DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Instruction
and
Syllabi of

B.E. (Mechanical Engineering)
III & IV SEMESTER

With effect from the academic year 2023-2024

UNIVERSITY COLLEGE OF ENGINEERING
(AUTONOMOUS)
OSMANIA UNIVERSITY
HYDERABAD – 500 007, TELANGANA

SCHEME OF INSTRUCTION EXAMINATION
B.E III Semester (Mechanical Engineering)

S.No.	Course Code	Course Title	Scheme of Instruction			Contact hrs/wk	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1	BS 304MT	Engineering Mathematics-III (PDE, Probability & Statistics)	3	-	-	3	40	60	3
2	ES 303EC	Microcontroller and Interfacing	3	-	-	3	40	60	3
3	PC 301ME	Engineering Thermodynamics	3	-	-	3	40	60	3
4	PC 302ME	Materials and Metallurgical Engineering	3	-	-	3	40	60	3
5	PC 303ME	Strength of Materials	3	-	-	3	40	60	3
6	PC 305ME	Automobile Engineering	3	-	-	3	40	60	3
PRACTICALS									
8	PC 351ME	Materials Engineering Lab	-	-	2	2	25	50	1
9	PC 352ME	Strength of Materials Lab	-	-	2	2	25	50	1
10	ES 353EC	Microcontroller Lab	-	-	2	2	25	50	1
Total			18		6	24	315	510	21

SCHEME OF INSTRUCTION & EXAMINATION
Service Courses Offered to other Departments

B.E III Semester (Mining Engineering)

S.No	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1	ES 301ME	Basics of Mechanical Engineering	3	-	-	3	40	60	3

BS304MT

ENGINEERING MATHEMATICS–III

(PDE, Probability &Statistics**)**

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3 hours*

CIE: 40 Marks *SEE: 60 Marks*

Course Objectives:

The course is taught with the objectives of enabling the student to:

- To introduce the solution methodologies for first order and second order partial differential equations
- To introduce separation of variables method to solve heat and wave equation
- To learn random variables and their properties
- To understand probability distributions, curve fitting, correlation and regression
- To introduce tests of significance

Course Outcomes:

On completion of this course, the student will be able to:

- Solve linear first order and second order partial differential equations
- Solve one – dimensional heat and wave equations using separation of variables
- Solve problems involving random variables
- Fit curves for a given data and perform a regression analysis and to compute and interpret the coefficient of correlation.
- Estimate unknown parameters of populations and apply the tests of hypotheses

Unit-I

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

Unit-II

Second-order linear equations and their classification, Initial and boundary conditions, D' Alembert's solution of the wave equation; Heat diffusion equation, Separation of variables method to simple problems in Cartesian coordinates., one dimensional diffusion equation and its solution by separation of variables.

Unit-III

Measures of Central tendency: Moments, skewness and Kurtosis, Discrete random variables, expectation of discrete random variables, moments, variance of a sum, continuous random variables & their properties, distribution functions, and densities.

Unit-IV

Probability distributions: Binomial, Poisson and Normal, evaluation of statistical parameters for these three distributions, Curve fitting by the method of least squares: fitting of straight lines, second degree parabolas and more general curves, Correlation, regression and rank correlation.

Unit-V

Test of significance: Large sample test for single proportion, difference of proportions, Small sample Test for single mean, difference of means, and difference of standard deviations, Test for ratio of variances, Chi- square test for goodness of fit and independence of attributes.

Suggested Reading:

1. R. K. Jain & S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 4th Edition 2014.
2. Erwin Kreyszi, Advanced Engineering Mathematics, John Wiley, 9th Edition, 2012.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 43rd Edition, 2014.
4. S. Ross, "A First Course in Probability", Pearson Education India, 2002
5. B.V .Ramana, Higher Engineering Mathematics, 23rd reprint, 2015.
6. S. C Gupta & Kapoor: Fundamentals of Mathematical statistics, Sultanch and & sons, New Delhi.
7. H.K. Dass, Er. RajnishVarma, higher Engineering Mathematics, S.Chand Technical 3rd Edition.

ES303EC

MICROCONTROLLER AND INTERFACING

Credits: 3

Instructions :(3L) hrs per week *Duration of SEE: 3hours*
CIE: 40 Marks *SEE: 60 Marks*

Course Objectives

- To learn the architecture and programming of typical microcontroller.
- To introduce the basic concepts of small and medium scale embedded system design using microcontroller
- To get familiarity of assembly as well as embedded C programming environment to control peripheral devices
- To develop assembly and C language programming skills for real time applications of Microcontroller
- To gives hands-on training of interfacing external sensors and actuators with microcontroller

Course Outcomes

- Explain the architecture of 8085 microprocessor and AVR 8-bit Microcontroller
- Differentiate microprocessor and microcontroller and Describe the importance and function of each pin of AVR ATmega32 Microcontroller
- Learn and analyze assembly language programs for AVR Microcontroller
- Develop embedded C language programs for AVR Microcontroller
- Interface I/O peripheral devices with AVR microcontroller to develop embedded system

UNIT I

Fundamentals of Microprocessors: History of microprocessor and microcontrollers, Difference between microprocessors and microcontrollers and Applications of microcontrollers, Architectural of 8-bit 8085 microprocessor, Pin details and functional operation of 8085, Memory and I/O interfacing. Role of microcontrollers in embedded Systems. Overview of the AVR family

UNIT II

Architecture and instruction set of 8-bit AVR Microcontroller: AVR Microcontroller architecture: Registers, AVR status register, Memory Space, ATmega32 pin-configuration & function of each pin, Addressing mode and instruction set of AVR microcontroller, Data transfer, Arithmetic, Logic and Compare, Rotate and Shift, Branch and Call instructions, Bit manipulation instructions.

UNIT III

AVR Assembly and C Programming: . AVR data types and assembler directives, AVR assembly language programs, AVR I/O Port Programming, Time delay loop, BCD, ASCII conversion Program, Look-up table, Bit addressability, MACROs, Pros and cons of C and assembly language programming, Data types, Intex Hex file format, Simple C programs for general purpose I/O and bit addressability.

UNIT IV

AVR on-chip peripherals and its programming: General purpose I/O Ports, Timers, Interrupts, serial port, Serial port Interfacing protocols, SPI, I2C, UART. Assembly and C Language programming for peripherals.

UNIT V

Device interfacing and its programming: LCD and GLCD interfacing, Keyboard Interfacing, TFT interfacing, ADC, DAC and sensor interfacing, Relay, Opto-isolator and Stepper Motor Interfacing, Industrial servo interfacing, Input capture and Wave Generator, PWM programming and DC motor control, SPI protocol and Display interfacing, I2C Protocol and RTC interfacing. Assembly and C Programming.

Suggested Readings:

1. Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi,"The AVR Microcontroller and Embedded Systems", Using Assembly and C, Pearson Education, 1st Edition, 2012.
2. DhananjayGadre, "Programming and Customizing the AVR Microcontroller", TMH, 1st Edition, 2001.
3. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996.

PC301ME

ENGINEERING THERMODYNAMICS

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 40 Marks *SEE: 60 Marks*

Course Objectives:

- To understand fundamental laws and principles of thermodynamics.
- To know the first law of thermodynamics with the conservation of energy Principles.
- To understand the second law of thermodynamics with the Concept of Entropy.
- To know the concept of pure substance and properties of steam.
- To understand the gas mixtures and psychometry concepts used for air conditioning systems.

Course Outcomes: Upon successful completion of this course, the student will be able to

- Acquire knowledge to the basic principles of thermodynamics.
- Distinguish the different types of thermodynamic laws
- Acquire knowledge to the properties of pure substances working with Rankine power plant cycle.
- Analyze the Psychrometry chart and Air conditioning systems.

UNIT-I

Introduction to Thermodynamics: Types of systems, Classification of Properties - fundamental and secondary, intensive and extensive. Basic laws of Thermodynamics, Thermodynamic equilibrium. Types of thermodynamic processes and their representation on P-V and T-s plots. Types of cycles- Open and Closed.

Ideal Gases- Equation of State. Specific Heats, Enthalpy, Internal energy, &Entropy. Real Gases- vander Waals Equation of State, Compressibility Factor.

