

SEMESTER- IV

CODE	COURSE OF STUDY	L	T	P	C
MA208	Transforms and Partial Differential Equations	3	0	0	3
ME202	Engineering Metallurgy	3	0	0	3
ME204	Production Technology - II	3	1	0	4
ME206	Heat and Mass Transfer	3	1	0	4
ME208	Mechanics of Machines - I	3	1	0	4
ME210	Fluid Mechanics and Hydraulics	3	1	0	4
Practical					
ME212	Fluid Mechanics and Hydraulics Lab	0	0	3	2
ME214	Metallurgy Lab	0	0	3	2
ME216	Production Process Lab -II	0	0	3	2
	Total	18	4	9	28

SEMESTER IV

MA208 Transforms and Partial Differential equations

UNIT-I

Fourier series – Dirichlet's conditions - Half range Fourier cosine and sine series - Parseval's relation - Fourier series in complex form - Harmonic analysis.

UNIT-II

Fourier transforms - Fourier cosine and sine transforms - inverse transforms - convolution theorem and Parseval's identity for Fourier transforms - Finite cosine and sine transforms.

UNIT-III

Formation of PDE- Solution of standard types of first order equations-Lagrange's linear equation-Second and higher order homogeneous and non-homogeneous linear equations with constant coefficients.

UNIT-IV

One-dimensional wave equation and one-dimensional heat flow equation- Method of separation of variables-Fourier series solution.

UNIT-V

Two-dimensional heat flow equation in steady state. Laplace equation in Cartesian and polar coordinates- Method of separation of variables- Fourier series solution.

Text Books

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers.
2. Kandasamy, P. Thilagavathy, K. and Gunavathy, K., Engineering Mathematics, Vol. III, Chand and Company.
3. S.C. Gupta & V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand Sons, New-Delhi, 2008.

Reference Books:

1. Venkataraman, M.K., Engineering Mathematics Vol.III, National Publishing Company.
2. N.P. Bali & Manish Goyal : A text book of Engineering Mathematics, Laxmi Publications, New- Delhi,2008.
3. Erwin Kreyszig : Advanced Engineering Mathematics, John- Wiley sons, New-York, 2005.
4. B. S. Grewal, : Higher Engineering Mathematics, Khanna Publishers, New-Delhi, 2008.

ME202 Engineering Metallurgy**UNIT-I**

Crystal structures - Solid Solutions – Types - Metallography – Metallurgical microscopes – specimen preparation- Cooling curves – Allotropy concept

UNIT-II

Construction and interpretation of binary phase diagrams – Types – Eutectic, Eutectoid, Peritectic and Peritectoid systems – Iron Carbon equilibrium diagrams – classification of steels and alloy steels – types, manufacture, properties and applications of cast irons.

UNIT-III

Heat treatment of steel: Critical temperature on heating and cooling, effects of residual stresses – Annealing, normalizing, hardening, Hardenability tests, tempering – construction and interpretation of TTT diagram – Martensitic transformation – Sub zero treatment - Surface hardening processes.

UNIT-IV

Non ferrous metals and alloys: Copper, Aluminium, Nickel, Zinc and Lead based alloys – concept and applications of metal matrix composites. Mechanical properties of materials – Testing of materials: Tensile, compression, torsion, hardness (micro & macro) and impact testing.

UNIT-V

Plastic deformation, Slip and twinning – Hot, cold and warm working – recovery and recrystallization concepts. Introduction to fracture mechanics – Types - ductile to brittle transition – Creep and Fatigue failures – Testing.

Text Books:

1. Avner, S.H., Introduction to Physical Metallurgy, 2nd ed., Tata McGraw-Hill, 1997.
2. Dieter, G.E., Mechanical Metallurgy, McGraw-Hill, 1988.
3. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian Edition 2007.
4. Raghavan V, Physical Metallurgy – Principles and Practice, Prentice Hall India Pvt. Ltd., New Delhi, 2006
6. O.P. Khanna, Materials Science and Metallurgy, Dhanpat Rai Publishers

Reference Books:

1. Donald S. Clark, and Wilbur R. Varney, Physical Metallurgy for Engineers, East-West Press, 1999.
2. Suriyanarayana, A.V.K, Testing of metallic materials, Tata McGraw-Hill, 2001.
3. Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd., 1999.
4. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint 2002.
5. Donald R. Askeland, The Science and Engineering of Materials, Chapman and Hall, 1990.
6. Budinski and Budinski, Engineering Materials – Properties and Selection, Prentice Hall India Pvt. Ltd., 2005
7. Upadhyay. G.S. and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt. Ltd., New Delhi, 2006.

