KAMARAJ
COLLEGE OF ENGINEERING & TECHNOLOGY
(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)
S.P.G.Chidambara Nadar - C.Nagammal Campus
S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

B.E. MECHATRONICS ENGINEERING
REGULATIONS – 2021
AUTONOMOUS SYLLABUS
CHOICE BASED CREDIT SYSTEM
III TO IV SEMESTER CURRICULUM AND SYLLABI

VISION:

To make the Department of Mechatronics Engineering of this Institution the unique of its kind in the field of Research and Development activities in this part of world.

MISSION:

To impart highly innovative and technical knowledge in the field of Mechatronics Engineering to the urban and unreachable rural student folks through Total Quality Education.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: Graduates will be able to apply their multi-disciplinary knowledge to formulate, design, develop and analyse Mechatronics Systems.

PEO 2: Graduates will be able to come up with solution for any real time problems in the field of Mechatronics Engineering and allied areas demanded by the Industry and Society.

PEO 3: Graduates will be able to get familiarized with economical issues in Mechatronics Engineering and work in multi-disciplinary teams with ethical code of conduct.

PROGRAM OUTCOMES:

After going through the four years of study, the Mechatronics Engineering graduates will have the ability to

POs	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/Development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1 : Graduates will be able to apply their knowledge in sensors, drives, actuators, controls, mechanical design and modern software & hardware tools to design & develop cost effective Mechatronics systems.

PSO2 : Graduates will be able to become Technocrats and Entrepreneurs, build the attitude of developing new concepts on emerging fields and pursuing higher studies.

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REGULATIONS - 2021
CHOICE BASED CREDIT SYSTEM
B.E. MECHATRONICS ENGINEERING
CURRICULUM AND SYLLABI FOR SEMESTER III TO IV
SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA2202	Transforms and Numerical Solution of Equations	BS	4	3	1	0	4
2	GE2201	Design Thinking	EM	3	3	0	0	3
3	ME2201	Engineering Mechanics	BS	3	3	0	0	3
4	MT2201	Analog Devices and Circuits	PC	3	3	0	0	3
5	MT2202	Electrical Circuits and Machines	BS	3	3	0	0	3
6	MT2203	Fluid Mechanics and Thermal Sciences	PC	3	3	0	0	3
PRACTICALS								
7	MT2204	Computer Aided Drafting Laboratory	BS	4	0	0	4	2
8	MT2205	Electrical Circuits and Machines Laboratory	BS	4	0	0	4	2
9	MT2206	Fluid Mechanics Laboratory	PC	4	0	0	4	2
TOTAL				**31**	**18**	**1**	**12**	**25**

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA2254	Probability, Statistics and Numerical Methods	BS	4	3	1	0	4
2	EE2259	Control Systems Engineering	ES	3	3	0	0	3
3	MT2251	Digital Electronics and Microprocessors	PC	3	3	0	0	3
4	MT2252	Manufacturing Technology	PC	3	3	0	0	3
5	MT2253	Sensors and Instrumentation	PC	3	3	0	0	3
6	MT2254	Solid Mechanics[#]	PC	4	2	0	2	3
7	GE2251	Quantitative Aptitude	EM	1	1	0	0	1
8	AUD110	Tamils and Technology	AU	1	1	0	0	0
PRACTICALS								
9	MT2255	Manufacturing Technology Laboratory for Mechatronics Engineers	PC	3	0	0	3	1
10	MT2256	Sensors and Instrumentation Laboratory	PC	3	0	0	3	1
11	EM2252	An Introduction to Advanced Reading and Writing	EEC	2	0	0	2	1
TOTAL				**30**	**19**	**1**	**10**	**23**

[#] Theory cum Laboratory Course

Course Code	Course Name	L	T	P	C
MA2202	TRANSFORMS AND NUMERICAL SOLUTION OF EQUATIONS	3	1	0	4

Category: Foundation Course (Basic Science Courses)

a. Preamble

Fourier analysis allows modelling periodic phenomena which appears frequently in engineering, alternating electric currents or the motion of planets. The idea of Fourier analysis is to represent complicated functions in terms of simple periodic functions, namely cosines and sines. This course aims to developing the ability to formulate an engineering problem in a mathematical form by appropriate numerical approach.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Construct the Fourier series for periodic functions and for function with discrete data.	K3
CO2	Classify and solve the initial and boundary value problems such as wave and heat flow equation.	K3
CO3	Compute the Fourier transforms of standard functions and learn its properties.	K3
CO4	Apply the techniques of Z - transform to get the solutions of difference equations.	K3
CO5	Compute numerical solution of algebraic, transcendental equations and system of linear equations.	K3

c. Course Syllabus **Total : 60 Periods**

FOURIER SERIES **12**

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

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Classification of partial differential equations – Method of separation of variables – Solutions of one-dimensional wave equation and one-dimensional heat equation – Steadystate solution of two-dimensional heat equation – Fourier series solutions in cartesian coordinates

FOURIER TRANSFORM **12**

Fourier integral theorem – Fourier transform pair – Sine and cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

Z-TRANSFORM **12**

Z-transform - Elementary properties - Initial and final value theorems - Inverse Z- transform - Convolution theorem - Formation of difference equation - Solution of difference equation using Z - transform.

NUMERICAL SOLUTION OF EQUATIONS **12**

Solution of Algebraic and Transcendental equations: Bisection Method - Fixed point iteration method - Newton Raphson method - Solution of linear system of equations: Gauss elimination method - pivoting - Gauss Jordan method - Iterative methods: Gauss Jacobi - Gauss Seidel.

d. Activities

Students shall be exposed to MATLAB programming to find the Fourier transform of the given functions.

e. Learning Resources

Text Books

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, Tenth Edition, New Delhi, 2015.
2. Grewal, B. S, *Higher Engineering Mathematics*, Khanna Publishers, Forty Fourth Edition, New Delhi, 2017.
3. Sastry, S. S, *Introductory Methods of Numerical Analysis*, PHI Learning, Fifth Edition, 2015.

Reference Books

1. Bali, N, Goyal, M, & Watkins, C, *Advanced Engineering Mathematics*, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), Seventh Edition, New Delhi, 2009.

2. Peter, V, O'Neil, *Advanced Engineering Mathematics*, Cengage Learning India Pvt., Ltd., Seventh Edition, New Delhi, 2012.
3. Ramana, B.V, *Higher Engineering Mathematics*, Tata McGraw Hill Co.Ltd., New Delhi, Eleventh Reprint, 2010.

Course Code	Course Name	L	T	P	C
GE2201	DESIGN THINKING	3	0	0	3

Category: Employability Enhancement Courses

a. Preamble

This course introduces the various principles of design thinking to achieve an effective design and to examine the implementation of the model or process for its successful operation.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Describe the basic principles of design and various stages of design thinking for better conceiving of idea and refinement.	K2
CO2	Elucidate the concepts of idea generation and refinement.	K3
CO3	Apply various prototype models for solving complex problems.	K3
CO4	Analyze real-time problems for effective design, implementation and operation.	K3
CO5	Device idea/solution towards development of a prototype for a chosen problem of interest.	K4

c. Course Syllabus **Total : 45 Periods**

INTRODUCTION TO DESIGN THINKING **9**

Introduction - Product life cycle – Design Ethics – Design Process – Stages in design thinking: Immersion, Analysis and synthesis, Ideation, Prototyping.

