8th Semester Mechanical Engineering					
Course No.	***Course Name***	***Credits***	***L***	***T***	***P***
MEC 801	Production & Operations Management	4	3	1	0
MEC 802	Internal Combustion Engines	4	3	1	0
MEC 803	Departmental Elective- I	3	2	1	0
MEC 804	Departmental Elective - II	3	2	1	0
MEC 805	Final Year Project	10	0	0	20
MEC 802P	I.C. Engine Lab.	1	0	0	2
	Total of Credits & LTP	**25**	**10**	**04**	**22**

ELECTIVE-I	
Course No.	***Course Name***
MEC 80*	Value Engineering
MEC 80*	Theory of Elasticity (TOE)
MEC 80*	Introduction to Acoustics
ELECTIVE-II	
MEC 80#	Power Plant Engineering (PPE)
MEC 80#	CAD of Thermal systems
MEC 80#	Introduction to MEMS

Course No.: MEC 801 PRODUCTION & OPERATIONS MANAGEMENT C L T (4 3 1)

COURSE OUTCOMES:

1. **Illustrate knowledge of fundamental concepts about operations management.**
2. **Compare and categorize the knowledge of different approaches to operational performance improvement.**
3. **Appraise the ability to work effectively in a team and in group and use of business tools.**
4. **Outline the various Japanese techmiques for justify the knowledge and performance improvement in industrial cost control.**

UNIT I

Managing and Planning Operations:

Introduction to operations management (OM), historical perspective and growth, operations strategies for competitive advantage. Forecasting (FC), nature and use of FC, sources of data, demand pattern, FC models. designing products, services and processes, new product design, product development, product life cycle, product development process, product reliability, process technology life cycle, flexible manufacturing systems,

UNIT II

Scheduling Systems and Aggregate Planning for Products and Services

Operations planning and scheduling systems, the aggregate planning process, strategies for developing aggregate planning, master schedule and rough cut capacity planning, implementing aggreate plans and master schedules, material requirement planning (MRP)

UNIT III

Managing for World class Competition

Japanese contribution for World Class Manufacturing(WCM), JIT manufacturing, basic concepts of TQM, ISO, PokaYoke and Kaizen. Business process re-engineering, lean manufacturing, concepts of supply chain management,

Text Books:

1. Panneerselvam R, " Production and Operations Management", 2nd Edition, New Delhi, 2005

Reference Book:

1. Roberta S. Russell, Taylor B.W, "Operations Management", *Pearson Prentice Hall, 4th edition, 2001.*

2. Everett, E.A., Ronald J.E, "Production and Operations Management" *Prentice Hall of India, 5th edition, New Delhi, 2001*

3. Evans J.R., Collier D.A., "Operations Management, An Integrated Goods and Services Approach", *Cengage Learning India, New Delhi, 2007.*

Course No: MEC 802 **INTERNAL COMBUSTION ENGINES** **C L T(4 3 1)**

COURSE OUTCOMES:

1. **Describe the different types of engines and engine operation parameters.**
2. **Synthesise an ability to optimise future engine designs for specific sets of constraints(fuel economy,performance emissions).**
3. **Compare & contrast S.I. & C.I. engines ,design aspects of combustion chamber and working of different types of carburetor including electronic modern injection system.**
4. **Discuss the real worls engine design issues and understand the significance of emission norms and the impact of vehicular pollution on the environment.**

UNIT I

Thermodynamics of actual working fluids: Working fluid before combustion, valve and port timing diagrams. Thermodynamic properties of fuel-air mixture before combustion. Use of combustion charts for unburned mixture. Use of combustion charts for burned mixture Appropriate treatment of fuel air mixtures. Fuel air cycles: Definition, constants, volume fuel air cycle, limited pressure cycle, characteristics of fuel-air cycles, comparison of real and fuel cycles. Air capacity of four stroke engines: Ideal air capacity , Volumetric efficiency , ideal induction process , actual induction process, Effect of operating conditions on volumetric efficiency, Effect of design on volumetric efficiency , estimating air capacity.

UNIT II

Two stroke engines: Scavenging process, ideal scavenging process, relationship of scavenging ratio and scavenging efficiency, power to scavenger, supercharged two stroke engines. Combustion and detonation: chemistry of combustion, normal combustion in S.I engines , pre- ignition and auto-ignition comparison, detonation in S.I engines, combustion in C.I engines, detonation in C.I engines, Methods of reducing detonation , preliminary detonation, preliminary facts about fuel and dopes, octane and cetane numbers, effect of design on detonation. Mixture requirements: Steady running, mixture requirements, transient mixture requirements, mixtures requirements for fuel injection engines, mixture requirements for S.I engines.

