MA1302	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		4	0	0	4

OBJECTIVES :

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving one dimensional wave and heat flow problems used in various situations.
- To acquaint the student with Fourier series techniques in solving two dimensional heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS-I **12**

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation –Integral surface passing through a curve-surface orthogonal to a system of surface-Non linear partial differential equation –Charpit's method-special methods of solution applicable to certain standard forms- Jacobi's Method

UNIT II PARTIAL DIFFERENTIAL EQUATIONS-II **12**

Homogenous Linear partial differential equations of second and higher order with constant coefficients – Non homogeneous Linear partial differential equations of second and higher order with constant coefficients- Partial differential equation reducible to equation with constant coefficients-partial differential equation of order two with variable coefficients

UNIT III FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT V FOURIER TRANSFORMS **12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

TOTAL : 60 PERIODS

OUTCOMES :

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one dimensional heat flow problems and one dimensional wave equations.
- Appreciate the physical significance of Fourier series techniques in solving two dimensional heat flow problems in Mechanical Engineering.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES :

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

ME1301	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of thermodynamics
- To study about the second law of thermodynamics and entropy principles.
- To understand the concept of steam power cycle.
- To study about the thermodynamic relations.
- To learn gas mixture concept and psychrometric processes .

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted)

UNIT I	BASIC CONCEPTS AND FIRST LAW	9

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. System, Property, specific quantities, Temperature and Temperature scales. Quasi-static, reversible and irreversible processes. Displacement work and other modes of work. Zeroth law of thermodynamics, Thermodynamic

states, equilibrium, process cycle, work, heat and other energy – First law of thermodynamics –application to closed and open systems – steady and unsteady flow processes. General Energy equation.

UNIT II	SECOND LAW AND ENTROPY PRINCIPLES	9

Kelvin-Planck and Clausius statements-heat engines and heat pump, reversibility, Carnot cycle, Carnot theorem and performance. Clausius theorem, Concept of entropy, T-s diagram, Tds Equations, entropy change for - pure substance, ideal gases - different processes.

UNIT III	PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE	9

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycle.

UNIT IV	IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS	9

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties. Compressibility factor - Principle of Corresponding states. - Generalized Compressibility Chart and its use. Maxwell relations, Energy equation, Joule-Thomson Coefficient and Clausius Clapeyron equation.

UNIT V	GAS MIXTURES AND PSYCHROMETRY	9

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures. Psychrometric processes – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

	TOTAL:	45	PERIODS

OUTCOMES:

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

- Apply the first law of thermodynamics for simple open and closed systems.
- Apply second law of thermodynamics to open and closed systems and calculate entropy .
- Apply the concepts of Rankine cycle to steam power plant.
- Derive simple thermodynamic relations of ideal and real gases.
- Calculate the properties of gas mixtures and moist air and its use in psychometric processes.

TEXTBOOKS:

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics ",Fifth Edition,2017.
2. Nag.P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw-Hill, New Delhi, 2013..

REFERENCES:

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2019.
2. Borgnakke & Sonnatag, "Fundamental of Thermodynamics", 8th Edition , 2016.
3. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 8th

Edition.

ME1302	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic properties of fluid and solve problems on fluid statics.
- To understand fluid kinematics, fluid dynamics and to analyze and appreciate the complexities involved in solving the fluid flow problems.
- To understand the importance of dimensional analysis.
- To study the conservation laws in flow through pipes are studies.
- To understand the importance of various types of flow in pump and turbine.

UNIT I	FLUID PROPERTIES AND FLUID STATICS	8

Units and dimensions -Properties of Fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension. Fluid statics: concept of fluid static pressure - Atmospheric pressure, Gauge Pressure and Absolute pressure - Pressure measurements by manometers. Hydrostatic Forces on surface – buoyancy and floatation.

UNIT II	FLUID KINEMATICS AND DYNAMICS	9

Fluid Kinematics – Classification and types of flow – Continuity equation for 3D flow in cartesian Co-ordinates - continuity equation for 1D flow. Fluid Dynamics - Forces acting on fluid in motion - Navier Strokes equation - Euler's Equation - Bernoulli's Equation. Application of Bernoulli's Equation - Venturi meter- Orifice meter-Pitot tube- Momentum Equation and its application to pipe bend.

UNIT III	DIMENSIONAL ANALYSIS AND MODEL STUDIES	8

Need for dimensional analysis - Fundamental dimensions - dimensional homogeneity - Rayleigh's method and Buckingham Pi- theorem - Dimensionless Numbers – Model Analysis – Similitude – Model Law - Dimensionless parameters - application of dimensionless parameters – Model analysis.

UNIT IV	FLOW THROUGH PIPES	10

Flow of viscous fluid through circular pipe - Reynold's experiment – Types of flow. Boundary Layer Theory. Energy and head losses through pipes – Major loss – Minor loss – Hydraulic Grade Line and Total Energy Line – Pipes in Series - Pipes in Parallel – Power Transmission by Pipe Line - Moody's diagram.