IDEA GENERATION AND REFINEMENT **9**

Basic design - directions - Themes of thinking - Inspiration and references – Brainstorming Value - Inclusion – Sketching - Presenting ideas - Thinking in images - Thinking in signs Appropriation - Personification - Visual metaphors - Modification - Thinking in words - Words and language - Thinking in shapes - Thinking in proportions - Thinking in color - Outside the Box.

PROTOTYPING **9**

Developing designs - Types of prototype - Prototyping for Designing Complex Systems - The Efficacy of Prototyping under Time Constraints.

IMPLEMENTATION **9**

Format - Materials - Finishing - Media - Scale - Series/Continuity - Emerging Landscapes of Design - Real-Time Design Interaction Capture and Analysis - Enabling Efficient Collaboration in Digital Design - Spaces Across Time and Distance - Software used in Developing in Virtual Environments.

DESIGN THINKING IN VARIOUS SECTORS **9**

Design & Development of Prototypes for Wall Plastering, Rubber shredding, Separation of Corn seeds, Electric vehicles, Smart gates, Burglar alarm, Tyre pressure monitor, Development of Online Voting System, Online Proctoring System, Online Health Monitoring System, IoT based Home Automation and any other problem of interest in your domain.

d. Learning Resources

Text Books

1. Binder, T., De Michelis, G., Ehn, P., Jacucci, G., Linde, P., and Wagner, I., 2011. *Design things*, MIT press.
2. Ambrose, G., and Harris, P., 2009. *Basics Design 08: Design thinking*, Bloomsbury Publishing.

Reference Books

1. Meinel, C., and Leifer, L. (Eds.)., 2011. *Understanding Innovation*, Springer.
2. Plattner, H., Meinel, C., and Leifer, L. (Eds.)., 2010. *Design thinking: understand - improve–apply*, Springer Science & Business Media.
3. Moran, T. P., and Carroll, J. M., 1996. *Design Rationale: Concepts, Techniques, and Use*, L. Erlbaum Associates Inc.
4. Cross, N., 1984. *Developments in Design Methodology*, Chichester: Wiley

Web Resources

1. https://www.designsociety.org/downloadpublication/39626/Design+prototyping+of+systems
2. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process

Video lectures

1. https://nptel.ac.in/courses/110/106/110106124/#

Course Code	Course Name	L	T	P	C
ME2201	ENGINEERING MECHANICS	3	0	0	3

Category: Foundation Course (Basic Science Courses)

a. Preamble

This course promotes the students to understand basic concepts of force and its relative effects in engineering problems and also helps in developing the capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply basic engineering principles such as laws of mechanics and vector calculus for solving problems related to particles at rest.	K3
CO2	Examine the various reactive forces and couples for equilibrium of rigid bodies using free body diagram.	K3
CO3	Determine the various section properties (Centroid, Moment of Inertia, Product Moment of Inertia and Mass moment of Inertia) for simple and composite sections.	K3
CO4	Solve simple application problems related to dynamics of particles (velocity, acceleration, forces that induce motion and work done).	K3
CO5	Calculate the frictional forces exerted when a body is sliding & Rolling over another body.	K3

c. Course Syllabus **Total : 45 Periods**

BASICS AND STATICS OF PARTICLES **9**

Introduction - Units and Dimensions - Laws of Mechanics - Lami's theorem, Parallelogram and triangular Law of forces - Vectorial representation of forces - Vector operations of forces - additions, subtraction, dot product, cross product - Coplanar Forces - rectangular components -Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility.

EQUILIBRIUM OF RIGID BODIES **9**

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions.

PROPERTIES OF SURFACES AND SOLIDS **9**

Centroid and Moment of Inertia – Centroid of lines and areas – Theorems of Pappus - Parallel axis theorem and perpendicular axis theorem for Second moment of Plane area - First and Second moment of plane area , Principal Moment of Inertia for T section- I section, - Angle section, Hollow section by using standard formula. Mass moment of Inertia for prismatic, cylindrical and spherical solids - Relation to area moments of inertia.

DYNAMICS OF PARTICLES **9**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

FRICTION **9**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance.

d. Activities

Students shall be given exposure to understand the concepts of force and motion behaviour of objects by framing the basic equations using Newton's Law of Motion.

e. Learning Resources

Text Books

1. Beer, F.P and Johnston Jr. E.R., (2004), *Vector Mechanics for Engineers* (In SI Units): Statics and Dynamics, 8th Edition, Tata McGraw-Hill Publishing Company, New Delhi.
2. Vela Murali, 2010, *Engineering Mechanics*, Oxford University Press.

Reference Books

1. Bhavikatti, S.S and Rajashekarappa, K.G., (1998*), Engineering Mechanics*, New Age International (P) Limited Publishers.
2. Hibbeller, R.C and Ashok Gupta, (2010), *Engineering Mechanics: Statics and Dynamics,* 11th Edition, Pearson Education 2010.

3. Irving H. Shames and Krishna Mohana Rao. G., (1993*), Engineering Mechanics – Statics and Dynamics*, 4th Edition, Pearson Education.
4. Meriam J.L. and Kraige L.G., (1993), *Engineering Mechanics- Statics - Volume 1, Dynamics*- Volume 2, Third Edition, John Wiley & Sons.
5. Rajasekaran S and Sankarasubramanian G., (2005*), Engineering Mechanics Statics and Dynamics*, 3rd Edition, Vikas Publishing House Pvt. Ltd.

Course Code	Course Name	L	T	P	C
MT2201	ANALOG DEVICES AND CIRCUITS	3	0	0	3

Category: Professional Core Courses

a. Preamble

This course provides engineering students with basic understanding of analog electronic components and designs of circuits using them. The syllabus includes different types of signal generation; followed by, some basic measurement and test devices and its uses. Then we cover some basic display devices and its construction and working principle.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Demonstrate the circuits using semiconductor diodes, transistors.	K2
CO2	Apply Op-Amp application circuits for signal analysis.	K3
CO3	Describe various Signal Generation, Voltage regulation circuits using ICs.	K2
CO4	Intrepret various internal functional blocks of test & measurement devices	K2
CO5	Comprehend the principles of various display devices.	K2

c. Course Syllabus **Total : 45 Periods**

ANALOG ELECTRONICS **9**

Semiconductor Diodes –Bipolar Junction Transistor – Characteristics Rectifiers and Filters - Regulated Power Supply –Switching Power Supplies, Thermal Considerations - Feedback and power amplifiers - Oscillators: Colpitts oscillator, Hartley oscillator and Wien bridge oscillator.

OPERATIONAL AMPLIFIERS AND APPLICATIONS **9**

Operational amplifiers – Principles, Specifications, characteristics and applications-. Arithmetic Operations, Integrator, Differentiator, Comparator, Schmitt Trigger, Instrumentation Amplifier, A/D & D/A converters.

WAVEFORM GENERATORS AND ICs **9**

Triangular, Saw tooth and Sine wave generators - Multivibrators - Function generator ICs - Timer ICs -Voltage regulator ICs: fixed, Adjustable and General purpose - V/F and F/V converters - Optocouplers.

TEST AND MEASURING INSTRUMENTS **9**

Measurement of voltage, current, frequency and power using Multi meters, oscilloscopes, recorders, data loggers, voltage-controlled oscillators, counters, analyzers and printers.

