

**SEMESTER VII**

<b>CODE</b>	<b>COURSE OF STUDY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
ME401	Industrial Organisation and Engineering Economics	3	0	0	3
MA401	Numerical Methods and Optimization	3	0	0	3
ME403	Theory of Metal cutting	3	0	0	3
	Elective – II	3	0	0	3
	Elective – III	3	0	0	3
<b>Practical</b>					
ME491	Comprehensive Viva-voce	0	0	0	1
ME493	Project Work Phase – I	0	0	6	2
	<b>Total</b>	<b>15</b>	<b>0</b>	<b>6</b>	<b>18</b>

## LIST OF ELECTIVES

### SEMESTER VII

#### Elective – II

CODE	COURSE OF STUDY	L	T	P	C
ME461	Computational Fluid Dynamics	3	0	0	3
ME463	Design of Gears and Cams	3	0	0	3
ME465	MEMS Devices – Design and Fabrication	3	0	0	3
ME467	Industrial Work Study	3	0	0	3
ME469	Pressure Vessel Design	3	0	0	3

#### Elective – III

ME471	Welding Engineering	3	0	0	3
ME473	Solar Power Engineering	3	0	0	3
ME475	Design of Heat Exchangers	3	0	0	3
HM401	Corporate Communication (or) Any one Elective from other Departments	3	0	0	3

## **SEMESTER VII**

### **ME401 Industrial Organization and Engineering Economics**

#### **UNIT-I**

Introduction to management –Evolution of scientific management, modern management, Principles- Elements of management planning, organizing, staffing, directing, coordinating, reporting, budgeting.

#### **UNIT-II**

Financial management, objectives, scope, Techniques of investment analysis, Payback period, sources of financing, technology management, product design, and plant layout. Inventory management, project management, PERT, CPM- Applications.

#### **UNIT-III**

Significance of Human resources management, HR Planning, Job evaluation, recruitment and selection. Placement and induction, training, Performance appraisal, compensation, Industrial relations.

#### **UNIT-IV**

Demand and Supply – Forecasting techniques – Cost and Revenues. Competitive nature of the firms – Keynesian economics – National income. Trade cycle – Inflation – Index numbers – Capital budgeting – Cash flow analysis – Balance sheet. Risk and Decision Making – Technological Change in Global Economy – Locating the Firm in a global economy – Taxes and Decision Making.

#### **UNIT-V**

Exchange Rate determination – Marketing – Product life cycle – Marketing research –Branding – Personality – Motivation – Leadership – Working in Teams.

#### **Text Books:**

1. Prasad, L.M., Principles and practice of Management, Sultan Chand & Sons, 2006.
2. Adhikary Manab, Business Economics, Excel Books, 2004.

3. Dwivedi, D.N., Macro Economics Theory & Policy, Tata McGraw-Hill, 2005.

**Reference Books:**

1. Gupta, R.N., Principles of Management, Sultan Chand & Co, 2001.
2. Aczel D. Amir, SoundarapandianJayavel, Complete Business Statistics, Tata McGraw-Hill, 2005.
3. Robins P. Stephen, Organizational Behaviour, Prentice-Hall, 2002.

**MA401 Numerical Methods and Optimization**

**UNIT-I**

Non-Linear Systems - Various types of errors - Bisection method - Regula-falsi method - Newton-Raphson method - Horner's Method - Graffe's method - Newton's method for solving  $f(x,y) = 0$  and  $g(x,y) = 0$ . Linear Systems - Gaussian elimination - Iterative methods - Sufficient conditions for convergence - LU decomposition method - Power method to find the dominant eigenvalue and eigenvector.

**UNIT-II**

Interpolation and Curve Fitting - Newton's forward and backward interpolation – Newton divided difference formula, Lagrange's interpolation formula, Linear and non-linear curve fitting by the Method of least squares.

**UNIT-III**

Numerical Solution of Ordinary Differential Equations-Euler's method, Euler's modified method. Taylor's method and Runge - Kutta method for simultaneous equations and 2nd order equations. Multistep methods. Milne's and Adams' methods.

#### **UNIT-IV**

Numerical solution of Laplace equation and Poisson equation by Liebmann's method. Solution of one dimensional heat flow equation. Bender - Schmidt recurrence relation. Crank-Nicolson method. Solution of one dimensional wave equation.

#### **UNIT-V**

Introduction - Optimization techniques. Single and multi-variable optimization. Constrained optimization. Specialized algorithms - Integer, geometric. Non-traditional algorithms.