ME204 Production Technology – II

UNIT-I

Lathes, capstan & turret lathe, drilling and boring machine -Classification - principles of working components, work holding & tool holding devices.

UNIT-II

Shaper, planner & slotter, machines - Classification - principles of working components, work holding & tool holding devices.

UNIT-III

Milling, hobbing, broaching & grinding machines - Classification - principles of working components, work holding & tool holding devices.

UNIT-IV

NC & CNC machine tools and manual part programming Machining centre, turning centre. NC part programming.

UNIT-V

Computer aided part programming - APP: Post processors. APT programming – motion statements, additional apt statements.

Text Books:

1. Khanna, O.P., and Lal, M., A Text Book of Production Technology, Vol II, Dhanpat Rai & Sons, 1992.
2. Yoram Koren, Computer Control of Manufacturing Systems, McGraw-Hill, 1986.
3. Choudhry, S.K.H., Elements of Work Shop Technology, Vol II, Media Promoters & Publishers, 1994.
4. Hajra Choudhury, "Elements of Workshop Technology", Vol. II., Media Promoters
5. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 2003.

Reference Books:

1. Production Technology by HMT, Tata McGraw-Hill, 2002.
2. Kundra, T.K., Rao., P.N., and Tiwari, N.L.K., Numerical Control and Computer Aided Manufacturing, Tata McGraw-Hill, 2006.
3. Roy. A.Lindberg, “Process and Materials of Manufacture,” Fourth Edition, PHI/Pearson Education 2006
4. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White “Machine Tool Practices”, Prentice Hall of India, 1998

ME206 Heat and Mass Transfer**UNIT-I**

Conduction - General 3-D equation - Heat generation problems - Fins - Unsteady state conduction.

UNIT-II

Radiation Laws - Black and Gray bodies - Radiation exchange between surfaces – Radiation shields- Gas radiation.

UNIT-III

Forced Convection - Boundary layer theory - External and internal flows - Free convection - Correlations.

UNIT-IV

Heat exchangers - Fouling factor, LMTD and NTU methods - Boiling and condensation -Boiling regimes and correlations, Nusselt's theory - Condensation over surfaces.

UNIT-V

Mass transfer - Fick's law - Similarities between heat and mass transfer.

Text Books:

1. Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt, Fundamentals of Heat and Mass Transfer, 5th ed., John Wiley, 2002.
2. Holman, J.P., *Heat Transfer*, 9th ed., Tata McGraw-Hill, 2004.
3. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002
4. R.C.Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age Science Publishers

Reference Books:

1. Ozisik, M.N., Heat Transfer - A Basic Approach, McGraw-Hill, 1985.
2. Cengel, Y.A., Heat Transfer - A Practical Approach, McGraw-Hill, 1998.1. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 2010
3. Yadav, R., "Heat and Mass Transfer", Central Publishing House, 1995.
4. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 1998.
5. M.Thirumaleshwar : Fundamentals of Heat and Mass Transfer, "Heat and Mass Transfer", First Edition, Dorling Kindersley, 2009

ME208 Mechanics of Machines - I**UNIT-I**

Mechanisms - classification of mechanisms, Kinematic inversions - Grashoff's law -Inversions of slider crank mechanism, Coupler curves, spatial mechanisms - Straight-line generators.

UNIT-II

Slider crank mechanisms and four bar mechanism; Velocities of points on a rigid body -relative velocity - velocity polygon Acceleration of points on a rigid body – relative acceleration - acceleration polygon - Coriolis acceleration - analytical method .

UNIT-III

Chebyshev spacing for precision positions - Structural error - Overlay method – Complex curve synthesis - Roberts Chebyshev theorem - Frudenstine's equation; Analytical synthesis using complex algebra; synthesis of dwell mechanism.

UNIT-IV

Classification of cam and follower - displacement diagrams - Graphical layouts of cam profiles. Derivatives of follower motion. High speed cams standard motions. Plate cam with flat face and roller followers.

UNIT-V

Terminology and definitions - law of gearing - profile for gears - Involute gearing - Interchangeability - Interference and undercutting. Contact ratio. Gear trains - types - Parallel axis gear trains. Epicyclic gear trains.

