Regulation 2018		Semester III	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18MES201T	ENGINEERING MECHANICS	3	1	0	4

Course Objective (s):

- To apply the fundamental knowledge of Mechanics concepts and force resolution.
- To gain knowledge on Equilibrium of rigid bodies in two dimensions.
- Solve the Centroid and Moments of Inertia of different objects using mathematical formula
- Impart knowledge in laws of motion, the kinematics and dynamics of particles and rigid bodies.
- Learn the concepts of static friction.

Course Outcome (s) (COs)

CO1	Illustrate the vectorial and scalar representation of forces and moments
CO2	Solve problems in engineering systems using the concept of static equilibrium
CO3	Determine the centroid of areas, and volumes and moment of inertia of composite areas
CO4	calculate the dynamic forces exerted in rigid bodies
CO5	Analyse the mechanism of friction and frictional forces involved in systems

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	2	-	2	-	1
CO2	3	2	1	-	-	-	-	-	-	-	2	-	2	-	1
CO3	3	2	1	-	-	-	-	-	-	-	2	-	2	-	1
CO4	3	2	1	-	-	-	-	-	-	-	2	-	2	-	1
CO5	3	2	1	-	-	-	-	-	-	-	2	-	2	-	1
CO (Avg)	2.8	1.8	1	-	-	-	-	-	-	-	2	-	2	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	BASICS & STATICS OF PARTICLES	12
Introduction–Units and Dimensions–Laws of Mechanics–Lami'stheorem,Parallelogram and triangular Law of forces–Vector representation of forces and moments–Vector operations: additions, subtraction, dotproduct, cross product–Coplanar Forces–Resolution and Composition of forces–Equilibrium of a particle—Equivalent systems of forces–Principle of transmissibility.		
UNIT II	EQUILIBRIUM OF RIGID BODIES	12
Free body diagram–Types of supports and their reactions–requirements of stable equilibrium–Moments and Couples–Moment of a force about a point and about an axis–Vector representation of moments and couples–Scalar components of a moment–Varignon's theorem–Equilibrium of rigid bodies in two dimensions		
UNIT III	PROPERTIES OF SURFACES AND SOLIDS	12
Determination of areas and volumes–First moment of area and the centroid of sections – Rectangle, circle, triangle from integration–T-section, I-section, -Anglesection, Hollow section by using standard formula–Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula– Parallel axis theorem and Perpendicular axis -Polar moment of inertia.		
UNIT IV	DYNAMICS OF PARTICLES	12
Displacements, Velocity and acceleration, their relationship–Relative motion–Curvilinear motion– Newton's law– Work Energy Equation of particles		
UNIT V	FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS	12
Frictional force–Laws of Coloumb friction–Simple contact friction–Rolling resistance– Belt friction.Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.		

Text Book (s)

1	Beer F P and Johnson E R, "Vector Mechanics for Engineers, Statics and Dynamics", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2010.
2	N.Kottiswaran 'Engineering Mechanics-Statics and Dynamics' Sri Balaji Publications 2014

Reference (s)

1	Meriam J.L, Kraige L.G, "Engineering Mechanics-Statics", 6th Edition, Wiley, 2010.
2	Palanichamy, M.S., Nagam, S., "EngineeringMechanics – Statics &Dynamics", Tata McGraw-Hill, 2007.
3	IrvingH.Shames,"EngineeringMechanics–StaticsandDynamics",IVEdition–Pearson Education Asia Pvt. Ltd., 2006.
4	Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
5	Shames. I.H, 'Engineering Mechanics – Statics and Dynamics', Pearson Education, Asia, 2006.