DISPLAY DEVICES **9**

Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, LED, Plasma Display, Liquid Crystal Displays, Touch Screens,
Numeric Displays, Photo transistor, Solar cell, CCD.

d. Activities

Students shall be given exposure to design simple electronic circuits using Op - Amp. Students shall given hands on exposure in test and measuring instruments.

e. Learning Resources

Text Books

1. Salivahanan S., Suresh kumar N. and Vallavaraj A.,2012, *Electronic Devices and Circuits*, Tata McGraw Hill publishing company, New Delhi, 3rd edition.
2. Roy Chowdhury D. and Jain Shail B., 2018, *Linear Integrated Circuits*, New Age Int. Pub., 5th edition.

Reference Books

1. Albert Malvino and Bates J.,2013, *Electronic Principles*, Tata McGraw- Hill Pub. Company Ltd., 7th edition.
2. Millman J., Halkias C.C. and SatyabrataJit., 2010, *Electronic Devices and Circuits*, Tata McGraw Hill, New Delhi, 3rd edition.
3. Thomas L. Floyd.,2010, *Electronic Devices*, Pearson Education Asia, 9th edition.
4. NPTEL Video Lecture Notes on Analog Electronic Circuits and Integrated Circuits, MOSFETs, Op-Amps and their applications.
5. Donald A Neaman., 2012 *Semiconductor Physics and Devices*, Fourth Edition, Tata McGraw Hill Inc.2012.

Course Code	Course Name	L	T	P	C
MT2202	ELECTRICAL CIRCUITS AND MACHINES	3	0	0	3

Category: Foundation Course (Basic Science Courses)

a. Preamble

This course promotes students to understand basic concepts of DC and AC circuits behavior and impart knowledge on solving circuit equations using network theorems. It also enables the students to understand single and three phase circuits, wiring & working principle of transformer, DC & AC Machines.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Comprehend the basic laws, mesh current, nodal voltage, voltage and current division for solving circuit problems.	K2
CO2	Solve the networks having DC and AC inputs using network theorems.	K3
CO3	Select DC Machines for a particular application based on its Characteristics.	K3
CO4	Select AC Motor for a particular application based on its Characteristics.	K3
CO5	Differentiate between various types of starting and speed control methods.	K3

c. Course Syllabus **Total : 45 Periods**

ELECTRICAL CIRCUITS **9**

Basic circuit components - Ohms Law - Kirchhoff's Law - Instantaneous Power - Inductors - Capacitors - Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis- Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer theorem - Linearity and Superposition Theorem.

AC CIRCUITS **9**

Introduction to AC circuits- Waveforms and RMS value- Power and Power factor, Single phase and Three-phase balanced circuits- Three phase loads- House wiring, Industrial wiring,

materials of wiring- Principle of Operation of Transformers- EMF Equation of Transformers.

DC MACHINES **9**

Types - Constructional details - Principle & operation - Emf equation -Methods of excitation of D.C. generators - Characteristics of series, shunt generator - Principle operation of D.C. motor - Back emf and torque equation - Characteristics of series shunt and Compound motors.

AC MACHINES **9**

Constructional details, principle of operation and performance characteristics Single phase induction motor, Three phase induction motor, Synchronous motors.

SPEED CONTROL AND STARTING **9**

Speed control of D.C. motors - Three phase induction motors - Synchronous motor - starting methods of D.C. motor, Three phase induction motor and Synchronous motor.

d. Activities

Students shall be given an exposure to understand the AC and DC circuits behavior by using MATLAB software.

e. Learning Resources

Text Books

1. D P Kothari and I.J Nagarath, *Basic Electrical and Electronics Engineering*, McGraw Hill Education (India) Private Limited, Third Reprint, 2016.
2. Thereja .B.L., *Fundamentals of Electrical Engineering and Electronics*, S. Chand & Co. Ltd., 2008.

Reference Books

1. Del Toro., 2007, *Electrical Engineering Fundamentals*, Pearson Education, New Delhi.
2. John Bird., 2006, *Electrical Circuit Theory and Technology*, Elsevier, First Indian Edition.
3. Allan S Moris., 2006, *Measurement and Instrumentation Principles*, Elsevier, First Indian Edition.
4. Rajendra Prasad., 2006, *Fundamentals of Electrical Engineering*, Prentice Hall of India.
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel.,2009, *Basic Electrical Engineering*, McGraw Hill Education(India) Private Limited.
6. N K De, Dipu Sarkar.,2016, *Basic Electrical Engineering*, Universities Press (India) Private Limited.

Course Code	Course Name	L	T	P	C
MT2203	FLUID MECHANICS AND THERMAL SCIENCES	3	0	0	3

Category: Professional Core Courses

a. Preamble

This course promotes students to understand basic concepts of fluid mechanics, applications of the conservation laws to flow through pipes, working principle of different types of pumps and Hydraulic turbines, basic laws of thermodynamics and various mechanisms of heat transfer.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Describe the properties of fluids and its importance in selection of fluid for suitable application.	K3
CO2	Identify the major and minor losses involved in the fluid flow through pipes.	K3
CO3	Differentiate the types of hydraulic machines and describe the working principle.	K3
CO4	Apply the basic laws of thermodynamics for different applications.	K3
CO5	Distinguish various modes of heat transfer and determine the heat transfer rate.	K3

c. Course Syllabus **Total : 45 Periods**

PROPERTIES OF FLUIDS **9**

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics- Concept of control volume - Application of continuity equation, Energy equation and Momentum equation.

FLOW THROUGH CIRCULAR CONDUITS **9**

Hydraulic and energy gradient- Laminar flow through circular conduits and circular annuli- Boundary layer concepts- Types of boundary layer thickness- Darcy Weisbach equation- Friction factor- Moody diagram- Commercial pipes- Minor losses – Flow through pipes in series and parallel- Basics of dimensional analysis.

HYDRAULIC MACHINES **9**

Introduction and classification of hydraulic machines - Reciprocating pump: constructional details, working principle, co-efficient of discharge, slip, power required. Centrifugal pump: classification and working principle, specific speed. Turbines: classification, working principle of impulse and reaction turbine.

LAWS OF THERMODYNAMICS **9**

Thermodynamic system and surroundings- Properties of system - State and Equilibrium - Forms of energy - Quasi static process - Zeroth law of thermodynamics - Work and heat transfer - Path and point functions - First law of thermodynamics applied to open systems - SFEE equation and its applications. Second law of thermodynamics applied to Heat engines, Refrigerators & Heat pumps- Carnot's theorem and Clausius inequality- Concept of entropy applied to reversible and irreversible processes- Third law of thermodynamics.

HEAT TRANSFER MECHANISMS **9**

Heat transfer mechanisms: Conduction- Fourier's Law, thermal resistance. Convection- Newton's law of cooling. Radiation- Wien's law, Kirchhoff's law, Stefan-Boltzmann law. Heat exchangers- LMTD- NTU- Fins.

d. Activities

Students shall be given exposure to understand basic concepts of fluid mechanics, laws of thermodynamics and various mechanisms of heat transfer.

e. Learning Resources

Text Books

1. Rajput R.K., 2008, *Heat and Mass transfer*, S.Chand and Co Publishing.
2. Modi PN., Seth SM.,2015, *Hydraulics and fluid mechanics including hydraulic machines*, 20th edition, Standard publishers.