#### **Text Books**

1. Deb, Kalyanmoy, Optimization for Engineering Design, Prentice - Hall, 1995.
2. C.F. Gerald and P.O. Wheatley, "Applied Numerical Analysis", McGraw-Hill, 1981

#### **Reference Books:**

1. Rao. S.S., Optimization Theory and Applications, Wiley Eastern Ltd., 1998.
2. Cheneg and Kincaid, "Introduction to Numerical Computing", Tata McGraw-Hill, 1998

## **ME403 Theory of Metal Cutting**

#### **UNIT-I**

Tool geometry – cutting tool geometry for turning, drilling and milling tools – tool signature – tool designation: ASM, DIN – their relationship.

#### **UNIT-II**

Mechanism of chip formation – continuous, discontinuous and built up edge chips – deformation of chips – single shear plane theory – chip formation in drilling and milling. Introduction to oblique and orthogonal cutting. Mechanics of metal cutting, force system, Merchant's Circle – velocity relationship, relationship between forces, cutting speed, feed and depth of cut – experimental determination of cutting forces – tool dynamometers.

### **UNIT-III**

Thermodynamics of chip formation: Sources of Heat – Mathematical modeling of sources of heat in affecting the rise of temperature – The shear plane temperature – average chip-tool interface temperature – distribution of shear plane temperature – non-iterative method for determining chip-tool and tool-work interface temperature – experimental determination of chip-tool interface temperature – experimental observation of metal cutting temperature – hot machining – theoretical estimation of work-piece temperature

### **UNIT-IV**

Machinability – mechanisms of tool wear – Taylor's tool life equation – tool failure criteria (direct and indirect) – effect of cutting variables on tool life, maintainability index.

### **UNIT-V**

Cutting fluids – types, different methods of application, economics of machining – basic concepts, tool materials (HSS, carbide and coated tools, CBN and ceramics) – Chatter in machining.

#### **Text Books:**

1. A.Bhattacharya, Metal Cutting – Theory and Practice, Central Book Publishers, 1989.
2. B.L.Juneja & G.S.Sekhon, Fundamentals of Metal Cutting and Machine Tools, New Age International (p) Ltd., 1998.
3. G.Kuppusamy, Principle of Metal Cutting, University Press, 1992.

#### **Reference Books:**

1. M.C.Shaw, Metal Cutting Principles, IBH Publishers, 1991.
2. G.Boothryd, Fundamentals of Metal Machining, Tata McGraw Hill, 1983.

### **ME491 Comprehensive Viva-Voce**

The student will be tested for his understanding of basic principles of the core Mechanical Engineering subjects. The internal assessment for a total of 50 marks will be made by an internal assessment committee. The committee will conduct two written examinations of objective or short questions type from all the core subjects. The external university examination, which carries a total of 50 marks, will be a Viva Voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.

### **ME493 Project Work - Phase I**

The objective of the project is to enable the students to work in groups of not more than four members in each group on a project involving analytical, experimental, design or combination of these in the area of Mechanical Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. The evaluation is based on continuous internal assessment by an internal assessment committee. The internal assessment marks for Phase I will be carried over to Phase II.

**SEMESTER VII**  
**Elective – II & III**  
**ME461 Computational Fluid Dynamics**

**UNIT-I**

Classification of partial differential equations - Discretization methods.

**UNIT-II**

Finite difference and finite volume formulations.

**UNIT-III**

Numerical solution of elliptical equations - Linear system of algebraic equations.

**UNIT-IV**

Numerical solution of parabolic equations - Stability analysis.

**UNIT-V**

Numerical solution of hyperbolic equations - Burgers equation. Incompressible Navier-Stokes equations and algorithms - Basics of grid generation.

**Text Books:**

1. Tannehill, J.E., Anderson, D.A., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, 2nd ed., Taylor & Francis, 1997.
2. Hoffmann, K.A. and Chiang, S.T., Computational Fluid Dynamics for Engineers, Engineering Education Systems, 2000.
3. Anderson J.D., Computational Fluid Dynamics – The basics with applications, McGraw-Hill, 1995.

**Reference Books:**

1. Versteeg, H.K. and Malalasekera, W., An Introduction to Computational Fluid Dynamics – The finite volume method, Longman Scientific & Technical, 1995.
2. Patankar, S.V., Numerical Heat Transfer & Fluid Flow, Hemisphere, 1980



3. Numerical method for Scientific & Engineering, Joe D HoffMan, Mc.Graw Hill
4. Numerical method for Scientific & Engineering, Peter A.Stark, Mc.Graw Hill

## **ME463 Design of Gears and Cams**

### **UNIT-I**

Gear drives - Advantage of Gear drives over other drives, Nomenclature, failures of gear tooth, Design of gears - spur, helical. bevel and worm & worm wheel.- based on bending and wear criteria - based on Lewis and Buckingham equation.