Regulation 2018		Semester III	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC201T	ENGINEERING THERMODYNAMICS	3	1	0	4

Course Objective (s):

- Represent a thermodynamic system , identify work and/or heat interactions between the system and surroundings and apply first law of thermodynamics
- Understand implications of the second law of thermodynamics placed by the second law on the performance of thermodynamic systems
- Quantify the behavior of power plants based on the Rankine cycle and effect of enhancements by reheat and regeneration
- Understand the thermodynamic relations of ideal and real gases
- Understand the psychrometric properties and processes

Course Outcome (s) (COs):

CO1	Apply the first law of thermodynamics for simple open and closed systems under steady conditions.
CO2	Apply second law of thermodynamics to open and closed systems and evaluate entropy and availability
CO3	Apply Rankine cycle to steam power plant and compare cycle improvement methods
CO4	Interpret basic thermodynamic relations of ideal and real gases
CO5	Compute the properties of moist air and illustrate its use in psychometric processes

CO-PO Mapping

COs	POs												PSOs		
	PO 1	PO 2	PO 3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO1 1	PO12	PSO 1	PS O2	PSO3
CO1	3	3	3				2					1	3	-	
CO2	3	3	3				2					2	3		1
CO3	3	3	3				2					1	3	2	
CO4	3	3	3				1			1			1	-	
CO5	3	3	3				2					2	3	3	1
CO(Avg)	3	3	3				1.8			1		1.5	2.6	2.5	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	BASIC CONCEPTS AND FIRST LAW	12

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention.P-V diagram. Zeroth law of thermodynamics – concept of temperature and thermal equilibrium–First law of thermodynamics –application to closed and open systems – steady flow processes.

UNIT II	SECOND LAW AND AVAILABILITY	12

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, entropy change for - ideal gases - different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Availablility and irreversibility.

UNIT III	PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE	12

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles.

UNIT IV	GAS MIXTURES AND THERMODYNAMIC RELATIONS	12

Gas mixtures - Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases. Compressibility factor-Principle of Corresponding states -Generalised Compressibility Chart and its use-Dalton's and Amagat's Law - Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Joule-Thomson Coefficient, Clausius Clapeyron equation.

UNIT V	PSYCHROMETRY	12

Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing.

Text Book (s)

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

Reference (s)

1	Yunus Cengel, Michael A Boles, "Thermodynamics –An Engineering Approach" Tata McGraw-Hill, Eighth Edition, New Delhi, 2015
2	Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", Eighth Edition, 2014
3	Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, Second Edition, 2015.
4	Claus Borgnakke & Richard E. Sonntag, "Fundamental of Thermodynamics", Ninth Edition , 2016.
5	Mark W Zemansky and Richard H Dittman, "Heat and Thermodynamics", Eighth Edition, 2011.

Regulation 2018		Semester III	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC202T	ENGINEERING MATERIALS AND METALLURGY	3	0	0	3

Course Objective (s):

- To impart knowledge on the constitution of alloys and phase diagrams.
- To correlate the materials behaviour and heat treatment process.
- To identify and select suitable materials properties and testing
- To identify ferrous and non ferrous metals.
- To impart knowledge on non-metallic materials.

Course Outcome (s) (COs):