Reference Books

1. Cengel YA., Cimbala J M.,2010, *Fluid Mechanics–Fundamentals and applications*, 2nd Edition, McGraw Hill higher education.
2. Bansal RK., 2011, *Fluid Mechanics and Hydraulics Machines*, 9th edition, Laxmi publications (P) Ltd., New Delhi.
3. Holman, J.P.,2007, *Heat Transfer*, 3rd Edition, McGraw-Hill.
4. White FM., 2011, *Fluid Mechanics*, 7th Edition, Tata McGraw-Hill, New Delhi.
5. Nag P.K.,2005, *Engineering thermodynamics*, Tata McGraw hill.

Course Code	Course Name	L	T	P	C
MT2204	COMPUTER AIDED DRAFTING LABORATORY	0	0	4	2

Category: Foundation Course (Basic Science)

a. Preamble

This course enables the students to understand the basics of drawing standards, fits and tolerances with a view to prepare drawings using standard CAD Packages and also to create isometric projections and orthographic projections of simple solids.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Sketch simple figures using CAD software	K3
CO2	Sketch curves like parabola, spiral and involute of square & circle	K3
CO3	Prepare orthographic projection of simple solids	K3
CO4	Sketch simple steel truss and sectional views of simple solids	K3
CO5	Prepare isometric projection of simple solids	K3

c. Course Syllabus **Total : 60 Periods**

1. Study of Code of Practice for Engineering Drawing, BIS specifications-welding symbols, riveted joints, keys, fasteners-Reference to hand book for the selection of standard components like bolts, nuts, screws, keys, etc.
2. Study of limits, fits-Tolerancing of individual dimensions-specification of fits-Preparation of production drawings and reading of part assembly drawings, basic principles of geometric dimensioning & Tolerancing
3. Study of capabilities of software for Drafting-Coordinate systems (absolute, relative, polar, etc.,)-Creation of simple figures like polygon and general multi-line figures
4. Drawing of a Title Block with necessary text and projection symbol
5. Drawing of curves like parabola, spiral, involute of square & circle.
6. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc., and dimensioning
7. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, simple stool, objects with hole and curves)

8. Drawing of a simple steel truss
9. Drawing sectional views of prism, pyramid, cylinder, cones etc,
10. Drawing isometric projection of simple objects.

d. Activities

Students shall be given exposure to draw daily usable products like mobile phones, gadgets etc., by selecting appropriate dimensions

e. Learning Resources

Text Books

1. Narayana, K. L., 2016, *Machine drawing*, New age International

Reference Books

1. Reddy, K.V., 2008, *Textbook of Engineering drawing*, BS Publications
2. Simmons, C.H. and Maguire, D.E., 2012, *Manual of Engineering Drawing: Technical product specification and documentation to British and International Standards*, Butterworth-Heinemann

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity required
1	Computer with suitable graphics facility	30
2	Licensed software for drafting	30
3	Printer or plotter to Print/plot drawings	2

Plotting of drawings must be made for each exercise and attached to the records written by students.

Course Code	Course Name	L	T	P	C
MT2205	ELECTRICAL CIRCUITS AND MACHINES LABORATORY	0	0	4	2

Category: Foundation Course (Basic Science)

a. Preamble

This course promotes students to understand the basic concepts of electrical circuits and associated theorems. To give hands-on practice to students on design of simple analog circuits. To make the students to understand the load test and performance characteristics of DC shunt motor, stepper motor and induction motors.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Compute the performance of the DC machines for varying load.	K2
CO2	Compute the performance of single phase & three phase AC motor for varying load.	K3
CO3	Select suitable speed control method of AC and DC motor.	K3
CO4	Calculate the performance parameters of stepper motor and transformers.	K3
CO5	Apply basic electrical laws and network theorems for solution of simple DC & AC circuits.	K3

c. Course Syllabus **Total : 60 Periods**

1. Verification of Ohm’s Law & Kirchhoff’s Laws.
2. Verification of Thevenin theorem
3. Verification of Norton's theorem
4. Load test on D.C. shunt motor.
5. Speed control of D.C. shunt motor.
6. Swinburne’s test.
7. Load test on three phase induction motor.
8. No load and blocked rotor tests on three – phase induction motor.
9. Load test on single phase induction motor.
10. No load and blocked rotor tests on single phase induction motor.

11. Load test on Synchronous motors.
12. Performance characteristics of Stepper motor.
13. Performance characteristics of Single phase transformer.
14. Study of Starters

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Shunt motor 5HP	3
2.	Single phase Induction Motor 2HP	2
3.	Three phase induction Motor 5HP	2
4.	Single phase transformer 2KVA	1
5.	Three phase auto transformer	2
6.	Single phase auto transformer	2
7.	3 point starter	3
8.	DPST, TPST Each	2
9.	DC source 300v, 100A	1
10.	Ammeter(0-5A),(0-10A)MC Each	2
11.	Ammeter(0-5A),(0-10A)MI Each	2
12.	Voltmeter(0-300V) MC	3
13.	Voltmeter(0-150V),(0-300V),(0- 600V)MI Each	2
14.	Wattmeter 150/300V, 5/10A UPF	2
15.	Wattmeter 300/600V,5/10A UPF	2
16.	Wattmeter 150/300V,5/10A LPF	2
17.	Wattmeter 300/600V,5/10A LPF	2
18.	Stepper motor 5Kg	1
19.	Synchronous motor 5KW	1
20.	Rheostat 360 ohm/1.2A	3
21.	Tachometer	5
22.	Rheostat 50 ohm/5A	3
23.	Resistors & Breadboards	-
24.	Dual Regulated power supplies	6
25.	Ammeter A.C and D.C	20
26.	Voltmeters A.C and D.C	20

Course Code	Course Name	L	T	P	C
MT2206	FLUID MECHANICS LABORATORY	0	0	4	2

Category: Professional Core Courses

a. Preamble

This course promotes students to verify the principles studied in Fluid Mechanics theory by performing experiments in pumps and turbines.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Perform test on different types of flow measuring devices.	K3
CO2	Perform test on centrifugal pump and reciprocating pump.	K3
CO3	Perform test on different types of rotary pumps.	K3
CO4	Perform test on different types of impulse turbines.	K3
CO5	Perform test on different types of reaction turbines.	K3

c. Course Syllabus **Total : 60 Periods**

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

d. Activities

Students shall be given exposure to understand basic concepts of flow measuring devices, verify the principles studied in Fluid Mechanics theory by performing experiments in pumps and turbines.

e. Learning Resources

Text Books

1. Rajput R.K., 2008, *Heat and Mass transfer,* S.Chand and Co Publishing.
2. Modi PN., Seth SM.,2015, *Hydraulics and fluid mechanics including hydraulic machines,* 20th edition, Standard publishers.