UNIT-II

First Law applied to Closed Systems: Heat and work transfers. Energy conservation equation for a closed system. Calculation of Work Transfer, Heat Transfer, and Internal Energy changes.

First Law applied to open Systems: Derivation of Unsteady Flow Energy Equation(UFEE) and Steady Flow Energy Equation (SFEE). Calculation of Work Transfer, Heat Transfer, and Enthalpy changes. Thermodynamic analysis of flow through Nozzles, Diffusers, Turbines, Compressors, Throttling devices and Heat Exchangers.

Application of Unsteady Flow Energy Equation (UFEE): Calculation of Heat transfer during charging /evacuation of a Cylinder.

UNIT-III

Carnot Cycle- Thermodynamic analysis of Carnot Cycle. Applications of Carnot cycle-Heat Engine, Heat Pump and Refrigerator.

Second Law of Thermodynamics: Statements of Second Law of thermodynamics. Equivalence of Kelvin -Planck and Clausius Statements. Clausius Inequality, Carnot Theorems, Thermodynamic Temperature Scale.

Concept of Entropy: Reversible and Irreversible processes. Calculation of Entropy change during various thermodynamic processes. Principle of Increase of Entropy. Second law analysis of a control Volume.

Concepts of Energy and Anergy: Loss in available energy. Second law efficiency of Turbines and Compressors.

UNIT-IV

Pure Substances. Concept of Phase Change. Graphical representation of thermodynamic processes on P-V, P-T, T-V, T-s, h-s, P-h and P-V-T diagrams. Thermodynamic relations involving Entropy, Enthalpy and Internal Energy. Derivation of Maxwell's relations. Clapeyron equation.

Properties of Steam-Use of Steam Tables and Mollier diagram.

Power Plant Cycles-Carnot and Rankine Cycles and their representation on P-V, T-s and h-s diagrams. Evaluation of performance parameters–Efficiency, Work ratio, Specific Steam Consumption and Heat Rate.

UNIT-V

Non-reactive Ideal homogenous gas Mixtures: Determination of properties of Mixture in terms of properties of individual components of the mixture. Gibbs Phase Rule.

Psychrometry: Moist Air Properties. Use of Psychrometric Chart and Tables.

Concept of Air-Conditioning: Heating, Cooling, Humidification and De-humidification and other psychrometric processes. Adiabatic Mixing of two Streams of Moist Air. Sensible heat factor and Bypass factor for heaters/coolers.

Introduction to summer and winter air-conditioning processes with a brief overview on devices used in Air Conditioning.

Suggested Reading:

1. Yunus Cengel, Michael Boles "*Thermodynamics: An Engineering Approach",* McGraw-Hill Education; 8 edition, 2017
2. NagP.K, "*Engineering Thermodynamics'*: Tata McGraw Hill Publishing, 6thEdn, 2017.
3. Richard E.Sonntag, C.Borgnakke,G. J Van Wylen, *"Fundamentals of Thermodynamics ':* John Wiley & Sons, 7th Edn., 2009.
4. Rajput R K, "*Engineering Thermodynamics*"LaxmiPublications,4thEdition,2016

PC302ME

MATERIALS AND METALLURGICAL ENGINEERING

Credits: 3

Instructions :(3L) hrs per week *Duration of SEE: 3hours*
CIE: 40 Marks *SEE: 60 Marks*

Course Objectives:

- Describe various imperfections, fracture and fatigue in metals.
- To understand the applications of ferrous and nonferrous metals and alloys
- To know the properties and applications of ceramics, polymers and composites
- To provide a detailed interpretation of equilibrium phase diagrams
- Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course Outcomes: Upon successful completion of this course, the student will be able to

- Identify crystal structures for various materials and understand various failures in metals like fracture, creep and fatigue.
- Acquire knowledge to tailor material properties of ferrous and non-ferrous alloys
- Differentiate the properties and applications of ceramics, polymer sand composites.
- Interpret thermal equilibrium diagram of binary non ferrous alloys
- Design various heat treatments to produce specific microstructure and properties for steels using time- temperature-transformation and continuous cooling diagrams as needed.

UNIT-I

Metals: Plain Carbon Steels ,Alloying of steel, properties of stainless steel and tool steels, maraging steels; cast irons: grey, white, malleable and spheroidal cast irons; **Non-ferrous metals**: Copper and copper alloys, Aluminium and Al-Cu–Mg alloys, Nickel based super alloys and Titanium alloys

UNIT-II

Non Metals: Ceramics - Crystalline ceramics, Glasses, Properties and applications of ceramics; **Polymers** - Polymerization, Thermoplastics and thermosetting plastics, Properties and applications of polymers; Methods of processing of plastics; **Composites** - Concept of composites, Matrix and reinforcement, Rule of mixtures, Classification of composites, Applications of composites.

UNIT–III

Crystal Structure: Unit cells, Metallic crystal structures. Imperfection in solids: Point, line, interfacial and volume defects; **Fracture:** Types of fracture in metals, modes of fracture, Ductile and brittle failure mechanisms, Griffith criterion for brittle materials. **Creep**: Creep strength, Creep curve, Creep Test. **Fatigue**: SN curve, endurance limit, Experimental determination of Fatigue strength

UNIT-IV

Phase diagrams: Substitutional and interstitial solid solutions. Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT-V

Heat Treatment of steels: Annealing, Normalizing, Hardening, Tempering. isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties. Austempering and Martempering. Case Hardening: Carburizing, Nitriding, Carbo-nitriding, Flame Hardening, Induction Hardening.

Suggested Reading:

1. W. D. Callister, 2007, adapted by R. Balasubramaniam, "MaterialsScience and Engineering", 7thEdition, Wiley India.
2. Kodgire V.D, Kodgire S.V., "Material Science and Metallurgy For Engineers" Everest Publishing House, 42ndEdition, 2018
3. Kenneth G. Budinski and Michael K. Budinski, "Engineering Mate rials", Prentice Hall of India Private Limited, 4thIndian Reprint, 2002.
4. Avner S.H, "Introduction to Physical Metallurgy", McGraw Hill Publishing Co.Ltd. 2nd Edition, 1974.
5. Nayak S.P, "Engineering Metallurgy And Material Science":Charotar Publishing House, 6thEdn., 1995.
6. RaghavanV,"Material Science and Engineering",PrenticeHall of IndiaLtd.,4thEdition,1994.

PC303ME

STRENGTH OF MATERIALS

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 40 Marks *SEE: 60 Marks*

Course Objectives:

- Understand the concept of stress, strain and elastic behavior of materials
- Know the concepts of strain energy, principal stress and principal planes
- Learn the bending moment, shear force and the corresponding stress distribution
- Study the deflections and its applications
- Understand the theory of torsion and stresses in springs

Course Outcomes: Upon successful completion of this course, the student will be able to

- Apply the fundamental concepts of stress and strain
- Determine principal stresses and principal planes of a state of stress
- Analyze the structural members subjected to tension, compression,
- Compute the bending, torsion and combined stresses
- Solve the stresses in springs

UNIT- I

Simple Stresses and Strains: Types of stresses and strains, Hook's law, stress-strain curve for ductile materials, moduli of elasticity, Poisson's ratio, linear strain, volumetric strain, relation between elastic constants, bars of varying sections, bar of uniform strength, compound bars and temperature stresses.

UNIT -II

Shear Force and Bending Moment: Relation between intensity of loading, shear force and bending moment, shear force and bending moment diagrams for cantilever and simply supported beams with and without overhanging for point loads, uniformly distributed loads, uniformly varying loads and couples. Compound Stresses: Stresses on oblique planes, principle stresses and principle planes, Mohr circle of stress and ellipse of stress.

UNIT -III

Theory of Simple Bending: Assumptions, derivation of basic equation, section modulus, moment of resistance, determination of flexural stresses. Direct and Bending Stresses: Basic concepts, core for rectangular solid and hollow circular and I sections. Distribution of Shear Stress: Equation of shear stress, distribution across rectangular, circular, diamond, T and I sections.