CO1	Describe the phase reactions, microstructures and compositions of the iron-iron carbide diagram.
CO2	Illustrate the appropriate heat treatment process in specific applications
CO3	Explain the testing procedure to evaluate material properties.
CO4	Identify the composition, properties and applications of various ferrous, non ferrous metals and their alloys
CO5	Illustrate the general concepts of Non metallic materials.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					2	2	1	2		3	3		2
CO2	3	2					2	2	2	2		2	2		2
CO3	3	2					2	3	3	2		2	3		3
CO4	3	2					2	2	2	2		3	3		2
CO5	3	2					2	2	2	2		3	3		2
CO (Avg)	3	2					2	2.2	2	2		2.6	2.8		2.2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS	9
Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectroid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron, microstructure, properties and applications.		
UNIT II	**HEAT TREATMENT**	**9**
Definition–Fullannealing,stress relief,recrystallisation and spheroidizing–normalising, 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 - carburising, nitriding, cyaniding, carbonitriding,flame and induction hardening.		
UNIT III	**MECHANICAL PROPERTIES AND TESTING**	**9**
Mechanism of plastic deformation,slip and twinning–Types of fracture–Testing of materials under tension,compression and shearloads–Hardness tests(Brinell,Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep tests, fracture toughnesstests.		
UNIT IV	**FERROUS AND NON FERROUS METALS**	**9**
Effect of alloying elements on steel(Mn,Si,Cr,Mo,V,Ti &W) – stainless and tool steels –HSLA-maraging steels–Cast Irons-Grey,White malleable,spheroidal–Graphite, Alloy cast irons,Copper and Copper alloys-Brass,Bronze and Cupronickel–Aluminum and Al-Cualloy–precipitation hardening–Bearing alloys.		
UNIT V	**NON-METALLIC MATERIALS**	**9**
Polymers–types of polymer,commodity and engineering polymers–Properties and applications of PE,PP,PS,PVC,PMMA,PET,PC,PA,ABS,PI,PAI,PPO,PPS,PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics.		

Text Book (s)

1	William D Callister —Material Science and Engineeringl, John Wiley and Sons, 2010.
2	AnupGoel, SSSabharwal, —Engineering Materials and Metallurgyl, Technical Publication, 2014.

Reference (s)

1	William D,Callister, "Material Science and Engineering",JohnWileyandSons2007.
2	Khanna O P, "A textbook of Materials Science and Metallurgy",KhannaPublishers, 2003.
3	Dieter GE, "Mechanical Metallurgy",Mc GrawHill BookCompany, 2006.
4	Winowlin Jappes J D, Alavudeen A, "A Textbook of Engineering Materials and Metallurgy", Laxmi publications, 2006.

Regulation 2018		Semester III	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC203J	FLUID MECHANICS AND MACHINERY	3	0	2	4

Course Objective (s):

- To gain knowledge in the basic concept of mechanics of fluids, properties of the fluid, conservation equations and their applications to fluid flow problems.
- To gain knowledge in the basic concept of Measurements and dimensions in fluid mechanics.
- To analyze the complexities involved in solving the solutions of practical flow problems.
- To familiarize the basic design aspects, working and operation principle of Turbines.
- To Understand the basic design aspects, working and operation principle of pumps.

Course Outcome (s) (COs):

CO1	Describe the properties of fluids and its flow characteristics.
CO2	Measure the flow and pressure of fluid and to apply dimensional parameters.
CO3	Calculate the losses during flow in a circular pipe
CO4	Explain Hydraulic turbines and its performance characteristics.
CO5	Demonstrate pumps and its performance characteristics.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3		1	2	2	2	1		2	3	2	3
CO2	3	3	3	3		1	2	2	2	1		2	3	2	3
CO3	3	3	3	3		1	2	2	2	1		2	3	2	3
CO4	3	3	3	3		1	3	2	2	1		2	3	2	3
CO5	3	3	3	3		1	3	2	2	1		2	3	2	3
CO (Avg)	3	3	3	3		1	2.4	2	2	1		2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION	9

Properties of fluid: Density- Specific volume-Specific gravity- specific weight- viscosity-capillarity and surface tension- compressibility-Bulk modulus- vapor pressure – Cavitation- Types of fluids.
Fluid Kinematics: Types of Fluid Flow -Concept of system, Continuum and Control Volume – Continuity Equation -Fluid Dynamics: Euler's energy equation – Bernoulli's Equation

UNIT II	MEASUREMENTS AND DIMENSIONAL ANALYSIS	9

Measurement of Pressure : concept of fluid static pressure, absolute and gauge pressures – Pascal's law, Hydrostatic Law - pressure measurements by manometers and pressure gauges.
Flow measurement: Orifice meter, Venturi meter, Pitot tube, advanced flow measurements instruments.
Dimensional analysis: Dimension and units – Dimensional Homogeneity- Rayleigh's method - Buckingham's Π theorem

UNIT III	FLOW THROUGH CIRCULAR CONDUITS	9

Viscous flow: Reynold's Experiment – Flow of Viscous Fluid in a circular pipe - Shear Stress Distribution, Velocity Distribution and Pressure Drop of a viscous fluid

Flow through pipes:Friction Factor – Darcy Weisbach's Equation and Chezy's formula- Moody's Diagram- Minor Losses – HGL & TEL – Pipes in Series and parallel.