### **UNIT – II**

Bevel Gears – Nomenclature - Design of bevel gears-based on bending and wear criteria- based on Lewis and Buckingham equation, Worm and Worm Wheel – Nomenclature – Design procedure

### **UNIT – III**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box. Speed reducer – Design of Speed reducer using spur and helical gears

### **UNIT-IV**

BIS standards for gear design and its Force analysis.

### **UNIT-V**

Design of cams - Tangential and Polynomial cams.

### **Text Books:**

1. Maitra, G.L., Hand Book of Gear Design, 2nd ed., Tata McGraw-Hill, 2005.

### **Reference Books:**

1. Merritt, H.E., Gear Engineering, A. H. Wheeler & Co. Pvt. Ltd., 1984.

## **ME465 MEMS Devices - Design and Fabrication**

### **UNIT-I**

An overview of microelectromechanical devices and technologies, and an introduction to design and modeling, Standard microelectronic fabrication technologies.

### **UNIT-II**

Bulk micromachining, surface micromachining, bonding technologies, related fabrication methods, and creating process flows.

### **UNIT-III**

Mechanical, thermal, electrical, magnetic, optical, and chemical properties of materials.

### **UNIT-IV**

Introduction to lumped modeling of systems and transducers; an overview of system Dynamics

### **UNIT-V**

MEMS examples, energy methods, the thermal energy domain; modeling dissipative processes, Fluids and Transport

### **Text Book**

1. Tai – Ran Hsu, “MEMS& Microsystems Design and Manufacturing”, Tata McGrawhill Edition, 2006
2. Mohamed Gad-el-Hak , “MEMS: Design and Fabrication (Mechanical Engineering)”, CRC; 1 edition, 2005.
3. Marc J. Madou, “Fundamentals of Microfabrication, the science of Miniaturization”, CRC Press Second Edition, 2002.

### **Reference Books:**

1. Sami Franssila , “Introduction to Microfabrication”, John Wiley; 1 edition, 2004.
2. John A. Pelesko, David H. Bernstein, “Modeling MEMS and NEMS”, CRC; First edition, 2002

## **ME467 Industrial Work Study**

### **UNIT-I**

Work study – Introduction to work study – objectives – factors for selection of work study job – uses of work study in industry- elements of work study- Qualities of a workman.

### **UNIT-II**

Methods study – objectives of method study – techniques of method study - elements of method study. Motion study – Benefits of motion study – tools of motion study. Time study – aims and objectives – benefits of time study - procedure of time study – time study equipments – standard elements of time

### **UNIT-III**

Use of standard data- advantages - methods – work sampling – confidence level – sample size determination – determination of accuracy for a given number of observation - determination of time standards by work sampling – over time study – errors in work sample study - types of standardization – benefits of standardization- standard of forms and sizes- standard tools, conditions, materials

### **UNIT-IV**

Job classification and job evaluation - advantages of job evaluation - Methods of job evaluation. Introduction to production – types of production – importance of production control –routing in industries – types of schedules – function of dispatching- forms used in dispatching- flow process chart.

### **UNIT-V**

Labour and industrial laws – Wages and incentives – control and record keeping of men, materials and machines – Regulations – HSE – Factory act- mines act- EPA- water and air act.

### **Text Books**

1.G.B.S.Narang & V.Kumar - Production and Costing, Khanna Publishers Delhi

2.Vijay Shantilal Sheth, Industrial Engineering Methods and Practice, 2005, Penram International Publishing (India)

### **References Books**

1.T.R.Banga and S.C.Sharma - Industrial organisation and Engineering Economics, Khanna Publishers, Delhi

## **ME469 Pressure Vessel Design**

### **UNIT - I**

Pressure vessels - introduction – functional requirements, size and shape, fluid contained, method of support, location of attachment and penetrations, operational requirements and limitations, loading, severity of duty, principal design codes, safety devices, pressure testing.

### **UNIT - II**

Stresses in pressure vessels – stresses in a circular ring, cylinder and sphere – Dilation of pressure vessels – Intersecting spheres – Membrane stresses in vessels under internal pressures – stresses in thick cylinders and spheres - Built up cylinders – Auto fretting of thick cylinders – Thermal stresses due to thermal gradients – Ultra-high pressure vessel design principles.