Reference Books

1. Cengel YA., Cimbala J M.,2010, *Fluid Mechanics – Fundamentals and applications,* 2nd Edition, McGraw Hill higher education.
2. Bansal RK., 2011, *Fluid Mechanics and Hydraulics* Machines, 9th edition, Laxmi publications (P) Ltd., New Delhi.
3. Holman, J.P.,2007, *Heat Transfer*, 3rd Edition, McGraw-Hill.
4. White FM., 2011, *Fluid Mechanics*, 7th Edition, Tata McGraw-Hill, New Delhi.
5. Nag P.K.,2005, *Engineering Thermodynamics*, Tata McGraw hill.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS:

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Orifice meter setup	1
2.	Venturi meter setup	1
3.	Rotameter setup	1
4.	Pipe Flow analysis setup	1
5.	Centrifugal pump/submergible pump setup	1
6.	Reciprocating pump setup	1
7.	Gear pump setup	1
8.	Pelton wheel setup	1
9.	Francis turbine setup	1
10.	Kaplan turbine setup	1

Course Code	Course Name	L	T	P	C
MA2254	PROBABILITY, STATISTICS AND NUMERICAL METHODS	3	1	0	4

Category: Foundation Course (Basic Science Courses)
(Common to BT, CIVIL, MECH, MTR)

a. Preamble

This course introduces the basic concepts and techniques of Random variables, Probability distributions, Testing of Hypothesis, Design of Experiments and Numerical Methods and highlights their applications in various fields such as Engineering and Technology.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply the concepts of probability distributions to solve engineering problems.	K3
CO2	Apply the concept of testing of hypothesis for small and large samples in real life problems.	K3
CO3	Apply the basic concepts of classifications of design of experiments in Engineering.	K3
CO4	Compute intermediate values of unknown function using interpolation.	K3
CO5	Apply the numerical techniques of integration for engineering problems.	K3

c. Course Syllabus **Total : 60 Periods**

PROBABILITY AND RANDOM VARIABLES **12**

Probability – Conditional Probability - Baye's Theorem - Random variables – Mathematical Expectations – Moments – Moment generating functions - Distributions: Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

TESTING OF HYPOTHESIS **12**

Sampling distributions - Statistical Hypothesis - Type I and Type II errors - Tests for single mean and difference of means of large samples (Z – test) and small samples (t – test) – F - test for variance - Chi-square test for goodness of fit - Independence of attributes.

DESIGN OF EXPERIMENTS **12**

Basic Principles of Experimental Design - Completely randomized design - Randomized block design – Latin square design - 22 factorial design.

INTERPOLATION AND APPROXIMATION **12**

Difference operators and relations - Interpolation with equal intervals: Newton's forward and backward difference formulae - Cubic Splines - Interpolation with unequal intervals: Lagrange's interpolation - Newton's divided difference interpolation.

NUMERICAL INTEGRATION AND INITIAL VALUE PROBLEMS **12**

Numerical Integration: Trapezoidal – Simpson's 1/3rd rule and 3/8th rule (double integration excluded) – Two point and three point Gaussian quadrature formulae - Single step methods: Euler's method – Modified Euler's method – Fourth order Runge – Kutta method for solving first order equations.

d. Activities

Students shall be exposed to Microsoft Excel for Design of Experiments and MATLAB programming to solve ordinary differential equations with initial condition.

e. Learning Resources

Text Books

1. Grewal, B.S, *Numerical Methods in Engineering and Science*, Eighth Edition Reprint, Khanna Publishers, New Delhi, India, 2018.
2. Johnson, R.A, Miller, I., & Freund, J.E, *Miller & Freund's Probability and Statistics for Engineers*, Eighth Edition, Pearson Education, Asia, 2015.

Reference Books

1. Gerald, C.F, Wheatley, P.O, *Applied Numerical Analysis* Seventh Edition, Pearson Education, Asia, New Delhi, 2007.
2. Walpole, R.E, Myers, R.H, Myers, S.L, & Ye, K, *Probability and Statistics for Engineers and Scientists*, Ninth Edition, Pearson Education, Asia, 2012.
3. Kandasamy, P, Thilagavathy, K, & Gunavathy, K, *Numerical Methods*, Third Edition Reprint, S. Chand & Co. Ltd., New Delhi, 2014.
4. Gupta, S.C, & Kapoor, V.K, *Fundamentals of Mathematical Statistics*, Twelth Edition Reprint, Sultan Chand & Sons, 2020.
5. Veerarajan,T, *Probability, Statistics and Random Processes*, Fourth Edition, Tata McGraw Hill Education, New Delhi, 2014.

Course Code	Course Name	L	T	P	C
EE2259	CONTROL SYSTEMS ENGINEERING	3	0	0	3

Category: Foundation Course (Engineering Science Courses)

a. Preamble

The Course introduces the components and their representation of control systems. It helps to learn various methods for analyzing the time response, frequency response and stability of the systems. It also helps to learn the various approaches for the state variable analysis.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Identify the various control system components and their representations.	K2
CO2	Analyze the various time domain parameters	K3
CO3	Analysis the various frequency response plots and its system.	K3
CO4	Apply the concepts of various system stability criterions.	K3
CO5	Design various transfer functions of digital control system using state variable models	K3

c. Course Syllabus **Total : 45 Periods**

SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure - Feed forward and Feedback control theory Electrical and Mechanical Transfer Function Models - Block diagram Models- Signal flow graphs models - DC and AC servo Systems-Synchros - Multivariable control system.

TIME RESPONSE ANALYSIS 9

Standard Inputs- Transient response & Steady state response - Measures of performance of the standard first order and second order system - Effect on an additional zero and an additional pole- Steady error constant and system type number - PID control - Analytical design for PD, PI,PID control systems.

FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain- Frequency response of standard second order system- Bode Plot - Polar Plot- Design of compensators

using Bode plots - Cascade lead compensation-Cascade lag compensation- Cascade lag-lead compensation.

CONCEPTS OF STABILITY ANALYSIS **9**

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS **9**

State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.

d. Activities

Students shall be given exposure in MATLAB to realize the concepts involved in the subject

- Realization of PI, PID & PD Controllers using MATLAB.
- Bode Plots, Polar plots.

e. Learning Resources

Text Books

1. M.Gopal., 2012, *Control System – Principles and Design*, Tata McGraw Hill, 4th Edition.

Reference Books

1. J.Nagrath and M.Gopal, 2007, *Control System Engineering*, New Age International Publishers, 5 th Edition.
2. K. Ogata., 2012, *Modern Control Engineering*, 5th edition, PHI.
3. S.K.Bhattacharya., 2013, *Control System Engineering*, 3rd Edition, Pearson.
4. Benjamin.C.Kuo.,1995, *Automatic control systems*, Prentice Hall of India, 7th Edition

Course Code	Course Name	L	T	P	C
MT2251	DIGITAL ELECTRONICS AND MICROPROCESSORS	3	0	0	3

Category: Professional Core Courses

a. Preamble

This course promotes students to understand basic concept of combinational and sequential circuits in digital circuit. It also enables the student to understand this course promotes students to understand basic concepts of logic families and programmable devices.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	State the fundamental operating concepts behind digital logic circuits and microprocessors.	K2
CO2	Recognize the use of various digital logic circuits and sub units in microprocessors.	K2
CO3	Sketch the digital logic circuits and the architectures of microprocessors	K2
CO4	Design the DLC and Microprocessor for the standard applications.	K2
CO5	Create the circuits using DLC and Microprocessor for given applications	K2

c. Course Syllabus **Total : 45 Periods**

DIGITAL FUNDAMENTALS **9**

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

COMBINATIONAL & SYNCHRONOUS SEQUENTIAL CIRCUITS **9**

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder - Multiplexer, Demultiplexer, Decoder, Priority Encoder. Flip flops – SR, JK, T, D, design of clocked sequential circuits - Design of Counters- Shift registers, Universal Shift Register.