UNIT IV	HYDRAULIC TURBINES	9

Introduction to Turbo machines and classification -Construction of velocity vector diagrams - head and specific work - components of energy transfer - degree of reaction. Pelton turbine - Francis turbine - Kaplan turbine - working principles - velocity triangles - work done – efficiencies – Performance Curves

UNIT V	HYDRAULIC PUMPS	9

Introduction to pumps – classifications. Centrifugal Pump working principle, - velocity triangles, specific speed, efficiency and performance curves.

Reciprocating pump: classification, working principle, indicator diagram- efficiency and performance curves .Rotary Pumps

Text Book (s)

1	Bansal, R K, "Fluid Mechanics and Hydraulics Machines", Laxmi publications (P) Ltd, New Delhi, 9th Edition, 2017
2	Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.

Reference (s)

1	Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
2	Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
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
5	Vasandani, V P, "Hydraulic Machines - Theory and Design", Khanna Publishers, 11th Edition, 2010

LIST OF EXPERIMENTS

Total:30 Hours

1.	Determination of the Coefficient of discharge of given Orificemeter.
2.	Determination of the Coefficient of discharge of given Venturi meter.
3.	Calculation of the rate of flow using Rotameter / Flow meter.
4.	Determination of friction factorfor agivenset of pipes – Major losses and minor losses
5.	Conducting experiments and drawing thecharacteristic curves of centrifugal pump
6.	Conducting experiments and drawing thecharacteristic curves of submergible pump
7.	Conducting experiments and drawing thecharacteristic curves of pumps in series and parallel operations
8.	Conducting experiments and drawing the characteristic curves of reciprocating pump.
9.	Conduction experiments and drawing the characteristic curves of Jet pump.
10.	Conducting experiments and drawing the characteristic curves of Gear pump.
11.	Conducting experiments and drawing the characteristic curves of Pelton wheel.
12.	Conducting experiments and drawing the characteristics curves of Francis turbine.
13.	Conducting experiments and drawing the characteristic curves of Kaplan turbine.

Regulation 2018		Semester III	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC204J	MANUFACTURING TECHNOLOGY	3	0	2	4

Course Objective (s):

- To acquire knowledge about the mechanism of chip formation, cutting tool materials, tool life, cutting fluids and welding processes
- To familiarize the working of machine tools such as semi-automatic, automatic lathes and CNC lathe.
- To obtain knowledge about Reciprocating machines and Gear Manufacturing
- To get wide knowledge and the concept of Additive Manufacturing
- To gain knowledge about the mechanism of unconventional machining process.

Course Outcome (s) (Cos):

CO1	Classify the various welding methods for fabrication process.
CO2	Explain concept and mechanism of center lathe and special purpose lathe.
CO3	Describe the working of milling machine, reciprocating and hole making machine.
CO4	Describe the concept of Additive Manufacturing
CO5	Illustrate the principle of unconventional machining process.

CO-PO Mapping

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					2	2	2	1		3	1		2
CO2	3	2					2	2	2	1		3	1		2
CO3	3	2					2	2	2	1		3	1		2
CO4	3	2					2	2	2	1		3	1		2
CO5	3	2					2	2	2	1		3	1		2
CO (Avg)	3	2					2	2	2	1		3	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	JOINING PROCESSES	9

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials – Arc welding equipments – Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding – Gas metal arc welding– Submerged arc welding – Tig welding –Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Weld defects – Brazing and soldering process.