UNIT -IV

Torsion: Theory of pure torsion, derivation of basic equation, hollow circular shafts, strain energy, transmission of power, combined bending and torsion. Springs: Close and open coiled helical springs subjected to axial loads and axial couples, strain energy in springs, carriage springs.

UNIT -V

Deflections: Deflections of cantilever and simply supported beams including overhanging beams forpointloadsanduniformlydistributedloadsbydoubleintegrationandMacaulay'smethod.

Strain Energy : Strain energy in bars due to gradually applied loads, sudden loads, impact loads and shock loads.

Suggested Reading:

1. Ferdin and P Beer et .al., Mechanics of Materials ,Tata McGraw-Hill, 2004.
2. B.C.Punmia, Strength of Materials, Laxmi Publishers, 2000.
3. S.Ramamrutham Strength of Materials, Dhanpat Rai&Sons, 1993.
4. D.S.Prakash Rao, Strength of Materials-A Practical Approach, Universities Press,1999.
5. G.H. Ryder, Strength of Materials, Third Edition in SI units, Macmillan Indian Limited, Delhi, 2002.

PC 305ME

AUTOMOBILE ENGINEERING

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 40 Marks *SEE: 60 Marks*

Course Objectives:

- To learn about the layout and arrangement of principal parts of an automobile.
- To understand working of different types of Drive train and Transmission Systems
- To learn about different types of Steering, Axle, Wheels and Tyres.
- To understand different types of Suspension and braking systems.
- To learn about Modern Automobiles-Hybrid, Electric, Autonomous vehicles.

Course Outcomes: Upon successful completion of this course, the student will be able to:

- Identify principal parts of an automobile and their layout.
- Illustrate the working principles of Drive train and Transmission Systems.
- Enumerate the working principles of Steering, Axle, Wheels and Tyres.
- Examine the functioning of Suspension and braking systems
- Illustrate working principles of Modern Vehicle Technologies -Hybrid, Electric, Autonomous vehicles

UNIT-I

INTRODUCTION & AUTOMOBILE CHASSIS

Automobile engineering-history, current scenario in Indian automotive sector.

Chassis: Classification of chassis layout with reference to power source locations and drive. Functions of chassis, Conventional, Semi-forward and Full-forward chassis. Front, Centre and Rear engine Chassis.

Advantages, Disadvantages & Applications of Ladder frame, Backbone, Monocoque, Tubular, Ulasab, Carbon Fibre and Aluminium Chassis. Materials used in chassis and body components of the vehicle

UNIT-II

DRIVE TRAIN, TRANSMISSION AND CLUTCH SYSTEMS

Layout of the Automotive **Drivetrain-** Functioning, Advantages and Disadvantages of Front Engine-Rear Wheel Drive, Front Engine-Front Wheel Drive, Rear Engine-Rear Wheel Drive and Four Wheel Drives.

Layout of Transmission System-**Gear Box**- Sliding Mesh, Constant Mesh and Synchromesh, Planetary Gear System- working principle of Allison 7 speed drive. Different types of transmission systems- Manual, Automatic, Automated Manual, Intelligent Manual, CVT and DCT types.

Classification of **Clutches-**Friction, Centrifugal, Semi–Centrifugal, Conical, Positive, Hydraulic, Electromagnetic, Vacuum and Overrunning Clutches. Clutch materials -KEVLAR etc, Dual Mass Flywheel.

Propeller Shaft, Universal Joint, Differential and final drive.

UNIT-III

STEERING SYSTEMS, FRONT & REAR AXLES, WHEELS & TYRES

Steering System: Centre pivoting and Side pivoting steering mechanisms, Steering linkages. Types of Steering gears, Power steering-Hydraulic, Hybrid and Electric power steering

Systems. Collapsible steering, Telescopic Steering. Reversibility of steering, Four wheel steering.

Axles: Purpose and requirement of front & rear axle, live and dead axles types & arrangement, types of loads acting on rear axles, full floating, three quarter floating and semi floating rear axles. Wheel and Tyres: Wheel construction, type of tyres, tyre construction, tyre materials, factors affecting tyre life, wheel alignment and wheel balancing.

UNIT-IV

SUSPENSION & BRAKES SYSTEM

Types of **Suspension systems-** Conventional suspension system, Independent suspension system, Air suspension system and Hydro elastic suspension system. Mac Pherson Strut, Double Wishbone and Trailing Arm Suspension systems, damping and shock absorbe rs.

Types of **Brake systems** - drum, disc, operation-mechanical, hydraulic, air brakes, servo and power braking, hand brake, Traction Control Vs Stability Control, ABS -Components of ABC, Types of ABS

UNIT-V

MODERN AUTOMOBILES

Use of Alternative Power Sources

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles

Hybrid Vehicles- Vehicle classification by propulsion system, HEV, PHEV & FHEVs, Power Flow in a Hybrid Vehicle , Types of Hybrid Electric Vehicles ,Solar Electric Vehicles, Hybrid Cars in India

Electric Vehicles- Key components of an All-Electric Car, Charging Infrastructure Terminology, Levels of Charging Stations

Autonomous vehicles –Basic physical ecosystem of Self Driving Vehicles, Levels of Automation, LiDAR Technology –Merits and Demerits. Camera Vs LiDAR Technology. Current status of development in India and World, Technological obstacles for Driverless cars

Connected Automobiles-Types of connectivity-V2I, V2V, V2C, V2P and V2E, Drawbacks and Challenges

Future Cars- Hydrogen Fuel Cell Cars and Flying Cars, Technology, infrastructure and regulatory challenges

Suggested Reading:

1. Kirpal Singh, "Automobile Engineering, Vol I and II", 12th Edition, Standard Publishers, 2020.
2. S. Srinivasan, "Automotive Mechanics", 2nd Edition, Tata McGraw Hill, 2004.
3. William H. Crouse, Donald L. Anglin, "Automotive Mechanics", 10th Ed., Tata McGraw Hill, 2007.
4. Chris Mi, M. Abul Masrur, "Hybrid Electric Vehicles-Principles and Applications with Practical Perspectives", Wiley, 2017.
5. Robert Bosch , "Bosch Automotive Handbook" Wiley, 2019.
6. Paul Nooncree Hasluck , "The Automobile: A Practical Treatise On the Construction of Modern Motor Cars Steam, Petrol, Electric and Petrol-Electric Based On Lavergne's L'automobile Sur Route", Legare Street Press, 2023.

PC351ME

MATERIAL SENGINEERING LAB

Credits: 1

Instructions: (2P) hrs per week *Duration of SEE: 3hours*
CIE: 25 Marks *SEE: 50 Marks*

Course Objectives:

- To get familiarized with the procedure of metallurgical specimen preparation for microscopic examination and viewing the structure
- To learn the concept of the preparation of sample stopper form characterization such as microstructure, grain size.
- To know the method of identifying phases of microstructure and identifying different metals and alloys
- To Explain hardenability and factors affecting it by Jominy Quench Test
- To learn the concepts of improving the mechanical properties of materials by different methods like heat treatment, surface treatment etc.

Course Outcomes: Upon successful completion of this course, the student will be able to

- Acquire experimentation skills in the field of material testing.
- Identify different metals and alloys based on metallurgical phases observed in the micro structure
- To analyze the microstructure of a specimen quantitatively.
- Apply various methods of preparing a specimen for viewing the microstructure
- Distinguish the phase changes in a heat treated specimen compared to untreated specimen.

List of Experiments:

1. Study of Crystal Structures, Metallurgical Microscope, Iron-Iron Carbide diagram
2. Sample Preparation techniques for Metallographic Analysis
3. Grain size measurement
4. Metallographic Study of Pure Iron, Low carbon steel
5. Metallographic Study of Medium carbon steel
6. Metallographic Study of Hyper Eutectoid steel
7. Metallographic Study of Wrought iron
8. Metallographic Study of Grey cast iron
9. Metallographic Study of White cast iron
10. Metallographic Study of Blackheart/White heart Malleable cast iron
11. Metallographic Study of Copper alloy
12. Metallographic Study of Aluminium alloy
13. Determination of hardenability by Jominy Quench Test
14. Study of microstructure after hardening, normalizing and annealing of steel specimen.