Performance of supercharged engines: engine performance measures, commercial engine ratings, basic performance equations for un-supercharged engines, effect of atmospheric conditions, altitude and compression ratio on performance characteristics, performance curves.

Supercharged engines: definitions, reasons for supercharging, supercharging of S.I engines, supercharging of diesel engines.

UNIT III

Heat losses and cooling: Area of heat flow engines, temperature profile, Engine cooling system, Numericals on heat transfer in IC engines, Engine design: selection of type, engine speed and principles of similitude. Numerical on alternative fuels, Numerical on diesel fuel injection system, Numericals on engine specification and verification, Numerical on two stroke engines. General design of petrol and diesel engine. Numericals on engine design, determination of main dimensions, Comparative Numerical on two stroke engines and four stroke engines

Text Book:

1. Heywood, J.B., " Internal Combustion Engine fundamentals", *Mc-Graw Hill Book Co., USA, 1989.*

Course No: MEC 802 **INTERNAL COMBUSTION ENGINES** **C L T(4 3 1)**

Reference Books:

1.Domkundvar V.M., "A course in internal combustion engines", *Dhanpat Rai and company, New Delhi, 1999.*

MEC 802P **I.C. ENGINES LAB.** **C P (1 2)**

COURSE OUTCOMES:

1. **Knowledge of the internal combustion engine parts and components.**
2. **Able to demonstrate the working of the internal combustion engines.**
3. **Able to perform the experiment on S I Engines and draw characteristic performance curves.**
4. **Able to perform the experiment on C I Engines and draw characteristic performance curves.**

1. Study of two stroke spark ignition engine model
2. Study of four stroke spark ignition engine model
3. Study of four stroke diesel engine model.
4. Study of rotary wankel engine.
5. Study of models of gas turbine engines.
6. Study of single cylinder four stroke direct injection diesel engine. (cut section)
7. Study of multi-cylinder optical spark ignition engine.
8. Experimental study of characteristic performance curves of spark ignition engine using gasoline as fuel.
9. Experimental study of characteristic performance curves of compression ignition engine using diesel as fuel.
10. Experimental study of characteristic performance curves of compression ignition engine using biodiesel blends, with diesel as fuel.
11. Study of engine components. (like cylinder block , crank shaft etc).
12. Study of components of ignition system of S.I. Engines.

Course No.: MEC- 80* **VALUE ENGINEERING** **C L T(3 2 1)**

UNIT I:

Introduction to value engineering (VE) & value analysis (VA), Life Cycle of a product, Methodology of VE, Reasons for the existence of unnecessary costs. Quantitative definition of Value, use Value and Prestige value, Estimation of product Quality/Performance, Types of functions, Relationship between use functions and Esteem Functions in product design, Functional cost and functional worth, Effect of value improvement on profitability, Tests for poor value, Aims of VE systematic approach.

UNIT II

Elementary introduction to VE, Job plan functional approach to value improvement, Various phases and techniques of the job plan, Factors governing project selection, Types of projects, Life cycle costing for managing the total value, concepts in LCC, Present value concept, Annuity concept, net present value, Pay Back period, internal rate of return on investment (1RR), Examples and Illustrations. Creative thinking and creative judgement, positive or constructive discontent, Tangible and intangible costs of implementation, False material, Labour and overhead saving, VE/VA yardsticks, Relationship between savings and probability of success, Reliability Estimation, system Reliability, Reliability elements in series and parallel.

UNIT III

PHASES AND TECHNIQUES OF VE JOB PLAN:

General Phase, Information phase, Function phase, Creativity/Speculation Phase, Evaluation Phase, Investigation Phase and Recommendation Phase*:* Value improvement recommendation theory, determination of cut-off point (cop), road blocks in implementation. Decision Matrix/Evaluation Matrix, Quantitative comparison of Alternatives, Estimation of weights factors and efficiencies, Utility transformation functions, Bench marking, Perturbation of weight factors (sensitivity analysis), and Examples.

FAST Diagramming: Critical path of functions, HOW, WHY & WHEN Logic, Supporting and all time functions.