UNIT II	CENTRE LATHE AND SPECIAL PURPOSE LATHES	9

Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – automats – single spindle, Swiss type, automatic screw type, multi spindle –Introduction to CNC-Working principle-types of codes

UNIT III	RECIPROCATING MACHINE TOOLS AND GEAR MANUFACTURING	9

Reciprocating machine tools: shaper, planer, slotter – Milling : types, milling cutters, operations – Grinding Machines – Grinding wheel Specifications – Honing – Tapping – Burnishing – Super Finishing – Surface Integrity concepts – Gear Manufacturing Processes – Gear Hobbing – Gear Shaping Machines – Manufacture of Spur – Helical – Bevel – Worm and Worm Wheel – Gear Finishing.

UNIT IV	ADDITIVE MANUFACTURING	9

Overview – History – Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Tooling – Applications - Liquid based system – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT V	UNCONVENTIONAL MACHINING PROCESSES	9

Principle of operations – Advantages and disadvantages – applications: Abrasive Jet machining process (AJM), Water Jet Machining process (WJM), Ultrasonic Machining process (USM), Electric Discharge machining process (EDM), Laser Beam Machining process (LBM) Chemical Machining process (CHM) and Electro Chemical Machining process (ECM)

Text Book (s)

1	S K Hajra Choudhury, Elements of Workshop Technology - Vol. I, Media Promoters & Publishers Private Limited, Mumbai,2013
2	Kaushish J P, "Manufacturing Processes", PHI Learning Pvt. Ltd., New Delhi, 2010
3	S. K. Hajra Choudhury, Elements of Workshop Technology. Vol. II, Media Promoters & Publishers Private Limited., Mumbai, 2013.
4	P.C. Sharma, Manufacturing Technology - I, S Chand and Company Private Limited,New Delhi,2010
5	P.C Sharma, Manufacturing Technology - II, S.Chand & Company Limited. New Delhi, 2012.

Reference (s)

1	P. N. Rao, Manufacturing Technology vol. I, Tata McGraw-Hill Publishing Company Private Limited, New Delhi, 2010
2	Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology,Pearson Education Limited,New Delhi, 2013.

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3	J. P. Kaushish, Manufacturing Processes, Prentice Hall of India Learning Private Limited, New Delhi, 2013.
4	P. N. Rao, Manufacturing Technology- Metal Cutting and Machine Tools, Tata McGraw Hill Publishing Company Private Limited., New Delhi, 2013
5	http://nptel.ac.in/courses/112107144/1

LIST OF EXPERIMENTS (Total:30 Hours)	
I LATHE	
1.1	Facing, plain turning, step turning and Taper turning
1.2	Single start V thread, cutting and knurling operations
1.3	Assembly of Machined Components for different fits
1.4	Tool wear, Cutting force measurements.
II RECIPROCATING MACHINE	
2.1	Round to square in Shaper
2.2	Keyway cutting in slotter
III GEAR MANUFACTURING, DRILLING MACHINE	
3.1	Gear Making, Hexagonal Milling in Milling Machine
3.2	Drilling, reaming, tapping in Drilling Machine
IV GRINDING MACHINE	
4.1	Prepare good surface finish on flat metal
4.2	Prepare good surface finish on circular metal
V FOUNDRY	
5.1	Mould with solid and split patterns
5.2	Mould with loose-piece pattern
5.3	Mould with Core
VI WELDING	
6.1	TIG welding of metal plate
6.2	MIG Welding of different types of joints

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Regulation 2018		Semester IV	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18MAB204T	STATISTICS AND NUMERICAL METHODS (Common to B.E Mech, EEE, Civil & EIE)	3	1	0	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Know the various methods of solving algebraic and transcendental equations numerically where analytical methods fail to give solution
2	Understand the concept of interpolation
3	Understand the concept of numerical differentiation and integration which is widely applicable when the function in the analytic form is too complicated or the huge amount of data are given such as series of measurements, observation or some other empirical information