### **UNIT - III**

Design codes and usage – design preliminaries – design loads – failure criteria – factor of safety. Selection and design of heads and enclosures – opening and compensation – Non standard flanges – Supports – Welded, bolted and gasketed joints - Long life design philosophy – vessel construction codes and usage.

### **UNIT - IV**

Fatigue and crack growth – causes – dynamic loading, stress concentration , surface effects and material properties – creep effects at elevated temperatures – thermal stress fatigue – embrittlement – fracture control.

## **UNIT - V**

Buckling of pressure vessels under external pressure (cylinders and spheres) – Effect of supports and imperfections on buckling – economics of pressure vessel fabrication – modern trends in pressure vessel construction - use of codes.

### **Text Books:**

1. J.F.Harvey, Theory and Design of Pressure Vessels, CBS Publishers & Distributors, 1987.
2. B.C.Bhattacharya, Introduction to Chemical Equipment Design – Mechanical Aspects, CBS Publishers & Distributors, New Delhi, 1991.
3. B.C.Bhattacharya, Introduction to Chemical Equipment Design – Mechanical Aspects, CBS Publishers & Distributors, New Delhi, 1991

### **Reference Books:**

1. Henry H.Bednar - Pressure Vessel Design Hand Book, CBS Publishers & Distributors, 1987.
2. L.E.Brownell and E.H.Young - Process Equipment Design, Wiley Eastern Ltd., 1986
3. IS: 2825 – 1969 - Code for Unfired Pressure Vessels, Bureau of Indian Standards,
4. Henry H.Bednar - Pressure Vessel Design Hand Book, CBS Publishers & Distributors, 1987.
5. L.E.Brownell and - Process Equipment Design, Wiley Eastern Ltd., 1986 E.H.Young
6. IS: 2825 – 1969 - Code for Unfired Pressure Vessels, Bureau of Indian Standards,

## **Elective-III**

### **ME471 Welding Engineering**

#### **UNIT-I**

Welding Processes - Gas welding, manual, submerged arc, TIG, MIG welding, plasma arc. Electroslag, electro-gas welding, pressure welding processes - cold and hot pressure welding. resistance, friction and explosive welding. Plastic and ceramic welding.

#### **UNIT-II**

Welding Processes - Radiant energy and solid phase welding processes and equipment - Beam power control. Laser beam cutting, under water welding. Diffusion welding.

#### **UNIT-III**

Allied Processes Brazing, Soldering, Cutting, Surfacing Methods - Need, Flame Spraying. Plasma Spraying.

#### **UNIT-IV**

Welding metallurgy - weld thermal cycles and their effects - structural changes in different materials, effect of pre and post heat treatment. Weldability.

#### **UNIT-V**

Testing And Design of Weldment- Design and quality control of welds. Edge preparation types of joints, weld symbols. Stresses in butt and fillet welds - weld size calculations. Design for fatigue. Testing - tensile, bend hardness. Impact, notch and fatigue tests. Visual examination - liquid penetration test, magnetic particle examination. Radio graphs, ultrasonic testing. Life assessment of elements.

#### **Text Books:**

1. Jackson, M.D., Welding Methods and Metallurgy, Charles Griffin & Company, London, 1967.
2. AWS, American Welding Society, Volume I to V, Miami, 1982.

**Reference Books:**

1. George E. Linnert, Welding Metallurgy, GML Publications, South Carolina, U.S.A., 1994.
2. Little LR, Welding and Welding Technology. Tata McGraw-Hill, New Delhi, 1980.

**ME473 Solar Power Engineering****UNIT-I**

Solar radiation - radiation at the earth's surface – measurement of solar radiation - solar radiation data geometry – solar radiation on tilted surfaces – relationship among absorption and emittance and reflectance – Selective surfaces.

**UNIT-II**

Flat plate collectors – transmissivity of cover system – collector efficiency – liquid plate collector – performance of flat Plate collector. Concentrating collectors Types of Collectors - Solar heating – air heating system – solar energy heat pump system – solar water heating system: forced and natural circulation system – passive solar heating system – green house effect.

**UNIT-III**

Solar cooling – absorption cooling – vapour absorption refrigeration – solar desiccant Cooling- Solar drier and dehumidifier – solar pond – domestic, commercial and industrial applications of solar heating / cooling systems.

**UNIT-IV**

Photovoltaic Principle –materials for photovoltaic cells – design and fabrication of photovoltaic cells – performance analysis of photovoltaic cells – Thermoelectric generator solar cell – photochemical solar cells – solar cells in terrestrial and space applications.