PC 352ME

STRENGTH OF MATERIALS LAB

Credits:1

Instructions: (2P) hrs per week *Duration of SEE: 3hours*
CIE: 25 Marks *SEE: 50Marks*

Course Objectives:

- Understand the experiments on various materials to assess their behavior and limitations
- Learn the brittle and ductile material failure patterns
- Understand the shear force, bending moment and deflection for different types of beams
- Know the rigidity modulus by conducting spring and torsion test

Course Outcomes: Upon successful completion of this course, the student will be able to

- EvaluateYoung'smodulus,rigiditymodulus,hardnessnumber,flexuralrigidityandimpact strength of given specimens
- Find the cracking stress and compressive strength.
- Determine the stiffness of close coiled helical springs
- Find the deflection of a beam

List of Experiments:

1. Uni-axial tension test on a specimen of ductile material
2. Stress-Strain characteristics of a ductile material
3. Hardness testing of metallic materials
4. Torsion test on a specimen of ductile material
5. Compression test on close coiled helical spring
6. Bending test on simply supported beam of steel
7. Bending test on fixed beam of steel
8. Izod and Charpy impact test
9. Stiffness of close coiled helical spring.

ES 353EC

MICROCONTROLLER LAB

Credits: 1

Instructions :(2P) hrs per week *Duration of SEE: 3hours*

CIE: 25 Marks *SEE: 50 Marks*

Course Objectives

1. Write programs using the functions in Arduino IDE Environment
2. Interface external devices with Arduino boards
3. Write assembly language program using instruction set in AVR 8 bit Micro Controller¬
4. Use features available in AVR Micro Controller
5. Interface application circuits with AVR Micro Controller

Course Outcomes: Upon successful completion of this course, the student will be able to

Learn the basics of electronics, including reading schematics (electronics diagrams)

1. Learn how to prototype circuits with a breadboard.
2. Learn the Arduino programming language and IDE.
3. Program the Arduino microcontroller to make the circuits work
4. Connect the Arduino microcontroller to a serial terminal to understand communication and stand-alone use

List of Experiments:

1. Understand Arduino open source hardware and programming environment and write program to blink LED using Arduino instructions, C language & Assembly language.
2. Interface Digital/Analog input output interfacing module with Arduino board and write programs related to I/O module
3. Generate PWM waveform and change intensity of LED connected with Arduino board.
4. Write and execute Arduino program for serial communication. Transmit temperature value through serial communication and store it in spreadsheet or text file
5. Write and execute Arduino program to display message and numbers on LCD, GLCD and TFT.
6. Write and execute Arduino program to read analog value. Sense temperature using LM35 sensor and display temperature value on LCD
7. Write assembly language programs for ATMega32 Microcontroller and simulate using ATMEL Studio
8. Understand hardware of ATMega32 Kit. Write program to flash LEDs, Read status of switches, Display count values on seven segment display. Upload programs in the kit one by one and execute.
9. Write program to read switch status and display it on LCD. Write program in Assembly as well as C language.
10. Write program to rotate stepper motor in half step and full step mode in Assembly as well as C language. Simulate program using PROTEUS software
11. Write program to rotate DC motor in clockwise and anti-clockwise direction in Assembly as well as C language. Simulate program using PROTEUS software.
12. Observe waveforms of I2C and SPI communication and understand I2C and SPI protocol 13. Write Arduino program to receive IR Signal from IR remote and operate Electrical device based on switch pressed.

Suggested readings:

1. Mike Cheich, "Arduino Book for Beginners", Kindle Edition, Programming electronics Academy,2021
2. James M. Fiore, "Embedded Controllers Using C and Arduino" Version 2.0.7, 06 March 2018, copyrighted under the terms of a Creative Commons license
3. Simon Monk, "Programming Arduino: Getting Started with Sketches" 2nd Edition, Kindle Edition, McGraw Hill ,2016

SCHEME OF INSTRUCTION & EXAMINATION

B.E IV Semester (Mechanical Engineering)

S.No	Course Code	Course Title	No of Hours			Contact hrs/wk	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1.	PC 401ME	Kinematics of Machines	3	-	-	3	40	60	3
2.	PC 402ME	Thermal Engineering	3	-	-	3	40	60	3
3.	PC 403ME	Manufacturing Processes	3	-	-	3	40	60	3
4.	PC 404ME	Design of Machine Elements	3	-	-	3	40	60	3
5.	PC 405ME	Machine Drawing	-	-	6	6	40	60	3
6	HS901ME	Managerial Economics & Accountancy	3	0	0	3	40	60	3
PRACTICALS									
8.	PC 451ME	Thermal Engineering Lab – I	-	-	2	2	25	50	1
9.	PC 452ME	Manufacturing Processes Lab	-	-	2	2	25	50	1
10	PC453ME	Design Thinking Lab	-	-	2	2	25	50	1
		Total	15		12	27	310	510	21

SCHEME OF INSTRUCTION & EXAMINATION

Service Courses Offered to other Departments

B.E IV Semester (ECE)

S.No	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1	**ES 401ME**	**Fundamentals of Robotics**	3	-	-	3	40	60	3

PC304ME

KINEMATICS OF MACHINES

Credits: 3

Instructions: (3L) hrs per week
CIE: 40 Marks

Duration of SEE: 3hours
SEE: 60 Marks

Course Objectives:

- Tounderstandthebasicelementsofmachineryandtheirmotioncharacteristics
- To know the kinematic properties of mechanisms and machines
- To understand basic machine elements
- To know the classification and applications of cams, gears and gear-trains

Course Outcomes: Upon successful completion of this course, the student will be able to

- To identify and enumerate different link based mechanisms with basic understanding of motion and geometry of components.
- Analyze the planar mechanisms for position, velocity and acceleration and synthesize planar four bar and slider crank mechanisms for specified design requirements
- To understand and identify the importance of various drive systems like Belt, gear, chain, Cams for specific applications
- Design and develop suitable drive systems like Belt, gear, chain, Cams for specific application
- Identify the importance of friction and apply it for developing various mechanisms

UNIT-I

Definitions of link, pair, chain mechanism, degrees of freedom, Kutzbach's and Grubbler's criterion. Grashof's Law, Inversions of four bar mechanisms with all revolute joints, single and double slider crank mechanisms. Instantaneous Centre, Space Centrode and Body Centrode, Kennedy Theorem. Definitions and scope of Type, Number and Dimensional Synthesis. Pantograph and Geneva mechanisms. Ackerman and Davis steering gear mechanisms and Hooke's Joint. Peaucellier, Hart, Scott-Russel, Watt and Tchebicheff mechanisms.

UNIT-II

Graphical methods to find velocities and accelerations in mechanisms using Instantaneous centre method and relative velocity method including Coriolis component of acceleration.

UNIT-III

Laws of friction. Screw threads, Pivots, Collars. Clutches -Single and Multi plate, Cone and centrifugal clutches. Friction circle and friction axis of a link. Belt,Rope and introduction to Chain drives.

UNIT-IV

Brakes and Dynamometers: Blockorshoe, band and block, internal expanding shoe brakes and disc brakes. Prony, Rope brake, Belt transmission and epicyclic train Dynamometers.
Cams and Followers: Types of Cams and followers, motion of the follower, follower displacement diagram, Cam profile for specified follower motion and Cams with specified contours.

UNIT-V

Theory of Gearing, Terminology and Definitions, Law of Gearing, Tooth profiles, Path of contact and Arc of contact. Interference, methods of avoiding interference. Contact Ratio. Introduction to Helical, Bevel and worm gears.

Gear Trains: Simple, Compound, Reverted and Epicyclic gear trains. Differential of an Automobile.

Suggested Reading:

1. S.S.Rathan, "Theory of Machines", McGrawHill, 5th Edition, 2019.
2. Thomas Bevan, "Theory of Machines", 3rdedition, Pearson Education, 2005
3. A.Ghosh and Mallick, "Theory of mechanisms and machines", 3rd edition, Affiliated to East-West Press, 2008.
4. Theory of Machines and Mechanisms, Shigley, J.E., and Uicker, J.J., McGraw Hill Int. Edition, New York, 2003, 2nd Edition.
5. Robert L. Norton, "Design of Machinery",Tata McGrawHill,2005.
6. Venkatachalam, R.Mechanical Vibrations, PHI, 2014.