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Analyze and evaluate the accuracy of common numerical methods.
CO2	Apply numerical methods to obtain approximate solutions to mathematical problems.
CO3	Predict the solution of a given problem and confirm it with its corrector value and if it deviates to apply the corrector again.
CO4	Understand the problems of Students t-test for single mean and difference of means.
CO5	Identify the applications, various design and concepts of experiments.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	-	-	1	-	3
CO2	3	3	2	1	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	2	3	-	-	-	-	-	-	-	-	1	-	3
CO4	3	3	2	1	-	-	-	-	-	-	-	-	1	-	3
CO5	3	3	1	1	-	-	-	-	-	-	-	-	1	2	1
CO (Avg)	3	3	2	1	-	-	-	-	-	-	-	-	1	2	2.6

2: Moderate (Medium) 3: Substantial (High)

UNIT I	SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS	9+3

Newton-Raphson method- Gauss Elimination method – Pivoting - Gauss-Jordan method – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method .

UNIT II	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	9+3

Lagrange's and Newton's divided difference interpolation –Newton's forward and backward difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal rule, Simpson's 1/3 rule and Simpson's 3/8 rule (Single Integral)

UNIT III	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	9+3

Taylor's series method – Euler's method - Modified Euler's method - Fourth order Runge- Kutta method for solving first and second order differential equations – Milne's predictor-corrector methods and Adam Bash Forth predictor-corrector method for solving first order equations - Finite difference methods for solving second order equation.

UNIT IV	TESTING OF HYPOTHESIS	9+3

Sampling distributions - Tests for Single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.

UNIT V	DESIGN OF EXPERIMENTS	9+3

Completely randomized design – Randomized block design – Latin square design - 2^2 - factorial design.

Text Book (s)

1	R.A. Johnson and C.B. Gupta, "Miller and Freund"s Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, 2007.
2	Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 2004.

Reference (s)

1	R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th edition, 2007.
2	M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum"s Outlines Probability and Statistics", Tata McGraw Hill edition, 2004.
3	Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.

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Regulation 2018		Semester IV	Total Hours			45
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
S	18MES202T	MECHATRONICS	3	0	0	3

Course Objective (s):

- To impart knowledge about the sensors and transducer involved in Mechatronics systems which are very much essential to understand the emerging field of automation.
- To know about the working principle of various Electrical actuating Systems
- To analyze the various Hydraulic & pneumatic components used in Mechatronics system
- To obtain knowledge in PLC components and its functions, basics of CNC & CIM
- To gain knowledge in basic Mechatronics system design and smart system

Course Outcome (s) (COs):

CO1	Outline appropriate sensors and actuators for an engineering application
CO2	Understand the various electrical actuating sytem used for automation
CO3	Describe the various Hydraulic & pneumatic systems components
CO4	Identify programme logic controller and its components , functions
CO5	Evaluate Mechatronics system design and smart systems

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-
CO2	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-
CO3	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-
CO4	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-
CO5	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-
CO (Avg)	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-

UNIT I	SENSORS AND TRANSDUCERS	9

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion , Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors.

UNIT II	ELECTRICAL ACTUATION SYSTEMS	9

Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – Construction and working principle of D.C and A.C Motors – Speed control of AC and DC drives, Stepper Motors - Switching circuitries for Stepper motor – Servo motors.

UNIT III	HYDRAULIC & PNEUMATIC SYSTEMS	9

Construction of Control Components : Directional control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Pneumatic Components: Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, and pneumatic actuators.