Reference Books:

1. Arthur E. Mudge, "Value Engineering- A Systematic Approach",*McGraw Hill Book Co.* 1971.
2. Miles L.D., "Techniques of value Analysis and Engineering", *McGraw Hill Book Co., New York, 1970.*
3. ASTME-American society for Tool and Manufacturing Engineers," Value engineering in Manufacturing", *Prentice Hall Inc. USA, 1967.*

Course No.: MEC 80* **THEORY OF ELASTICITY (TOE)** **C L T (3 2 1)**

COURSE OUTCOMES:

1. **Explain the fundamental concept of stress & strain followed by an analytical expression relating the stress & strain in 3-D systems.**
2. **Apply the compatibility equations & boundary conditions to solve the problems of T.O.E in practices.**
3. **Analyze the structural members subjected to pure bending using the fundamental concept of stress,strain & elastic behaviours of materials.**
4. **Apply analytical techniques to predict the ffects of stress concentration in simple solids & structural components.**

UNIT I

Introduction: Elasticity, stress components of stress and strain, Hooks law. Equations in polar coordinates, Plane stress and plane strain: Strain at a point, Mohr circle for strain rosette, differential equation of equilibrium, boundary conditions, compatibility equations, overview of Airys stress functions.

UNIT II

Two dimensional problems in rectangular coordinates: solution by polynomials, St Venants principles, determination of displacement, bending of beams, solution by Fourier series. Two dimensional problems in polar coordinates: Equations in polar coordinates, equation about 1-axis, and pure bending in curved bars.

UNIT III

Determination of strains and displacement, effect of circular hole on stress distribution in plate concentrated and vertical loading of a straight boundary, circular disc, general solution and its applications, Analysis of stress and strain in thee dimensions: stress at a point, principal stress, stress ellipsoid and stress director surface, homogenous deformation, strain at a point, principle strain rotation.

Text Books:

1. Timoshanko, S.P. and Goodier, J.N., "Theory of Elasticity," *Mc-Graw Hill Book Company, N.Y. , USA, 1970.*

Reference Books:

1. Love, A.E.H., "The Mathematical Theory of Elasticity," *Dover Publications, NewYork, USA, 1944.*

Course No.:MEC 80* **INTRODUCTION TO ACOUSTICS** **CL T (3 2 1)**

UNIT I

Fundamentals of Vibrations: Introduction, The simple oscillator, Complex exponential method of solution, Transient response of an oscillator, Power relations, Equivalent electrical circuits for oscillators, The Fourier Transform.

Transverse Motion: Vibrations of extended systems, Transverse waves on a string, The one-dimensional wave equation, General solution of the wave equation, The wave nature of the general solution, Initial values and boundary conditions, Reflection at a boundary, Forced vibration of an infinite string, Forced vibration of a string of finite length, Normal modes of the fixed string, Acoustic measurements.

UNIT II

The Two-Dimensional Wave Equation: Vibrations of a plane surface, The wave equation for a stretched membrane, Free vibrations of a rectangular membrane, Free vibrations of a circular membrane, Normal modes of membranes, The diaphragm of a condenser microphone, Vibration of thin plates.

The Acoustic Wave Equation and Simple Solutions: The equation of state, the equation of continuity, The Euler's equation, The linear wave equation, Speed of sound in fluids, Harmonic plane waves, Energy density, Acoustic intensity, Specific acoustic impedance, Spherical waves, The inhomogeneous wave equation, The point source.

UNIT III

Radiation and reception of acoustic waves: Radiation from a pulsating sphere, Acoustic reciprocity and the simple source, The continuous line source, Radiation from a plane circular piston, Radiation impedance, Fundamental properties of transducers (directional factor, beam pattern, beam width, source level, directivity).

Reflection and Transmission of Acoustic Waves: Transmission from one fluid to another: normal incidence, and oblique incidence, Normal specific acoustic impedance, Reflection from the surface of a solid: normal incidence, oblique incidence.

Text Book:

1. Kinsler, L.ER., Austin R. Frey, A. B., Coppens, J. V.,Sanders, "Fundamentals of Acoustics", *4th edition , John Wiley & Sons.*

Reference Book:

1. Philip M. Morse, Ingard,K.U., " Theoretical Acoustics", *Princeton University Press.*

Course No.: MEC 80# **POWER PLANT ENGINEERING (PPE)** **C L T (3 2 1)**

COURSE OUTCOMES:

1. **Identify the different types of power plants and understand the layout of steam power plant.**
2. **Understanding of Hydroelectic Power plant and Coordination of different types of power plants.**
3. **Able to descibe the working operations of Nuclear,Diesel,Gas and Steam power plants.**
4. **To apply & analyses the economics of power plant and able to decides the tariffs for different power plants.**

UNIT I

Introduction:- Energy source for generation of electric power. Principle types of power plants, their special features and applications, major power plants in India.