PC402ME

THERMAL ENGINEERING

Credits: 3

Instructions: (3L) hrs per week *Duration of SEE:3hours*
CIE: 40 Marks *SEE: 60 Marks*

Course Objectives:

- To understand the working principles and quantify the behavior of reciprocating air compressors.
- To understand classification of IC Engines and their supporting systems and their working principles. ,
- To understand Combustion Phenomena in Engines and working principles of Combustion chambers.
- To gain the knowledge on construction and working principles of Thermal Power plant Devices-Boilers, Condensers
- TounderstandconstructionandworkingprinciplesofSteamNozzlesandtoanalyseRankine cycle applied to thermal power plants.

Course Outcomes:

Upon successful completion of this course, the student will be able to

- To quantify the behavior of reciprocating air compressors.
- To explain thermal design and working principles of IC Engines and their supporting systems and carry out performance analysis of IC Engines.
- To explain working principles of Combustion chambers used in IC Engines and understand methods to minimize abnormal combustion in IC Engines.
- To explain the thermal design and working principles of Power plant devices - Boilers, Condensers.
- To quantify the behavior of power plants based on the Rankine cycle, including the effect of enhancements such as superheat, reheat and regeneration (Direct and Indirect).
  They are expected to understand construction and working principles of Steam Nozzles.

Unit-I

Steam Boilers: Classification and Working Principles. Water tube boilers- Babcok & Wilcox and Stirling boilers. Fire tube boilers- Cornish, Cochran, Locomotive and Lancashire boilers. High Pressure boilers / Supercritical boilers: Lamont, Benson boiler, Loeffler boiler and Velox boiler.

Boiler Mountings and Accessories: Working Principles of Water level indicator, Pressure gauge, Steam stop valve, Feed check valve, Blow-off cock, Fusible plug, Safety valves, Economizers, Super heaters and Steam separator. Steam Condensers: Jet and Surface co ndensers, Principle of Operation and Applications.

Unit-II

Steam power plant cycles: Carnot and Rankine cycles of operation and their efficiencies. Analysis of Rankine cycle with superheating, reheating and regeneration (Direct and Indirect types).

Steam Nozzles: Flow of steam through convergent - divergent nozzles, velocity of steam flowing through the nozzle, mass of steam discharge through the nozzle, condition for maximum discharge, critical pressure ratio and nozzle efficiency. Super saturated expansion of steam through nozzles. General relationship between area, velocity and pressure in Nozzle flow.

Unit-III

Reciprocating Air Compressors: Classification and applications. Ideal and actual P-V diagrams, work input and efficiency relations for single and multi stage compressors. Effect of clearance volume on work input and efficiency. Inter cooling and after cooling concepts.

Unit-IV

Internal Combustion Engines: Classification and applications. Working principles of four stroke and two stroke engines, Spark Ignition and Compression ignition engines. Deviation of actual cycles from Air Standard cycles. Performance parameters of I.C.Engines. Heat balance sheet of I.C. Engine.

Overview of Engine supporting systems- Cooling Systems, Lubrication systems- Wet sump, Dry sump and Mist Systems. Working principles of S.I. Engine fuel systems- Carburetors, Battery and Magneto Ignition systems. Working principles of C.I. Engine fuel systems- Fuel pump and Fuel injector.

Unit-V

I.C.EngineCombustionphenomena: StagesofcombustioninS.I.Engines-Ignitiondelay,Flame front propagation and After burning. Abnormal combustion- Pre-ignition and Knocking.

Factors affecting Knocking. Stages of combustion in C.I. Engines, Delay period, Period of Uncontrolled Combustion, Period of Controlled Combustion and after burning. Abnormal Combustion-Knocking. Factors affecting Knocking. Octane and Cetane rating of fuels. Design considerations for combustion chamber and cylinder head. Type of combustion chambers of S.I. engines and C.I. engines.

Suggested Reading

1. P.L.Ballaney, "*Thermal Engineering: Engineering Thermodynamics & Energy Conversion Techniques*" Khanna Publishers, 19th Edn, 2005.
2. Richard J Martin, Thermal System Design: Fundamentals and Projects, 2 nd Edition, John Wiley & Sons, Inc., 2022.
3. Heinz P Bloch, John J Hoefner, Reciprocating Compressors: Operation & Maintenance, Butterworth-Heinemann, 1996.
4. V.Ganesan, *"Internal Combustion Engines" ,* Tata McGrawHillPublishing,4thEdn,2017.
5. Richard Stone, *"Introduction to I.C.Engines*", PalgraveMacMillan,4thEdn.,2012.

PC403ME

MANUFACTURINGPROCESSES

Credits: 3

Instructions :(3L) hrs per week *Duration of SEE: 3hours*
CIE: 40 Marks *SEE: 60 Marks*

Course Objectives:

- To understand the concept of various casting processes & furnaces
- To gain knowledge on various metal forming processes like rolling & extrusion
- To know the principle of forging and various press working operations.
- To familiarize the different techniques of joining processes.
- To understand the manufacturing of plastics, powder metallurgy and composites.

Course Outcomes: Upon successful completion o f this course, the student will be able to:

- Understand the basic working principles of casting, forming and welding.
- Some understanding of types, manufacturing processes and applications of plastics and composite materials.
- Recommend appropriate part manufacturing processes when provided a set of functional requirements.
- Ability to analyze problems on forging, rolling, drawing and extrusion.
- Communicate effectively with industry personnel by developing a manufacturing-centric vocabulary.

UNIT-I

Casting: Steps involved in making a casting, Advantages, limitations & applications of casting processes, Patterns-Types, pattern materials & pattern allowances, Moulding materials, mouldings and ingredients, essential requirements, moulding processes–types, Principles of Gating, Gating ratio, Riser and its types.

Special casting processes: Shell moulding, Centrifugal Casting, Die Casting, Investment Casting, CO_2moulding. Casting defects - causes and remedies.

Melting furnaces: Cupola, LD process, Arc and Induction.

UNIT-II

Metal Forming: Cold and hot working, strain hardening, recovery, Re-crystallization, and grain growth.

Rolling: Rolling fundamentals–theory of rolling, types of Rolling mills and product, Forces in rolling and power requirements**.**

Extrusion of Metals: Basic extrusion process and its characteristics. Cold extrusion and hot extrusion, Forward extrusion and backward extrusion, Impact extrusion, Hydrostatic extrusion.

UNIT-III

Forging processes: Principles of forging, Tools and dies. Types of Forging–Smith Forging, Drop Forging, Roll Forging, Rotary forging. Heading, Forging hammers, Forging defects**.**

Sheet Metal Forming and Other Cold Working Processes: Blanking and Punching, Bending, Deep Drawing, Spinning, Types of presses and press tools, Wire Drawing and Tube Drawing-Forces and power requirement in the above operations. Introduction to HERF process.

UNIT -IV

Welding: Classification of welding process, types of welds and welded joints and their characteristics, Gas Welding, Arc Welding - Shielded Metal Arc, Submerged Arc, Inert Gas welding - TIG & MIG Welding.

Resistance Welding, Thermit Welding, Plasma (Air and water) Welding. Friction Welding, Induction welding, Explosive Welding, Laser Welding, Heat Affected Zones in welding, Soldering & Brazing, Welding defects–Causes and remedies–Destructive, non-destructive testing of welds. Principle of Friction Stir Welding Process.

UNIT-V

Processing of Plastics: Processing methods & Equipment-blow moulding, injection moulding, extrusion, thermo forming, compression moulding, transfer moulding, calendaring.

Powder Metallurgy: Basic steps, Powder preparations, blending, compaction, sintering, Applications.

Manufacturing of Composites: Hand lay-up, Filament winding, Compression molding, Resin infusion molding.

Note: The related simulation software to be introduced where ever it may be applicable.