ASYNCHRONOUS SEQUENTIAL CIRCUITS AND MEMORY DEVICES 9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits. Basic memory structure – ROM -PROM – EPROM – EEPROM – EAPROM, RAM - Static and dynamic RAM - Programmable Logic Devices - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).

8085 PROCESSOR 9

Hardware Architecture, pin diagram - Functional Building Blocks of Processor - Memory organization – I/O ports and data transfer concepts - Timing Diagram - Interrupts.

PROGRAMMING OF 8085 PROCESSOR 9

Instruction - format and addressing modes - Assembly language format – Data transfer, data manipulation& control instructions - Programming: Loop structure with counting & Indexing - Look up table - Subroutine instructions - stack -8255 architecture and operating modes.

d. Activities

Students shall be given exposure to understand the combinational and sequential digital circuits and to develop an application by using digital logic.

e. Learning Resources

Text Books

1. M. Morris Mano and Michael D. Ciletti, *Digital Design*, 5th Edition, Pearson, 2014.
2. Krishna Kant, *Microprocessor and Microcontrollers*, Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.

Reference Books

1. Charles H.Roth. *Fundamentals of Logic Design*, 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, *Digital Fundamentals*, 10th Edition, Pearson Education Inc, 2011.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely *The 8051 Micro Controller and Embedded Systems*, PHI Pearson Education, 5th Indian reprint, 2003.
4. R.S. Gaonkar, *Microprocessor Architecture Programming and Application*, with 8085, Wiley Eastern Ltd., New Delhi, 2013.

Course Code	Course Name	L	T	P	C
MT2252	MANUFACTURING TECHNOLOGY	3	0	0	3

Category: Foundation Course (Basic Science Courses)

a. Preamble

This course promotes students to understand basic concepts of sand casting technique, special casting technique and principles, equipment's of different welding techniques. It also enables the students to understand the basic concepts and working of Traditional, Non-traditional machining process and working principles of different types of metal forming and Plastic manufacturing methods.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Identify and select suitable casting process for a specific component.	K3
CO2	Explain the working principles and applications of different arc welding processes, special welding process and	K2
CO3	Select the suitable process for manufacturing of components using suitable conventional machining.	K3
CO4	Select the suitable process for manufacturing of components using suitable unconventional machining.	K3
CO5	Understand various metal forming process and manufacturing methods of plastic components.	K2

c. Course Syllabus **Total : 45 Periods**

METAL CASTING PROCESSES **9**

Casting types, procedure to make sand mould, types of core making, moulding tools, machine Moulding - melting furnaces: Blast and Cupola Furnaces; special moulding processes – CO2 moulding; shell moulding, investment mounding, Permanent mould casting, pressure die-casting, centrifugal casting, continuous casting – Stir casting – casting defects.

METAL JOINING PROCESSES **9**

Classification of welding processes. Principles of Oxy-acetylene gas welding - A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert

gas welding - plasma arc welding - thermit welding- electron beam welding- laser beam welding- Friction welding and Friction Stir Welding -soldering and brazing- defects in welding.

CONVENTIONAL MACHINING PROCESSES 9

General principles, working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Milling machines, Drilling machine –types- Gear generation methods - broaching machines - cylindrical grinding, surface grinding, centreless grinding and internal grinding - Introduction to CNC Machining.

UNCONVENTIONAL MACHINING PROCESSES 9

General principles, working and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, Electron beam machining and Laser beam machining. Abrasive flow machining, chemo-mechanical polishing, magneto rheological finishing. Comparison of Conventional & Unconventional machining processes.

METAL FORMING AND MANUFACTURING OF PLASTIC COMPONENTS 9

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning. HERF Process - Powder metallurgy – Additive manufacturing.

Types of plastics – Moulding of Thermoplastics – Injection moulding– Blow moulding – Rotational moulding – Film blowing – Extrusion – Thermoforming – Processing of Thermosets – Compression moulding – Transfer moulding – Bonding of Thermoplastics

d. Activities

Students shall be given exposure to understand the concepts of metal forming processes by activity based assignments.

e. Learning Resources

Text Books

1. Hajra Choudhary. S.K and Hajra Choudhary. A.K., *Elements of Workshop Technology*, volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 2010.
2. Kalpakjian. S, *Manufacturing Engineering and Technology*, 7th Edition, Pearson Education India Edition, 2018.
3. Sharma, P.C., *A Text book of production Technology*, S.Chand and Co. Ltd., 2006.

Reference Books

1. *H.M.T. Production Technology* – Handbook, Tata McGraw-Hill, 2000.
2. Roy A. Lindberg, *Processes and Materials of Manufacture*, PHI / Pearson education, 2006
3. Adithan. M and Gupta. A.B., *Manufacturing Technology*, New Age, 2006.

Course Code	Course Name	L	T	P	C
MT2253	SENSORS AND INSTRUMENTATION	3	0	0	3

Category: Professional Core Courses

a. Preamble

This course will introduce the students to understand the purpose of sensors in measurement, the methods of measurements, errors associated with measurements, the basic principles of sensors and instrumentation, including: the operating principles of various sensors, classifications and the characteristics of different transducers, instrumentation design and to know the principle of signal conditioning and data logging for various applications.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the various calibration techniques and types of sensors and transducers.	K2
CO2	Summarize the various sensors used in the Motion and Ranging applications	K2
CO3	Describe the working principle and characteristics of force, magnetic, heading and optical sensors.	K2
CO4	Understand the basic principles of various pressure and temperature, smart sensors.	K2
CO5	Ability to implement the DAQ systems with different sensors for real time applications.	K3

c. Course Syllabus **Total : 45 Periods**

INTRODUCTION **9**

Basics of Measurement Units and Standards– Classification of sensors - Contact and Non Contact Sensors - Classification of errors - Error analysis – Static and dynamic characteristics of transducers - Performance measures of sensors -–Sensor calibration techniques - Sensor Output Signal Types - Wiring Techniques- specifications and manufacturer of sensors.

MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors - Potentiometers, Resolver, Encoders - Optical, Magnetic, Inductive, Capacitive, LVDT - RVDT - Synchro - Microsyn, Accelerometer - GPS, Bluetooth, Range

Sensors - RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

FORCE, MAGNETIC, HEADING AND OPTICAL SENSORS 9

Strain Gage, Load Cell, and Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive - Hall Effect - Current sensor Heading Sensors - Compass, Gyroscope, Inclinometers - Photo conductive cell, photo voltaic, Photo resistive, LDR - Fiber optic sensors.

PRESSURE TEMPERATURE AND ADVANCED SENSORS 9

Pressure - Diaphragm, Bellows, Piezoelectric - Tactile sensors, Temperature - IC, Thermistor, RTD, Thermocouple. Acoustic Sensors - flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

SIGNAL CONDITIONING AND DAQ SYSTEMS 9

Amplification - Filtering - Sample and Hold circuits - Data Acquisition: Single channel and multichannel data acquisition - Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

d. Activities

Students shall be given exposure to select & interface the sensors with controllers for real time applications.

e. Learning Resources

Text Books

1. Ernest O Doebelin., 2009, *Measurement Systems - Applications and Design*, Tata McGraw-Hill.
2. Sawney A K and Puneet Sawney., 2013, *A Course in Mechanical Measurements and Instrumentation and Control*, 12th edition, Dhanpat Rai & Co, New Delhi.