UNIT IV	PROGRAMMABLE LOGIC CONTROLLERS	9

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC. Introduction to CNC systems and Computer Intergrated Manufacturing

UNIT V	DESIGN OF MECHATRONICS SYSTEMS	9

Stages in designing Mechatronics Systems – Traditional and Mechatronics Design - Possible Design Solutions – Case Studies of Mechatronics Systems: Pick and place robot, Wireless surveillance ballon, Automatic tool and pallet changers – Autonomous mobile robot – Engine Management System - Automatic Car Park barrier, Introduction to smart systems.

Text Book (s)

1	W. Bolton, "Mechatronics', Pearson Education Limited, 5th Edition, 2013
2	R. Srinivasan, "Hydraulics and Pneumatic Controls", McGraw Hill Education, 2nd Edition, 2008

Reference (s)

1.	Ogata k., "Modern Control Engineering" , Prentice Hall, 5th Edition, 2010
2.	David. W. Pessen, "Industrial Automation", John Wiley & Sons, 4th Edition, 2012
3.	S. Brain Morass, "Automated Manufacturing Systems: Sensors, Actuators", TATA McGraw Hill, 4th Edition, 1995.
4	Singh M.D. and Joshi J.G., Mechatronics, PHI Learning Private Limited, 3rd Edition, 2014
5	Dan Necsulescu, "Mechatronics", Pearson Education, 4th Edition 2009

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Regulation 2018		Semester IV	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC205J	STRENGTH OF MATERIALS	3	0	2	4

Course Objective (s):

- To gain knowledge in stresses, strains and deformation in components due to external loads.
- To gain knowledge on shear force and bending stress distribution in different beams under various loads.
- To learn the deformation of shaft under torsion and deflection of closed helical springs.
- To impart knowledge on finding slope and deflection of beams and buckling of columns for various boundary conditions.
- To learn two dimensional stress systems and stresses in thin cylinders and spherical shells.

Course Outcome (s) (COs):

CO1	Explain the fundamental concepts of stress and strain in simple and compound bar.
CO2	Construct shear force and bending moment diagram for mechanism in beams in various loading conditions.
CO3	Illustrate the basic equation of simple torsion in designing of shafts and helical spring
CO4	Calculate the slope and deflection in beams using different methods and Familiarize the behavior of column under axial and eccentric loads.
CO5	Examine the stresses related to thin and thick cylinders subjected to fluid pressure.

CO-PO Mapping

Cos	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3		1	1	2	2	2		2	2	2	1
CO2	3	3	3	3		2	2	2	2	2		2	2	2	1
CO3	3	3	3	3		2	2	2	2	2		2	2	2	1
CO4	3	3	3	3		2	2	2	2	2		2	2	2	1
CO5	3	3	3	3		1	1	2	2	2		2	2	2	1
CO (Avg)	3	3	3	3		1.6	1.6	2	2	2		2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	STRESS STRAIN AND DEFORMATION OF SOLIDS	9
Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants.		
UNIT II	**BEAMS - LOADS AND STRESSES**	**9**
Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section.		
UNIT III	**TORSION**	**9**
Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads.		
UNIT IV	**BEAM DEFLECTION**	**9**
Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method, and Moment-area Method –Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.		
UNIT V	**ANALYSIS OF STRESSES IN TWO DIMENSIONS**	**9**
Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane– Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress		

Text Book (s)

1	Rajput, R K, "Strength of Materials", S.Chand & Co, New Delhi, 2014.
2	Beer F P and Johnston R," Mechanics of Materials", McGraw-Hill Book Co, Seven Edition, 2016

Reference (s)

1	Bansal R.K, "Strength of Materials", Laxmi Publications, New Delhi, 2017.
2	Rattan S.S, "Strength of Materials", Tata McGraw-Hill Education, 2011
3	R S Khurmi & N. Khurmi, "Strength of Materials", S.Chand & Co, New Delhi, 2015
4	Jindal U.C., "Strength of Materials", Pearson Education India, 2012
5	Russell C Hibbler, "Mechanics of Materials", 2014