Suggested Reading:

1. P.N.Rao,"ManufacturingTechnology,"Vol.1,TataMcGrawHillPubl.,3rdEd.,2011.
2. Amitabh Ghosh & Mallick, "Manufacturing Science", Assoc. East west Press Pvt. Ltd. 4thEd.,2011.
3. Serope Kalpakjian, "Manufacturing Engineering and Technology", Addison, Wesley Publishing Company, 2006
4. KaushishJ.P,"ManufacturingProcesses",PHILearningPvt.Ltd.,2nd Ed.,2010.
5. R S Parmar, Welding Technology, IITD, third Edition, Khanna Publishers, 2013.
6. Heine Cooper Rosenthal, Metal Casting Process, TMH, 2009.

PC 404ME

DESIGN OF MACHINE ELEMENTS

Credits: 3

Instructions :(3L) hrs per week *Duration of SEE: 3hours*
CIE: 40 Marks *SEE: 60 Marks*

Course Objectives:

- To understand the basics of mechanics of materials and design of a machine for static and fatigue strength, rigidity and wear criterions, usage of codes and standards.
- To know the principles of ergonomic design.
- To learn the principles to design shafts, keys, belt drives, joints and couplings.

Course Outcomes: Upon successful completion o f this course, the student will be able to:

- Identify the preferred sizes and codes and selection of proper material for designing machine elements.
- To select and identify suitable material and dimensions for the machine components based on theories of static and fatigue failures.
- Determining size and dimensions of simple machine components under various loads viz tensile, axial, shear, bending and torque loads.
- Compare and contrast use of various joints and fasteners for a given application.
- Design the temporary and permanent joints required to assemble the machine elements.

Unit-I

Introduction, Important mechanical properties of materials used in design. Codes and standards used in design. Reliability, Principles of good Ergonomic Design, Manufacturing considerations. Preferred numbers. Value analysis.

Analysis of Stress and Strain: Definition of stress and strain, Types of loading, Direct normal stress, bending stress, Torsional stress, crushing and bearing stresses, Biaxial stress and Triaxial stress.

Theories of elastic failure, Stress concentration factor, factor of safety, Design of components for static loads, Introduction to thermal stresses.

Unit-II

Design for Fatigue and Impact loads; Importance of fatigue in design, Fluctuating stresses, fatigue strength and endurance limit. Factors affecting fatigue strength. S-N Diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue, Miner's rule, Design of components for fatigue. Design of components for impact loading.

Unit-III

Design of keys, shafts – solid hollow stepped shafts and splined shafts under torsion and bending loads.
Design of couplings – Muff and Split Couplings, Flange, Flexible and Marine type of couplings

Unit-IV

Design of cotter and knuckle joints, riveted and welded joints under direct and eccentric loading.

Unit-V

Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints, design of power screws and screw jack. Thick and thin cylinders.

Suggested Reading:

1. V.B.Bhandari, *Machine Design*, Tata McGraw Hill Publication, 1991.
2. J.E.Shigley, C.R.Mischne, *Mechanical Engineering Design*, Tata McGraw Hill Publications, 2003.
3. Robert C. Juvinall, *Fundamentals of Machine Component Design*, John Wiley & Sons, 2005.
4. Robert L.Norton, *Machine Design: An Integrated Approach*,2/e Pearson Education ,2000.
5. Merhyle Franklin Spotts, *Design of Machine Elements*, Prentice Hall of India, 1971.

PC405ME

MACHINE DRAWING

Credits: 3

Instructions: (6P) hrs per week *Duration of SEE: 3hours*
CIE: 40 Marks *SEE: 60 Marks*

Course Objectives:

- To understand format of drawing sheet, angle of projections, isometric projections, sectional views and practice on simple machine elements.
- To practice sketching of standard machine elements
- To have knowledge on ISO system of Limits and Fits
- To understand assembly drawings of typical machine parts such as Connecting rod, Eccentric, Cross head, Machine vice, Screw jack, Bearings, Tail stock etc.
- To understand manufacturing/Industrial drawings with all dimensional and geometrical tolerances and surface finish requirements.

Course Outcomes: At the end of the course students will be able to

- Draw isometric and orthogonal projections and sectional views of various mechanical components.
- Draw sketches of standard machine elements
- Select suitable limits &fits for a given assembly of machine parts.
- Draw assembly views of various mechanical components from part drawings.
- Understand various conventions and symbols given on the industrial drawings (shop floor production drawings) and draw manufacturing drawings of simple components.

The following contents are to be drawn using conventional method

UNIT-I

Standard Drawing Practices: Format of drawing sheet, title block, conventions of drawing lines and dimensions, conventional representation of materials and parts (Screwed joint, Welded joints, Springs, Gears, machine tool elements). Abbreviated indication of standard parts in assembly drawings.

First and third angle projections, conventions for sectional views, views of simple machine elements from the given pictorial and orthographic views.

UNIT II

Machine Elements: sketching of the following standard machine elements

Screwed Fastenings: Screw thread nomenclature, thread series, designation, thread profiles, multi start threads, representation of threads, bolted joints, studded joint, eye bolt.

Keys, Cotters and Pin Joints: Introduction, saddle keys, sunk keys, cotter joint with sleeve, cotter joint with socket and Spigot ends, cotter joint with a Gib and knuckle joint.

Shaft Couplings: Rigid couplings, flexible couplings and non-aligned couplings.

Riveted Joints: Introduction, classification of riveted joints, terminology of riveted joints

Welded Joints: Introduction, types of welded joints, representation of Weldon drawings, symbols.

Unit-III

Assembly Drawings: Assembly drawings from given details of component drawings and working description of the assembly. Ability to supply additional views. The exercises will be drawings of typical machine parts, assemblies e.g., Connecting rod, Eccentric, Crosshead, Machine vice, pipe vice, Screw jack,

Plummer block, Swevel Bearing, Tail stock, Tool post, shaper tool head, Universal coupling, Knuckle Joint etc. (These are only examples and actual exercise or examination may include any assembly).

Unit-IV

Limits and fits: Introduction, ISO system of limits & fits, fundamental deviations for Hole based and Shaft based systems, alpha numeric designation of limits & fits. Types of Fits.

Geometrical Tolerances: Form and positional tolerances.

Conventional practices of indicating dimensional limits and fits, geometrical form and position tolerances in production drawings.

Examples involving selection of fits and calculation of limits. Suggestion of suitable fits for mating parts.

Surface finish symbols, surface treatments requirements, their indication on production drawing.

UNITV

Manufacturing drawing: Representation of limits& fits for mating parts, geometrical tolerances, surface finish requirements in manufacturing drawings. Use above assembly drawings (Unit III) and from each assembly drawing prepare manufacturing drawings of mating components with dimensional tolerances, geometric tolerances and surface finish requirements.

Note: Tolerance charts to be provided in the examination Hall for calculation of limits.

Suggested Reading:

1. Siddeshwar N, Kannaiah P and Sastry VVS, "*Machine Drawing*", Tata McGraw Hill Publishing Co. Ltd., 5th Edition, 1994.
2. Bhatt N.D, "*Machine Drawing*", Charotar Publishing House, Anand, New Delhi, 28th Edition, 1993.
3. NarayanK.L ,Kannaiah P,VenkatReddyK,"*MachineDrawing*",New Age International(P) Ltd., 2nd Edition, 1999.
4. K.C.John,"*Text book of Machine Drawing*", PHILearning, 2010.
5. P. Narsimha Reddy, T.A. Janardhan Reddy, C.S. Rao, *Production Drawing Practice*, High Tech Publishers, 2001.
6. R.K.Jain, *Engineering Metrology*, Khanna Publishers, 8thEd.1985.
7. K.L.Narayana,P.KannayyaandK.VenkatReddy,*ProductionDrawing*,NewAge International (p)Ltd.Revisededition,1997.

HS 901 ME

MANAGERIAL ECONOMICS AND ACCOUNTANCY

Credits: 3

Instructions :(3P) hrs per week *Duration of SEE: 3hours*
CIE: 40Marks *SEE: 60 Marks*

Course Objectives:

- To understand responsibilities of a manager of a business undertaking.
- To analyze various factors in fluencing demand elasticity
- To Forecast & compute the future sales level.
- To determine Break Even Point (BEP) of an enterprise
- To understand the features, steps, merits, uses& limitations of Pay Back, ARR, NPV, PI & IRR methods of Capital Budgeting
- To understand the principles of accounting and prepare Journal, Ledger, Trial Balance, Manufacturing A/c,Trading A/c., Profit & Loss A/c. and Balance Sheet of an enterprise.