Reference Books

1. C. Sujatha Dyer, S.A., 2001, *Survey of Instrumentation and Measurement*, John Wiley & Sons, Canada.
2. Hans Kurt Tönshoff (Editor), Ichiro., 2001, *Sensors in Manufacturing* Volume 1, Wiley-VCH April.
3. John Turner and Martyn Hill., 1999, *Instrumentation for Engineers and Scientists*, Oxford Science Publications.
4. Patranabis D., 2011, *Sensors and Transducers*, 2nd Edition, PHI, New Delhi.

5. Richard Zurawski., 2015, *Industrial Communication Technology* Handbook 2nd edition, CRC Press.

Course Code	Course Name	L	T	P	C
MT2254	SOLID MECHANICS	2	0	2	3

Category: Professional Core Courses

a. Preamble

This course endorses the students to understand the basic concepts of stress, strain, principal planes, principal stresses and also helps to determine stresses & deformation in beams, shafts, springs and shells. It also enables the student to explore practical knowledge on various structural testing equipment.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.	K3
CO2	Apply the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.	K3
CO3	Apply basic equation of simple torsion in designing of shafts and helical spring	K3
CO4	Calculate the slope and deflection in beams using different methods.	K3
CO5	Analyze and design thin and thick shells for the applied internal and external pressures.	K3
CO6	Calculate the mechanical properties of materials when subjected to axial, transverse & shear loading conditions and evaluate the properties under heat treated conditions	K3

c. Course Syllabus **Total : 60 Periods**

STRESS, STRAIN AND DEFORMATION OF SOLIDS **6**

Rigid bodies and deformable solids-Tension, Compression and Shear stresses- Deformation of simple and compound bars- Thermal stresses- Principal stresses and principal planes.

TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM **6**

Beams - Types transverse loading on beams – Shear force and bending moment in beams - Cantilevers - Simply supported beams and over hanging beams - Theory of simple bending - Bending stress distribution – Load carrying capacity – Proportioning of sections.

TORSION **6**

Torsion formulation stresses and Deformation in circular and hollow shafts - Stepped shafts - Deflection in shafts fixed at the both ends - Stresses in helical springs - Deflection of helical springs.

DEFLECTION OF BEAMS **6**

Double integration method - Macaulay's methods - Area moment method - Conjugate beam method for computation of slopes and deflections of determinate beams.

THIN CYLINDERS, SPHERES AND THICK CYLINDERS **6**

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and Deformation in thin and thick cylinders - Spherical shells subjected to internal pressure – Deformation in spherical shells.

LIST OF EXPERIMENTS **30**

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Izod Impact test
5. Charpy impact test
6. Hardness test on metals - Brinell and Rockwell Hardness Number
7. Deflection test on beams
8. Compression test on helical springs
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
    i. Unhardened specimen
    ii. Quenched Specimen and
    iii. Quenched and tempered specimen.

d. Activities

Students shall be given exposure to compare the properties of different materials under hardening

e. Learning Resources

Text Books

1. Bansal, R.K., 2016, *Strength of Materials*, Laxmi Publications (P) Ltd.
2. Jindal U.C., 2009, *Strength of Materials,* Asian Books Pvt. Ltd., New Delhi.

Reference Books

1. Egor. P.Popov, 2002, *Engineering Mechanics of Solids*, Prentice Hall of India, New Delhi.
2. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole, 2005, *Mechanics of Materials*, Tata McGraw Hill Publishing 'co. Ltd., New Delhi.
3. Hibbeler, R.C., 2013, *Mechanics of Materials*, Pearson Education, Low Price Edition.
4. Subramanian R., 2010, *Strength of Materials*, Oxford University Press, Oxford Higher Education Series.
5. Timoshenko Timothy., *Strength of Materials*, CBS Publishers & Distributors, 2002

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1	Universal Tensile Testing machine with double shear attachment	1
2	Torsion Testing machine	1
3	Impact Testing machine	1
4	Brinell Hardness Testing machine	1
5	Rockwell Hardness Testing machine	1
6	Spring Testing machine for Tensile and compressive loads	1
7	Muffle furnace	1

Course Code	Course Name	L	T	P	C
GE2251	QUANTITATIVE APTITUDE	1	0	0	1

Category: Employability Enhancement Course

a. Preamble

To develop the thinking ability and problem solving skills of students to compete themselves in placement and competitive examinations.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply the concept of profit in real life problems	K3
CO2	Solve the problems by using proportion	K3
CO3	Compute accurate speed, time and distance	K3
CO4	Apply the concept of Time & Speed	K3
CO5	Calculate the work done based on various methods	K3

c. Course Syllabus **Total : 15 Periods**

PROFIT AND LOSS **3**

Profit and Loss - Cost Price, Selling Price, Profit and Loss %, Marked Price, Discount.

RATIO AND PROPORTION **3**

Ratio and Proportion - Ratio, Proportion, Comparison of Ratios, Duplicate, Triplcate Ratio.

TIME, SPEED AND DISTANCE **3**

Time, Speed and Distance - Concept of time, speed and distance, Conversion of units and proportionality, Avearge speed concept.

APPLICATIONS ON TIME, SPEED AND DISTANCE **3**

Problems on trains - Relative speed concept and application. Boats and Streams - Upstream speed, Downstream speed, Speed of stream, Speed of boat.

TIME AND WORK **3**

Time & work - Problems based on time and work, Formulae, Computation of work together, Wages based work problems. Pipes & Cisterns - Inlet-outlet, Part of tank filled, Time based problems.

d. Learning Resources

Text Book

1. Dinesh Khattar, *Quantitative Aptitude for Competitive Examinations*, Pearson India Education services Pvt Ltd, Fourth Edition, Uttar Pradesh, 2019.

Reference Books

1. TCY online, *Reasoning ability and Quantitative Aptitude*, Wiley India Pvt. Ltd, First Edition, New Delhi, 2016.
2. Agarwal.R.S, *Quantitative Aptitude for Competitive Examinations*, S.Chand Limited, 2011.
3. Abhijit Guha, *Quantitative Aptitude for Competitive Examinations*, Tata McGraw Hill, 3rd Edition, 2011.

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Course Code	Course Name	L	T	P	C
MT2255	MANUFACTURING TECHNOLOGY LABORATORY FOR MECHATRONICS ENGINEERS	0	0	3	1

Category: Professional Core Courses

a. Preamble

Students will be given hands on training/practice on sand molding, fusion and non- fusion welding, sheet metal work using hand tools, various metal cutting machine tools and CNC program and simulation. Determination of shear angle during orthogonal cutting is practiced. Students will be exposed to processing of plastic components.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Demonstrate the use of molding tools, welding processes and sheet metal fabrication tools.	K3
CO2	Practice making simple components comprising steps, taper, eccentric turning, knurling and thread cutting using lathe.	K3
CO3	Utilize shaping machine, milling and other machines to convert round work into other forms like hexagon and cut slot and gears	K3
CO4	Apply various machine tools to grind specimen and tools.	K3
CO5	Construct manual part program for machining in CNC.	K3

c. Course Syllabus **Total : 45 Periods**

1. Preparation of green sand mold
2. Joining of plates using arc welding and sheets
3. Making simple sheet metal components involving shearing and bending operation.
4. Turing a component involving features; taper turning, knurling, grooving and thread cutting.
5. Eccentric turning
6. Cutting internal threads
7. Shaping a hexagon and slotting internal keyway
8. Cutting a helical gear using horizontal milling machine.