UNIT V	PUMPS AND TURBINES	10

Impact of jets- Euler's equation- Theory of roto dynamic machines- Centrifugal pumps– working principle-work done by the impeller - performance curves - Reciprocating pump- working principle. Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working Principles of operation of turbine calculation of main dimensions, regulation and performance - governing of turbines.

	TOTAL:	**45**	**PERIODS**

OUTCOMES:

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

- Gain basic knowledge on fluid properties, solve problems on static.
- Solve problems on fluid kinematic and dynamic.
- Mathematically predict the nature of physical quantities.
- Analyze and calculate major and minor losses associated with pipe flow in piping networks.
- Analyze the performance of pumps and turbines.

TEXTBOOKS:

1. Bansal.R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications Pvt. Ltd., New Delhi, 2015.
2. Jain.A.K.., "Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, Twelth Edition, 2016.

REFERENCES:

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
3. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010

EE1308	**ELECTRICAL DRIVES AND CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- **To understand the basic concepts of different types of electrical machines and their performance.**
- **To understand the concepts of Battery Technologies.**
- **To study the different methods of starting D.C motors and induction motors.**
- **To understand the starting methods of DC & AC motors.**
- **To study the conventional and solid-state drives DC & AC drives**

UNIT I	**INTRODUCTION**	**9**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading. Types of Batteries, Characteristics of Batteries.

UNIT II	**DRIVE MOTOR CHARACTERISTICS**	**9**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound – single phase and three phase induction motors. Construction and Mechanical characteristics of BLDC motor.

UNIT III	**STARTING METHODS**	**9**
Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.		
UNIT IV	**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES**	**9**
Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system – Introduction to controlled rectifiers & choppers-converter and chopper fed DC drives.		
UNIT V	**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES**	**9**
Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.		

	TOTAL	**45**	**PERIODS**	

OUTCOMES:

Upon Completion of this subject, the students can able to explain

- Different types of electrical machines and their performance and battery techniques
- Dc and Ac motor performances
- Starting methods of Ac and Dc motors
- Solid state speed control of Dc drives
- Solid state speed control of Ac drives

TEXTBOOKS

1. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 2006
2. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2010

REFERENCES:

1. Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2017
2. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 2012
3. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2006.
4. David Linden and Thomas B. Reddy, "Handbook of Batteries" McGraw-Hill Professional,2001

ME1303	**PRODUCTION TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To study the basic casting processes, various metal joining processes and gain relevant skills.
- To learn about the theory behind metal cutting and principle of working of basic machines
- To learn about the various plastic moulding and forming processes and to make simple plastic part.
- To provide the knowledge on various bulk deformation processes and various abrasive machining processes.

- To expose knowledge on sheet metal forming processes and special forming processes and to make small sheet metal parts.

UNIT I	**CASTING PROCESSES AND METAL JOINING PROCESSES**	**9**

Introduction to production processes and its classifications - Pattern Types and Allowances. Moulding sand – Types & Properties. Moulding machines and its types. Melting furnaces. Sand casting defects. Special casting processes – Centrifugal casting and Investment casting. Introduction to welding processes - Principle of Gas welding and arc welding. Principle of Resistance welding, Gas metal arc welding, Submerged arc welding, Tungsten Inert Gas welding, Thermit welding and Electron beam welding

UNIT II	**THEORY OF METAL CUTTING AND BASIC MACHINES**	**9**

Mechanics of metal cutting, orthogonal and oblique cutting, Mechanism of chip formation, Types of chips, Merchant's Circle Diagram, Cutting Force Measurements, Tool life & Cutting Tool Materials.
Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, Capstan and turret lathes- tool layout, Shaper - Basic operations. Milling operations - types of milling cutter.

UNIT III	**MOULDING AND FORMING OF PLASTICS**	**9**

Introduction to plastics - Moulding of Thermoplastics - Principle and applications of Injection moulding and its types, Blow moulding, Rotational moulding, Thermoforming and Extrusion. Moulding of Thermosets - Principle and applications of Compression moulding and Transfer moulding - Bonding of Thermoplastics - Fusion and solvent methods.

UNIT IV	**BULK DEFORMATION PROCESSES AND ABRASIVE MACHINING**	**9**

Introduction - Hot and cold working of metals - Forging processes - Open and close die forging, Forging equipments. Rolling -Types of Rolling mills, Tube piercing and Defects. Principle of Extrusion and its types.
Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding and internal grinding.