Course Outcomes: Upon successful completion of this course, the student will be able to

- Understand the responsibilities of a manager of a business undertaking
- Able to Forecast & compute the future sales level
- Outline the features, steps, merits, uses & limitations of Pay Back, ARR, NPV, PI & IRR methods of Capital Budgeting
- Assess various factors influencing demand elasticity and determine Break Even Point (BEP) of an enterprise.
- Understands the principles of accounting and prepare Journal, Ledger, Trial Balance, Manufacturing A/c, Trading A/c., Profit & Loss A/c. and Balance Sheet of an enterprise

UNIT-I

Introduction to economics and its evolution: Managerial Economics its Scope, Importance and relation to other sciences, its usefulness to engineers-Basic concepts of Managerial Economics.

UNIT-II

Demands: Analysis-concept of demand, determinants, law of demand, its assumptions, elasticity of demand, price, income and cross elasticity, demand forecasting-markets competitive structure, price- output determination under perfect competition and Monopoly. (Theory questions and small numerical problems can be asked).

UNIT-III

Theory of Production: Firm and industry-production function-input-output relations-laws of returns- internal and external economics of scale. Cost analysis-Cost concepts-fixed and variable costs-explicitly and implicitly costs-out pocket of costs and imputed costs-opportunity cost-cost output relation- ship-break even analysis. (Theory and Problems).

UNIT-IV

Capital management: Significance, determinates and estimation of fixed and working capital requirements, sources of capital. Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems. (Theory questions and numerical problems on estimating working capital requirements and evaluation of capital budgeting opportunities can be asked)

UNITV

Book-keeping: Principles and significance of double entry book keeping, journal, subsidiary books,

ledger accounts, trial balance concepts and preparation of final accounts with simple adjustments-analysis and interpretation of financial statements through ratios.
(Theory questions and numerical problems on preparation of final accounts, cash book, petty cash book, bank reconciliation statement, calculation of some ratios)

Suggested Readings:

1. Varshney, R. L., and K. L. Maheshwari. Managerial Economics. Sultan Chand & Sons. 2010.
2. Eugene F. Brigham, James L. Pappas, Managerial economics, Dryden Press, 1979
3. Grawal T.S. S C Gupta, Introductionto Accountancy, S Chand Publications, 1978
4. I.M. PandayI.M. , Financial Management, Vikas Publishing House Pvt Limited, 11th Ed. 2015
5. S K Maheshwari S N Maheshwari, An Introduction to Accountancy, 8th Ed. Vikas Publishing House Pvt Limited, 2006

PC451ME

THERMAL ENGINEERING LAB-1

Credits:1

Instructions :(2P) hrs per week *Duration of SEE: 3hours*
CIE: 25 Marks *SEE: 50 Marks*

Course Objectives

- To understand applications of thermal engineering concepts through experimentation.
- To measure flow properties of fuel/lubricants.
- To test reciprocating and heat transfer machinery.

Course Outcomes: Upon successful completion of this course, the student will be able to:

- Will be able to perform experiments to find the efficiency of Petrol and Diesel engines.
- Will be able to find the properties of unknown fuels/lubricants.
- Will be able to perform experiments CI and SI engines.
- Will be able to experiments on heat exchangers and design suitable exchangers for a given application.

List of Experiments:

1. To determine valve/port timing diagram of a diesel/petrol engine
2. To conduct performance test on diesel engine
3. To conduct the at balance test on diesel engine
4. To conduct performance test on petrol engine
5. To conduct he at balance test on petrol engine
6. To determine the viscosities of lubricating oils
7. To determine the flash point and fire points of fuels
8. To conduct Performance test on VCR engine
9. To conduct Heat balance test on VCR engine
10. To conduct the Morse test on multi cylinder Petrol Engine.
11. To determine volumetric efficiency and mass flow rates of a two stage reciprocating air compressor.

PC 452ME **MANUFACTURING PROCESSES LAB**

Credits: 1

Instructions: (2P) hrs per week *Duration of SEE: 3 hours*
CIE: 25 Marks *SEE: 50 Marks*

Course Objectives:

- To understand the manufacturing processes, preparation of sand mould, casting process
- To learn about electrode composition and different welding processes like arc, gas, spot, TIG, MIG welding.
- To know the forming process. Course Outcomes:
- Able to test sand properties, make gating system and prepare mould for sand casting.
- Able to join materials using different welding techniques, study of welding properties and defects
- Able to manufacture components using drawing, blanking, piercing, extrusion and sheet metal forming.

List of Experiments:

Foundry:

1. Study of foundry setup, equipment and the displayed charts with particular attention to moulding machines, sand muller, shell moulding machine & centrifugal casting machine.
2. Mixing and preparation of molding sand samples, Testing of greensand properties.
3. Preparation of molding sand aggregate and simple moulds of greensand complete with sprues, gates and risers.
4. Exercise of melting and casting involving prepared moulds, aluminium metal and crucible furnace. Cleaning of castings, study of the features of the final casting, its features and any visible defects.
5. Experimental Study of blow moulding.
6. Experimental study of centrifugal casting

Welding:

1. Study of the welding equipment and tools related to Arc, gas and resistance welding & displayed charts.
2. Practice of Arc, Resistance Spot, Resistance Butt and Gas welding. Identification of different types of gas flames.
3. Experimental study of
    a) (a)Electrode characteristics of SMAW.
    b) (b)Arc length and welding speed on bead characteristics.
    c) (c)Welding current on bead penetration.
4. Determination of weld characteristics using DC and AC power sources.
5. TIG and MIG welding process - study and exercises.

Forming:

1. Study of the forming equipment: Different types of mechanical presses and hammers, Metal spinning Lathe.
2. Conventional extrusion of metals.
3. Study of sheet metalworking dies and sheet metal working with existing dies.
4. Testing of metals: Fatigue tests. Testing of sheet metals for formability by using Erichson cupping test. 5. Study of HERF processes. Sheet metal forming with water hammer forming equipment.

PE453ME

DESIGN THINKING LAB

Credits: 1

Instructions: (2P) hrs per week *Duration of SEE: 3hrs*
CIE: 25 Marks *SEE: 50 Marks*

COURSE OUTCOMES:

Upon Completion of the course ,the students should be able to:

- understand principles of Design Thinking, a creative solution-based approach to problem solving
- Define key concepts of design thinking
- Practice design thinking in all stages of problem solving
- Apply design thinking approach to real world problems

LIST OF EXPERIMENTS /ACTIVITIES TO DO IN CLASS ROOM:

(i) 2030 Schools Challenge: Concept: Design thinking is often presented without teaching content. This is very different. Learners get 30 minutes to choose a UN 2030 Goal (there are 17) that is relevant and meaningful to them, then they get into small groups. The group researches the goal quickly, by answering the questions: What does the world need to know about this goal and what can we do about it? The group then creates a short PSA (Public Service Announcement) and shares it widely with an authentic audience. It is fun, fast, and shows the power of design sprints to teach content and skills.

(ii) THE GIFT-GIVING PROJECT VIA STANFORD D-SCHOOL Concept: The Gift-Giving Project is 90-minute (plus debrief) fast-paced project through a full design cycle. Students pair up to interview each other, come to a point-of-view of how they might design for their partner, ideate, and prototype a new solution to "redesign the gift giving experience" for their partner.

(iii) THE WALLET PROJECT VIA STANFORD D-SCHOOL Concept: Very similar to the Gift Giving Project, the Wallet Project is 90-minute (plus Tentative 48 debrief) fast-paced project through a full design cycle. Students pair up, show and tell each other about their wallets, ideate, and make a new solution that is "useful and meaningful" to their partner.

(iv) INVENT A SPORT (WITH JUST THESE ITEMS) Concept: We've all played sports at some point in our life. Who came up with the rules? Who created the game? Who made the constraints? And who decided the objects to play with? Now, with limited time and resources, your group will create and invent a new sport, and a set of directions for people to actually play the game.