9. Cutting a slot and measuring cutting force during end milling.
10. Surface grind square rod
11. Cylindrical grinding
12. Single point tool grinding
13. Hobbing a spur gear
14. Shear angle measurement
15. Manual part program to turn a component
16. Manual part program to mill a component
17. Exercise on Capstan lathe
18. Demonstration of plastic processing machines (Injection, blow, extrusion, and compression molding)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity required
1	Sand mould	2 sets
2	Arc welding transformer with cables and holders	5
3	Welding booth with exhaust facility	5
4	Welding accessories like welding shield, chipping hammer, wire brush etc.,	5
5	Sheet metal snips	5
6	Sheet metal stakes	4
7	Shearing machine	2
8	Lathe	12
9	Milling Machine	2
10	Planning machine	1
11	Shaping machine	2
12	Slotter machine	1
13	Surface Grinding machine	1
14	Cylindrical grinding machine	1
15	Tool and cutter grinder	1
16	Gear hobbing machine	1
17	Shear angle measuring equipment	1
18	CNC lathe	1
19	CNC Mill	1
20	Capstan lathe	1
21	Injection moulding machine	1
22	Blow moulding machine	1
23	Extrusion moulding machine	1
24	Compression moulding machine	1

Course Code	Course Name	L	T	P	C
MT2256	SENSORS AND INSTRUMENTATION LABORATORY	0	0	3	1

Category: Professional Core Courses

a. Preamble

This course promotes students to become a successful automation engineer by providing the fundamental knowledge of various sensors and transducers for industrial applications.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Ability to use the sensors for the measurement of different forms of signals.	K3
CO2	Ability to use the signal processing techniques to convert them to useful signal.	K3
CO3	Ability to select the suitable sensor and for different applications.	K3
CO4	Design appropriate circuits by using conventional formulas used in signal conditioning and conversion.	K3
CO5	Implement their design in bread board and test it.	K3

c. Course Syllabus **Total : 45 Periods**

1. Design and testing of Digital Comparator
2. Design and testing of Voltage to frequency converter and frequency to voltage converter.
3. Design and testing of sample and hold circuit.
4. Design and testing of Flash type Analog to Digital Converters.
5. Design and testing of instrumentation amplifier using OP-AMP.
6. Displacement measurement using potentiometer and LVDT and plotting the characteristic curves.
7. Study of Characteristics and calibration of strain gauge and Load Cell
8. Temperature measurement using Thermocouple, Thermistor and RTD and comparing the characteristics.
9. Temperature Measurement using MultiSIM Live Software

10. Measurement of sound using microphones and sound level meter.
11. Conversation of time domain audio signal into frequency domain signal (FFT).
12. Study of Temperature & Pressure Transmitter

d. Activities

Students shall be given exposure for a Team interaction / Case Studies to choose the right sensor/transducer for the given application.

e. Learning Resources

Text Books

1. Ernest O Doebelin., 2009, *Measurement Systems – Applications and Design*, Tata McGraw-Hill.
2. Sawney A K and Puneet Sawney., 2013, *A Course in Mechanical Measurements and Instrumentation and Control*, 12th edition, Dhanpat Rai& Co, New Delhi.

Reference Books

1. C. Sujatha Dyer, S.A., 2001, *Survey of Instrumentation and Measurement*, John Wiley & Sons, Canada.
2. Hans Kurt Tönshoff (Editor), Ichiro., 2001, *Sensors in Manufacturing* Volume 1, Wiley-VCH April.
3. John Turner and Martyn Hill., 1999, *Instrumentation for Engineers and Scientists*, Oxford Science Publications.
4. Patranabis D., 2011, *Sensors and Transducers*, 2nd Edition, PHI, New Delhi.
5. Richard Zurawski., 2015, *Industrial Communication Technology*, Handbook 2nd edition, CRC Press.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Digital Signal Oscilloscope	6
2.	Function Generator	5
3.	Breadboard	10
4.	Regulated Power supply	6
5.	LVDT	1
6.	Thermistor	1
7.	Thermocouple	1

S.No.	Description of Equipment	Quantity Required
8.	RTD	1
9.	Load cell setup	1
10.	4 Channel data acquisition system for strain gauge	1
11.	Sound level meter	1
12.	Computer with LABVIEW/ MATLAB/SCILAB/MULTISIM	1
13.	Prony brake dynamometer	1
14.	Hygrometer	1

Course Code	Course Name	L	T	P	C
EM2252	AN INTRODUCTION TO ADVANCED READING AND WRITING	0	0	2	1

Category: Employability Enhancement Course

a. Preamble

The course will enable learners

- To strengthen the reading skills of students of engineering.
- To enhance their writing skills with specific reference to technical writing.
- To develop their critical thinking skills.
- To provide more opportunities to develop their project and proposal writing skills.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Understand how the text positions the reader	K3
CO2	Develop critical thinking while reading a text	K3
CO3	Develop a descriptive paragraph	K3
CO4	Make use of sentence structures effectively when creating an essay	K3
CO5	Demonstrate proper usage of grammar in writing E-Mails, Job application and project proposals	K3

c. Course Syllabus **Total : 45 Periods**

EFFECTIVE READING **6**

Reading – Strategies for effective reading-Use glosses and footnotes to aid reading comprehension- Read and recognize different text types-Predicting content using photos and title . Reading-Read for details-Use of graphic organizers to review and aid comprehension.

CRITICAL READING **6**

Reading– Understanding pronoun reference and use of connectors in a passage- speed reading techniques. Reading– Genre and Organization of Ideas- Reading– Critical reading and thinking- understanding how the text positions the reader.

PARAGRAPH WRITING **6**

Writing - Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence -Write a descriptive paragraph Writing-State reasons and examples to support ideas in writing - Write a paragraph with reasons and examples - Write an opinion paragraph.

ESSAY WRITING **6**

Writing - Elements of a good essay - Types of essays - descriptive-narrative - issue-based-argumentative-analytical.

EFFECTIVE WRITING **6**

Writing–Email writing- visumes - Job application- Report Writing - Project writing-Writing convincing proposals

d. Activities

Students shall be exposed to various passages for reading and trained to write in different forms.

e. Learning Resources

Text Books

1. Gramer, F, Margot and Colin, S, Ward, 2011, *Reading and Writing* (Level 3) Oxford University Press, Oxford.
2. Debra Daise, Charl Norloff, and Paul Carne, 2011, *Reading and Writing* (Level 4) Oxford University Press: Oxford.

Reference Books

1. Davis, Jason and Rhonda LIss.2006 *Effective Academic Writing* (Level 3) Oxford University Press: Oxford
2. E. Suresh Kumar 2012 *Enriching Speaking and Writing Skills*, Second Edition. Orient Black swan: Hyderabad.
3. Withrow, Jeans 2004 *Inspired to Write. Readings and Tasks to develop writing skills*. , Cambridge University Press: Cambridge.
4. Goatly, Andrew.2000 *Critical Reading and Writing, Routledge*: United States of America.
5. Petelin, Roslyn and Marsh Durham, 2004 *The Professional Writing Guide: Knowing Well and Knowing Why*, Business& Professional Publishing: Australia.