Steam Power Plants :- Selection of site, general layout of the power plant, special features of the modern steam boilers, circulation principle, steam separation and purification, economizers and air pre-heater types and estimation of performance, super-heater and superheat control, feed water heaters, cooling tower , temperature and pressure control. Introduction to hydro electric power plant, types of hydro-electric plant in combination with steam plant, Runoff river plant in combination with steam plant, storage plant in combination with steam or nuclear plant, Coordination of hydro-electric and gas turbine stations, coordination of different types of power plants.

UNIT II

Nuclear Power Plants :- Nuclear fuel, nuclear energy by fission, main components of nuclear reactors, pressurized water, boiling water, liquid metal and gas nuclear reactors.

Diesel Power Plants :- Plant layout , two and four stroke cycle diesel engines, fuel injection, lubrication and cooling systems, supercharging and starting systems. Gas and Steam Turbine combined Cycles:- Simple gas and steam combined cycle power generation.

UNIT III

Economic Analysis of Power Plants and Tariffs :- The cost of electrical energy , selection of types of generating equipment , performance and operating characteristics of power plant , load division among generators , Tariff methods of electrical energy .Combined operation of different power plants :- Advantages of combined working , Load division among power stations , Storage

Text Book:

1. Rajput R.K., "A text book of power plant engineering", *Laxmi Publication, Pvt. Ltd., New Delhi, 2007.*

Reference Books:

1. Domkundwar, S., "Power Plant Engineering", *S.C. Chand and company, New Delhi, 2000.*
2. Joel W, Roy E, "Modern Power Plant Engineering", *Prentice-Hall of India Ltd.,* New

Course No.: MEC 80# **POWER PLANT ENGINEERING (PPE)** **C L T (3 2 1)**

Delhi, 1985.

Course No.: MEC 80# **CAD OF THERMAL SYSTEMS** **C L T(3 2 1)**

UNIT I

Introduction, Engineering Design, Design as Part of Engineering Enterprise, Thermal Systems, Formulation of the Design Problem, Conceptual Design, Steps in the Design Process, Types of Models, Mathematical Modelling, Physical Modelling and Dimensional Analysis.

UNIT II

Curve Fitting, Numerical Modelling, Solution Procedures, Numerical Model for a System, System Simulation, Methods for Numerical Simulation, Initial Design, Design Strategies, Design of Systems from Different Application areas, Additional Considerations for Large Practical systems, Economics.

UNIT III

Optimization, Basic Concepts, Mathematical formulation, Optimization Methods, Calculus Methods, Search Methods, Linear and Dynamic Programming, Geometric Programming, Introduction to Calculus Methods, Optimization of Unconstrained problems, Use of Gradient for Optimization, Optimization of Constrained problems, , Search Methods, Types of Approaches, Application to Thermal Systems, Single-Variable Problem, Uniform Exhaustive Search, Dichotomous Search, Fibonacci Search, Comparison of Different Elimination Methods, Unconstrained Search with Multiple Variables, Geometric, Linear and Dynamic Programming, Knowledge-based systems, Basic Components, Expert Knowledge, Design Methodology.

Text Book:

Janna, W.S., " Design of Fluid Thermal Systems", *PWS Publishing Company, Place, 1990*.

Reference Book:

Stoecker,W.F., "Design of Thermal Systems", *McGraw Hill, Place, 2001*.

Course No.: MEC 80# **INTRODUCTION TO MEMS** **C L T (3 2 1)**

UNIT I

Definition of MEMS, MEMS devices, Silicon as a MEMS material, mechanical properties of silicon, Fabrication technologies, Introduction to micro-fabrication, Silicon based MEMS processes, Surface Micromachining, Sacrificial Etching Process, Bulk Micromachining and Silicon Anisotropic Etching, Bulk versus surface micromachining, mechanical components in MEMS.

UNIT II

Review of essential electrical and mechanical concepts, Conductivity of Semiconductors, Review of solid mechanics for design of mechanical components, Crystal Planes and Orientation, Mechanical properties of Silicon and their related thin films.

UNIT III

Review of electrostatics and electrodynamics for electrical domain calculations, Electrostatic Sensing and actuation, analysis of comb drives, Dynamics of comb drives, Piezoelectric Sensing and actuation, Piezoresitive Sensing, Scaling laws, Instrumentation for MEMS testing and characterization.

Reference Books:

1. Senturia, S.D., "Microsystem Design", *Kluwer Academic Publisher,2000.*

2. Nadim M, "An Introduction to Micro Electromechanical Systems Engineering", *Artech house,1999.*