UNIT V	**SHEET METAL AND SPECIAL FORMING PROCESSES**	**9**

Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes – Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning– Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming

TOTAL:	**45**	**PERIODS**	

OUTCOMES:

Upon the completion of this course the students will be able to

- Explain different metal casting processes, compare different metal joining processes merits and demerits
- Describe the mechanism of material removal processes and operational features of centre lathe, shaper

and milling machines

- Distinguish various methods of manufacturing plastic components
- Summarize various hot working and cold working methods of metals, grinding and other super finishing processes
- Explain various sheet metal making special forming processes

TEXTBOOKS:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", Volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2013

REFERENCES:

1. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition, TMH-2013
2. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2014.
3. HMT, "Production Technology", Tata McGraw Hill, 1998.
4. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984
5. Roy. A.Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education 2006

ME1304	ENGINEERING METALLURGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study alloys formation, phase diagrams, invariant reactions and iron-carbon diagram
- To introduce concept of heat treatment processes, Explain isothermal transformation, continuous cooling diagrams and different surface heat treatment methods.
- To study the effect of alloying elements on ferrous and non-ferrous metals and properties, applications of various alloys.
- To explain the properties and applications of non-metallic materials and smart materials.
- To impart knowledge on the testing of mechanical properties of materials and principles of plastic deformation mechanisms.

Review (Not for Exam):

- Crystal structure – BCC, FCC and HCP structure – unit cell – crystallographic planes and directions, miller indices – crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number- Atomic Diffusion

UNIT I	ALLOYS AND PHASE DIAGRAMS	9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic and peritectoid reactions, Iron – carbon equilibrium diagram. Classification of steel, properties and applications.

UNIT II	HEAT TREATMENT OF METALS	9

Purpose of Heat treatment– Full annealing, stress relief, recrystallization and spheroidising – normalizing,

hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram,CCR – Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening.

UNIT III	FERROUS AND NON-FERROUS METALS	9

Effect of alloying additions on steel- α and β stabilizers– stainless and tool steels – HSLA, Maraging steels – Cast Iron – Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium alloys and Al-Cu – precipitation strengthening treatment – Mg-alloys, Bearing alloys, , Ni-based super alloys and Titanium alloys.

UNIT IV	NON METALS & SMART MATERIALS	9

Polymers– types, commodity and engineering polymers – Properties and applications of common thermosetting and thermoplastic polymers - Engineering Ceramics – Properties and applications-Composites- Classifications-FRP,MMC,CMC-Applications of Composites, Fiber Optic materials, Piezo Electrics – Shape Memory Alloys

UNIT V	MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS	9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell) hardness tests, Impact test- lzod and charpy, fatigue and creep failure mechanisms-testing.

TOTAL:	45	PERIODS

OUTCOMES:

Upon the completion of this course the students will be able to

- Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
- Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
- Clarify the effect of alloying elements on ferrous and non-ferrous metals
- Summarize the properties and applications of non metallic materials.
- Explain the testing of mechanical properties. .

TEXTBOOKS:

1. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2014
2. O.P. Khanna, A text book of Materials Science and Metallurgy, Khanna Publishers, 2003

REFERENCES:

1. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 2010.
2. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 2015.
3. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012

4. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.
5. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1997.

EE1309	ELECTRICAL DRIVES & CONTROL LABORATORY	L	T	P	C
		0	0	4	2

Objectives:

- To validate the principles studied in theory by performing experiments in the laboratory

LIST OF EXPERIMENTS:

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Study of DC & AC Starters

TOTAL PERIODS: 60

Course Outcomes:

- Ability to perform speed characteristic of different electrical machine

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	DC Shunt motor	2
2	DC Series motor	1
3	DC shunt motor-DC Shunt Generator set	1
4	DC Shunt motor-DC Series Generator set	1
5	Single phase transformer	2
6	Three phase alternator	2
7	Three phase synchronous motor	1
8	Three phase Squirrel cage Induction motor	1
9	Three phase Slip ring Induction motor	1

ME1305	PRODUCTION TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

Objectives:

- To Study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.

LIST OF EXPERIMENTS:

Machining and Machining time estimations for:

1. External Thread cutting
2. Internal Thread Cutting
3. Eccentric Turning
4. Knurling
5. Hexagonal Head Shaping
6. Contour milling using vertical milling machine
7. gear cutting in milling machine
8. Gear generation in hobbing machine
9. Gear generation in gear shaping machine
10. Tool angle grinding with tool and Cutter Grinder
11. Measurement of cutting forces in Milling / Turning Process

TOTAL PERIODS: 60

Course Outcomes:

Upon completion of this course students will be

- Able to use different machine tools to manufacturing components.
- Able to use different machine tools for finishing operations

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1	Centre Lathes	7 Nos.
2	Shaper	1 No.
3	Horizontal Milling Machine	1 No
4	Vertical Milling Machine	1 No
5	Turret and Capstan Lathes	1 No each

6	Radial Drilling Machine	1 No.
7	lathe Tool Dynamometer	1 No
8	Milling Tool Dynamometer	1 No
9	Gear Hobbing Machine	1 No
10	Tool Makers Microscope	1 No
11	Gear Shaping machine	1 No
12	Centerless grinding machine	1 No
13	Tool and cutter grinder	1 No