDBC, ODBC Drivers, JDBC ODBC Bridges, Seven Steps to JDBC, Importing java SQL Packages, Loading & Registering the drivers, Establishing connection. Creating &Executing the statement.

Suggested References:

1. Programming with Java - E. Balagurusamy
2. Java the complete reference, 7th editon, Herbert schildt, TMH.
3. Understanding OOP with Java, updated edition, T. Budd, pearsoneduction.
4. Object oriented Programming in Java - Dr. G.Thampi
5. Let us Java – Yashavant Kanetkar - BPB Publications, New Delhi - First Edition 2012
6. An Introduction to Oops with Java - C Thomas WU - TataMc-Graw Hill, 4th Edition

HS3201 **Soft Skills II**

Externals: 60 **L-T-P-C***

Internals: 40 **2-0-0-1**

Objectives:

- To implement practically the skills needed for employment.
- To deal with the society in an acceptable way maintaining ethical standards.
- To make them competent to attempt and qualify in various tests.

UNIT-I

PPTs – Introduction - Oral presentation – Power point Presentation – Individual presentation – Group presentation

UNIT-III

Group Discussions - Speaking in Group Discussions - Discussing Problems and Solutions - Creating a Cordial and Cooperative Atmosphere - Using Persuasive Strategies - Being Polite and Firm - Turn-taking Strategies - Effective Intervention - Reaching a Decision - **Organizational GD** - Brainstorming - Nominal Group Technique - Delphi Technique - **GD as Part of Selection Process** - Characteristics - Evaluation and Analysis - Approach to Topics and Case Studies

UNIT-IV

Interviews – Types of interviews – Body language – Fluency – Etiquettes – Mock interviews

UNIT-V

Formal Letters and Email - Introduction - Formats of Written Correspondence - Types of Messages - **Letter Writing** - The Seven Cs of Letter Writing - Purpose - Structure - Layout - Principles - Planning a Letter - **Cover Letters** - Writing the Cover Letter - Academic and Business Cover Letters - Cover Letters Accompanying Résumés - **Emails** - Advantages and Limitations - Style, Structure, and Content - Email Etiquette - Effectiveness and Security

Suggested References:

1. Business Communication – Meenakshi Raman
2. Presenting to Win - Jerry Weissman
3. Boring to Bravo - Kristin Arnold
4. Advanced Presentations by Design- Andrew Abela

CODE: ME3801 **HEAT TRANSFER LAB**

Externals: 60 **L-T-P-C***

Internals: 40 **0-0-3-2**

Course Educational Objectives:

- To understand the principles of conduction, convection and radiation heat transfer and their applications in the design of heat exchangers and insulations.

Course Outcomes:

Students undergoing this course are able to

- Design of experiments to study thermal power cycles and other thermal systems including compressors, turbines and combustion systems.

LIST OF EXPERIMENTS

1. Evaluation of thermal conductivity using lagged pipe apparatus.
2. Determination of thermal conductivity using guarded plate apparatus.
3. Evaluation of Stefan Boltzmann Constant.
4. Determination of radiation from a grey body.
5. Determination of heat transfer co-efficient using pin-fin apparatus.
6. Evaluation of COP of refrigerant
7. Experiment on parallel flow heat exchanger
8. Experiment on counter flow heat exchanger
9. Determination of convective heat transfer coefficient during natural convection.
10. Determination of convective heat transfer coefficient during forced convection.
11. Study of air-conditioning test rig
12. Study of air blower
13. Study of air compressor

LIST OF EQUIPMENTS

For a student's strength of 40

S. No.	Equipment Name	Nos. Required
1	Lagged Pipe Apparatus	1
2	Guarded Hot Plate Apparatus	1
3	Stefan Boltzmann Apparatus	1
4	Emissivity Measurement Apparatus	1
5	Heat Transfer Through Pin Fin Apparatus	1
6	Refrigeration Test Rig	1
7	Parallel Flow And Counter Flow Heat Exchanger	1
8	Natural Convection Apparatus	1
9	Forced Convection Apparatus	1
10	Horizontal Single Stage Double Acting Compressor	1
11	Air Conditioning Test Rig	1

BEYOND THE SYLLABUS:

1. Shell and tube heat exchanger
2. Thermal convective coefficient for AL using natural convection
3. Thermal convective coefficient for AL using forced convection
4. Study of vapour absorption refrigeration system

CS3601 OBJECTED ORIENTED PROGRAMMING LAB

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-3-2**

Objectives:

- To be able to apply an object oriented approach to programming and identify potential benefits of object-oriented programming over other approaches.
- To be able to reuse the code and write the classes which work like built-in types.
- To be able to design applications which are easier to debug, maintain and extend.
- To be able to apply object-oriented concepts in real world applications.

Experiments:

1. A program to illustrate the concept of class with constructors, methods and overloading.
2. A program to illustrate the concept of inheritance and dynamic polymorphism.
3. A program to illustrate the usage of abstract class.
4. A program to illustrate multithreading.
5. A program to illustrate thread synchronization.
6. A program to illustrate Exception handling.
7. A program to illustrate user-defined Exceptions
8. A program to demonstrate use of User-defined Packages.
9. A program using String Tokenize.
10. A program using Linked list class
11. A program using Tree Set class
12. A program using Hash Set and Iterator classes
13. A program using Map classes.
14. A program using Enumeration and Comparator interfaces.
15. A program using File and Filename Filter
16. A program to illustrate the usage of Byte and Character I/O streams.
17. A program to illustrate the usage of Serialization.
18. Program using Data class.\
19. An application involving GUI with different controls, menus and event handling.
20. A program to implement an applet.

For the detailed list of programs refer the lab manual.

Note: Any experiment according to the syllabus of CS3001 can be substituted

CODE: ME3902 **SEMINAR-III**

Scheme of Internal Exam **: 25 Marks**
Credits **: 1**

Objectives:
Objective of the project seminar is to actively involve the students in preparation of the final year project with regard to following components:

- Problem definition and specification
- Literature survey, familiarity with research journals
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of graphs, bar (activity) charts and analyzing the results.
- Presentation - oral and written.

The evaluation is purely internal and will be conducted as follows:

Preliminary Report on progress of the work and viva	05 marks
Final report	05 marks
Presentation and Defence before a departmental committee consisting of Head, a senior faculty and supervisor	15 marks

CODE: ME3000 **COMPREHENSIVE VIVA-I**

Scheme of External Exam **: 50 Marks**
Credits **: 1**

Students are assessed in the courses they have undergone till the completion of that academic year. They are asked to comprehend the concepts in the core subjects and the elective subjects, to make them ready to face technical interviews which improve their employability skills.

There are no sessional marks. The end examination shall be conducted by a committee consisting of an External examiner, Head of the department and two senior faculty members. The evaluation is purely external and it carries marks 50.