(v) "BOOK IN AN HOUR" ACTIVITY (VIA ALL WHO WONDER) Concept: Give a group a book (fiction or non-fiction). Then you break them up into smaller groups (or individuals) to read different parts of the book. Each group (or person) has to read and then create an overview/trailer of their part of the book to share chronologically with the rest of the class. Here 58 the design really starts with the creative process driving how you share the information, plot, characters etc. Perfect use for professional development when you want to introduce a topic in a fun, engaging way.

(vi) CHILDREN'S STORY DESIGN ACTIVITIES Concept: The University of Arkansas created a series of STEM Challenges that work as great design activities with groups old and young! For example after reading "The Three Billy Goat's Gruff" they set up a challenge like this: You decide to help the billy goats reach the opposite side of the creek so they can eat. You must create a model structure to help the billy goats get from one side to the other while using the design loop and only the materials provided. Your teacher will also provide you with model billy goats, with specific weights, that your bridge must be able to withstand.

(vii) New Product Development Activity: Student teams were given products ranging from toys to air fresheners. In 2 days, they had to create pitches on how to improve these products. The idea was to give them a clear sense of the scope of what they would do in a product development.

Suggested Readings:

1. Christian Mueller-Roterberg, Handbook of Design Thinking - Tips & Tools for how to design thinking.
2. Designing for Growth: a design thinking tool kit for managers By Jeanne Liedtka and Tim Ogilvie.
3. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown.
4. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media, 2017.
5. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
6. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011.

Service Courses Offered to other Departments

SCHEME OF INSTRUCTION & EXAMINATION

B.E III Semester (Mining Engineering)

S.No	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1	ES 301ME	Basics of Mechanical Engineering	3	-	-	3	40	60	3

B.E IV Semester (ECE)

S.No	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1	ES 401ME	Fundamentals of Robotics	3	-	-	3	40	60	3

ES 301 ME

Basics of Mechanical Engineering

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*

CIE: 30 marks *SEE: 70 marks*

Course Objectives:

- To understand basic concepts of thermodynamics.
- To understand practical application of thermal engineering concepts in various energy consumption and energy conversion systems
- To understand the working principles of I.C. engines, Reciprocating compressors and Refrigeration systems
- To familiarize the design and working principles of transmission drive systems.
- To understand various manufacturing processes.

Course outcomes: After completion of the course, students will be able to

- Differentiate between heat and work transfers and relates them with enthalpy changes
- Formulate various power cycles, represents them on p-V, T-S diagrams and also study their feasibility in practical applications
- Understand the work saving methods in functioning of Compressors and refrigeration cycles Design belt drives and gear drives and formulate methods for balancing of rotating masses
- Demonstrate the working of various welding processes and gain knowledge of working of unconventional methods of manufacturing.

UNIT- I

Statements of zeroth law, 1st, 2nd and 3rd Laws of thermodynamics with their applications. Representation of thermodynamic processes on p-V and T-s plots. Ideal gas equation. Relations for internal energy and entropy changes, heat and work transfers for closed systems. Steady flow energy equation for an open systems-derivation and applications in turbines, compressors, nozzles and diffusers. Relations for enthalpy changes, heat and work transfers for open systems.

UNIT-II

Power Cycles: Concept of air standard cycles- Carnot cycle, Otto, Diesel, Joule cycles with applications. Representation of Cycles on P-V and T-s plots. Calculation of Cycle efficiencies. IC Engines: Classification of IC Engines. Mechanical components of IC Engines. Working Principles of four stroke and two stroke cycle engines. Differences between petrol and diesel engines. Calculation of engine parameters -IP, BP, Specific fuel consumption, mechanical and thermal efficiencies.

UNIT-III

Working principles of reciprocating air compressors-single and double acting, single stage and two stage. Effect of clearance. Conditions for maximum efficiency. Isentropic and isothermal efficiencies. Problems on work input, power required and efficiencies of single and two stage compressors. Methods for improving efficiency –use of intercooler and after cooler. Refrigeration: Working of vapour compression refrigeration system and window Air conditioners. COP calculation. Common refrigerants in use, environmental impacts of refrigerants.

UNIT-IV

Belt drives: Velocity ratio, effect of slip. Length of open and cross belts. Ratio of tensions, centrifugal tension and its effect on power transmission. Gear drives: Nomenclature and types of gears. Problems on simple and compound gear trains. Governors: Working of Watt, Porter and Hartnell governors. Effect and power of governor. Stability of governor and isochronism. Balancing of several masses in one plane and in several planes.

UNIT- V

Production Techniques: Principles of Arc, Gas and Resistance welding, soldering and Brazing, working mechanism of Lathe, milling and drilling machines by simple sketches. Working principle of NC machines. Basic principles of USM, EDM, LBM and ECM. Principles of sand casting and die casting. Plastics and their moulding methods.

Suggested Reading

1. R.K. Rajput, "Thermal Engineering", Laxmi Publications, New Delhi, Eighth Edition, 2010.
2. P.K. Nag, “Basic and Applied Thermodynamics”, Tata Mc-Graw Hill, Eigth Reprint, 2006.
3. Thomas Bevan, "Theory of Machines", College Book Store (CBS) Publishers, 3rd Edn., 1986.
4. Hajra Choudary, "Elements of Workshop Technology-Vel. I and 2, Asian Publishers, 6th Edn., 1993.
5. P. N. Rao, "Manufacturing Technology", Vol. I &2, Tata McGraw- Hill, 2nd Edn., 2009.

ES 401ME

FUNDAMENTALS OF ROBOTICS

Credits: 3

Instruction: (3L) periods per week *Duration of SEE: 3 hours*
CIE: 40 marks *SEE: 60 marks*

Course Objectives:

- Familiarize students with various robot configurations.
- Learn to perform forward and inverse kinematics for general robot configurations.
- Familiarize with various trajectory planning and control techniques.
- Will learn to integrate various components in to a robotic system.

Course Outcomes: After completion of the course student will be able to

- Identify and classify various robot configurations with their workspaces & their usage in industry.
- Perform forward and inverse kinematics operations & determine singularity conditions for various robot configurations.
- Implement various path planning techniques & control algorithms for computing end effector motions for generalized robotic tasks.
- Understand and Use appropriate sensors for specified applications.
- Interface various hardware and software components to develop robotic systems for industry including the effects of multiple finger kinematics.

UNIT – I

Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.

UNIT – II

Rotation matrices, Euler angle and RPY representation, Homogeneous transformation matrices, Denavit-Hartenberg notation, Direct kinematics, Derivation of DH parameters for various robot configurations, Representation of absolute position and orientation in terms of joint parameters,

UNIT – III

Inverse Kinematics, direct v/s inverse kinematics, inverse orientation, inverse locations, Singularities, Determination of Singular conditions for various common robot configurations, Jacobean,

UNIT – IV

Trajectory Planning: joint interpolation, task space interpolation, execution of user specified tasks. Independent joint control, PD and PID feedback, Computed torque control

UNIT – V

Sensors: types of sensors, tactile & non tactile sensors, sensors to measure Position, velocity & acceleration measurement, Optical encoders. Range and Proximity sensing, acoustic, pneumatic, hall effect sensor, Eddy current sensors, Force and Torque sensors. Vision: Image acquisition, types & components of vision system, Image representation, digitization, binary, gray scale, RGB representation, Image processing, Image segmentation, image smoothening, object descriptors, object recognition.

Robots used in general applications like material handling, process applications, assembly operations, inspection applications, healthcare, entertainment.

Suggested Readings:

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003.
2. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008.
3. S K Saha, "Introduction to Robotics ", 2nd edition, TMH, 2013.
4. Harry Asada &Slottine "Robot Analysis& Control" , Wiley Publications, 2014.
5. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, Robotics, control, sensing, Vision and Intelligence, McGraw Hill International, 1987.
6. A Mathematical Introduction to Robotic Manipulations- Richard M. Murray, Zexiang Li, S.Shankar Sastry CRC Press. Inc. 1st edition, 1994.