**UNIT-V**

Solar power systems – electrical power generation – solar thermal power plants – low, medium and high temperature power generation systems: using flat plate collectors or solar ponds, concentrating collectors, central receiver and solar chimneys – solar energy process economics.

**Text Books:**

- 1.S.P.Sukhatme, Solar Energy – Principles of Thermal Collection and storage, Tata McGraw Hill Publishing Co., New Delhi, 1996.
2. J.A.Duffie&W.Beckmann, Solar Engineering of Thermal Processes, John Wiley, 1991.
3. S.P.Sukhatme, Solar Energy – Principles of Thermal Collection and storage, Tata McGraw Hill Publishing Co., New Delhi, 1996.
4. J.A.Duffie & W.Beckmann, Solar Thermal Processes, John Wiley, 1980.

**Reference Books:**

- 1.N.K.Bansal et al, Renewable Energy Sources and Conversion Technology, Tata McGraw Hill Publishing Co., New Delhi, 1990.
- 2.Jiu Sheng Hsieh, Solar Energy Engineering, Prentice Hall, 1991
3. L.L.Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.
4. D.A.Spera, Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press.
5. J.F.Kreider and F.Kreith-Solar Energy Handbook McGraw-Hill (1981)

**ME475 Design of Heat Exchangers****UNIT – I**

Definition – Classification – Application – Parallel Flow, Counter Flow – Single Pass and Multi Pass – Overall Heat Transfer Coefficient – Fouling Factor – Temperature Distribution – LMTD – LMTD Method and LMTD Correction Factor – Effectiveness – NTU Method – Methodology of Heat Exchanger & Calculation.

**UNIT – II**

Double Pipe Heat Exchanger – Application and Design Parameters – Film Coefficient for Fluids in Pipes and Tubes – Caloric Temperature and wall Temperature – Series and Parallel Arrangement – Design Procedure – Pressure Drop Calculation.



### **UNIT – III**

Shell and Tube Heat Exchanger – Tubes, Shells, Baffles – Types and Application – Exchanger using Water, Oil Solutions, Steam as Heating Medium – Design Procedure – Flow Arrangement for increased Heat Recovery.

### **UNIT – IV**

Types of Condenser and their selection – Design Procedure – types of Evaporators – Shell and Tube Re-Boilers – Types and Thermal Design.

### **UNIT – V**

Energy Recovery - Definition of HEN – Pinch point – Pinch Technology – Cascade Diagram – Pinch and its implication - Minimum number of Heat Exchangers – Design – above and below the Pinch – Synthesis of HEN.

#### **Text Books:**

1. D.Q.Kern, Process Heat Transfer, McGraw Hill Book Co., New York, 1957.
2. W.M.Kays and A.L.London, Compact Heat Exchangers, III Edition, McGraw Hill, New York, 1984.

#### **Reference Books:**

1. E.U.Schlunder, (Editor-in-chief) Heat Exchanger Design Hand Book, Vols.1-5, Hemisphere Publishing Corporation, New York, 1983
2. T. Taborek, G.F. Hewitt and N.Afgan, Heat Exchangers, Theory and Practice, McGraw Hill Book Co., 1980
3. Walker, Industrial Heat Exchangers - A Basic Guide, McGraw Hill Book Co., 1980
4. Nicholas Chermisioff, Cooling Tower, Ann Arbor Science Pub 1981
5. Arthur P.Fraas, Heat Exchanger Design, John Wiley & Sons, 1988

# HM401 Corporate Communications

## UNIT I

Communication in the corporate world – Communication process – Networks and Channels of communication.

## UNIT II

Technology for communication – Role of psychology – Motivation - Speech mechanics – Mental process of speaking

## UNIT III

Extempore speech practice – Group dynamics – Seminar & Presentation skills and interview strategies.

## UNIT IV

Listening skills & practice – Familiarity to accents and tones – Varieties of Styles & registers – Mechanics of technical writing – Report & Executive summary

## UNIT V

Abstracts, Circulars & Notices – Proposals, Agenda & Minutes – Papers for Presentation – Marketing Language.

### **Text Books:**

1. Simon Sweeney, *English for Business Communication*, Cambridge University Press, 1997.
2. Shiv Khera, *You Can Win*, Macmillan, 1998.
3. June A. Valladares, *The craft of Copywriting*, Response Books, 1998.

### **References Books:**

1. M.M. Monippally, *Business Communication Strategies*, Tata McGraw-Hill, 2001.
2. Raymond V.Lesikar & M.E. Flatley, *Basic Business Communication*, Tata Mc Graw- Hill, 2005.