Text Books:

1. Uicker, J. J., Jr., Pennock, G. R., and Shigley, J. E., Theory of Machines and Mechanisms, 3rd ed., Oxford University Press, 2003.
2. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.
3. Rao, J.S. and Duggipati, R.Y., Mechanism and Machine Theory, 2nd ed., Wiley Eastern Ltd., 1995.
4. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.

Reference Books:

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
2. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
3. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961
4. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.8.
5. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 2002.
6. Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005
7. Sadhu Singh: Theory of Machines, "Kinematics of Machine", Third Edition, Pearson Education, 2012

ME210 Fluid Mechanics and Hydraulics

UNIT-I

Basic concepts - Fluid properties - Basic hydrostatic equation - Manometry - Submerged and floating bodies. Pressure at a point - Hydrostatic equations for incompressible and compressible fluids -Manometers - Hydrostatic force on a submerged plane and curved surfaces - Buoyancy and equilibrium of floating bodies - Metacentre - Fluid in rigid motion bodies. Fluid dynamics; integral and differential formulations - Continuity equation - Navier-Stokes equations.

UNIT-II

Laminar and turbulent flows - Some exact solutions of Navier-Stokes equations – Flow through pipes. Fluid rotation and deformation - Stream function - Condition of irrotationality -Governing equations of potential flow - Laplace equation. Boundary layer concept -Prandtl's equation - Drag on flat plates - Buckingham π -theorem - Dimensionless numbers.

UNIT-III

Introduction - Classification - Dimensional analysis - Specific speed - Basic laws and equations. Hydraulic turbines - Pelton, Francis, and Kaplan turbines - Turbine efficiencies - Cavitation in turbines. Steam turbines; basic cycle, impulse and reaction turbines - Gas turbine; basic cycle and multi-staging - Power and efficiency calculations.

UNIT-IV

Centrifugal pumps; theory, components, and characteristics - Cavitation - Axial flow pumps - Pump system matching. Centrifugal and axial flow compressors; slip, surging and choking. Basic concepts of fluid power system design - Hydraulic oils properties – Seals and Seal materials - Filters and Filtration. Hydraulic pumps, cylinders, and motors - Construction, sizing, and selection.

UNIT-V

Control valves; pressure, flow, and direction - Servo-valves. Basic hydraulic circuits, hydrostatic transmission - Cartridge valve circuits. Control of hydraulic circuits - Electrical, electronics, and PLC - Pneumatic components and basic circuits.

Text Books:

1. Fox, R.W. and Mc Donald, A.T., Introduction to Fluid Mechanics, 6th ed., John Wiley, 2003.
2. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbomachines, 5th ed., Butterworth-Heinemann, 2005.
- Sayers, A.T., Hydraulic and Compressible Flow Turbomachines,
3. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2004.
4. Esposito. A., Fluid Power with Applications, 5th ed., Pearson Education, 2003.
5. R.K. Bensal, Fluid Mechanics and Hydraulic, Laxmi Publishers

Reference Books:

1. White, F.M., Fluid Mechanics, 5th ed., McGraw-Hill, 2003.
2. Lakshminarayana, B., Fluid Dynamics and Heat Transfer of Turbomachinery, Wiley-Interscience, 1995.
3. Industrial Hydraulics, Vickers - Sperry Manual, 2002.
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
5. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2004
7. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011

ME212 Fluid Mechanics and Hydraulics Lab

1. Determination of Metacentric height of buoyancy
2. Determination of force due to impact of jets
3. Determination of co-efficient of discharge of venturi meter
4. Determination of co-efficient of discharge of orifice meter
5. Determination of major losses and minor losses in pipe flow
6. Study and performance test of the any five following hydraulic machines
 - a. Centrifugal Pump
 - b. Reciprocating Pump
 - c. Jet – Pump
 - d. Submersible Pump
 - e. Parallel & Series Pump
 - f. Gear Pump
 - g. Pelton Wheel Turbine
 - h. Francis Turbine

ME214 Metallurgy Lab

1. Study of microstructure in metals
2. Specimen preparation & microscopic study of ferrous/nonferrous metals
3. Effect of heat treatments viz., Annealing and hardening on ferrous/nonferrous metals
4. Study of various Quenching mediums
5. Jominy end quenching test

ME216 Production Process Lab - II

1. Study of Shaper
2. Cube shaping
3. Step shaping
4. Study of Milling Machine
5. Cube Milling
6. Step Milling
7. Key Way Milling
8. Study of CNC milling machines

9. Programming in CNC milling
10. Study of Grinding Machine
11. Cylindrical Grinding operation
12. Study of tool and cutter grinder
13. Grinding of single point cutting tool