LIST OF EXPERIMENTS

Total:30 Hours

1	Tension test on a mild steel rod, Aluminum & Cast Iron
2	Double shear test on Mild steel and Aluminum rods
3	Torsion test on mild steel rod
4	Impact tests on metal specimen
5	Hardness test on metals - Brinnell and Rockwell Hardness Number
6	Deflection test on beams (Aluminium, Steel, Wood)
7	Compression test on helical springs.
8	Microscopic examination of ferrous alloys (plain carbon steels, stainless steels, tool steels etc.)
9	Microscopic examination of non ferrous alloys (Magnesium alloys, Aluminium alloys, Titanium alloys).
10	Microscopic examination of welded samples (ferrous and or non ferrous alloys).
11	Quantitative metallography of specimen by measure the volume fraction of a phase in a polycrystalline material (image analysis).
12	Hardness measurement on heat treated samples (unhardened specimen, quenched, quenched and tempered specimen.

Regulation 2018		Semester IV	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC206J	THERMAL ENGINEERING	3	0	2	4

Course Objective (s):

- Integrate concepts, laws and methodologies from the first course in thermodynamics and cyclic processes
- Apply thermodynamic concepts in IC engines
- Understand the principles of nozzles and steam turbines
- Describe the principles of air compressors
- Explain the working of refrigeration ,air conditioning and cooling tower.

Course Outcome (s) (COs):

CO1	Analyze thermodynamic cycles.
CO2	Summarize the construction, operation and performance of IC engines.
CO3	Understand the working of Steam Nozzles and & Steam Turbines and their performance.
CO4	Calculate the performance of reciprocating air compressor.
CO5	Describe the working of refrigeration and Air conditioning system.

CO-PO Mapping

Cos	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3			2	1	1	1		2	3	2	3
CO2	3	3	3	3			2	1	1	2		2	3	2	3
CO3	3	3	3	3			2	1	1	2		2	3	2	3
CO4	3	3	3	3			2	1	1	1		2	3	2	3
CO5	3	3	3	3			3	1	1	2		2	3	2	3
CO (Avg)	3	3	3	3			2.2	1	1	1.6		2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	GAS POWER CYCLES	9

Otto, Diesel, Dual, Brayton, with PV and TS diagrams-heat supply methods .Calculation of mean effective pressure, and air standard efficiency - Actual and theoretical PV diagram of four stroke and two stroke engines.

UNIT II	PERFORMANCE OF IC ENGINES	9

Introduction to basic Construction-Performance test- Measurement of brake power – Indicated power – Fuel consumption – Air consumption; Heat balance test – heat carried away by exhaust gases and Morse test on IC engines – Standard testing procedure of IC engines – Performance curves and effect of various parameters on the performance of the engines-Knocking and Detonation.

UNIT III	STEAM NOZZLES AND TURBINES	9

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow, Impulse and Reaction principles, compounding of Turbines, velocity diagram for single-stage turbine, speed regulations –Governors.

UNIT IV	AIR COMPRESSOR	9

Classification of Air compressors - working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

UNIT V	REFRIGERATION AND AIR CONDITIONING	9

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration. Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.

List of Practical Experiments (Practical-30 Hours)

1. Draw the Valve timing diagram and Port timing diagram for IC Engine
2. Determine Flash and Fire point of sample of oil by open cup and Closed Cup apparatus
3. Determine absolute viscosity by Saybolt viscometer / Redwood viscometer
4. Determine COP of Refrigeration test rig
5. Determine COP of Air Conditioning test rig
6. Determine Performance characteristics of Air Blower test rig
7. Determine Performance characteristics of Reciprocating Air Compressor
8. Determine Performance characteristics of four stroke diesel engine by load test
9. Draw the heat balance sheet of four stroke diesel engine
10. Determine performance characteristics of four stroke diesel engine by speed test

Text Book (s)

1.	Rajput. R K , "Thermal Engineering", S.Chand Publishers, 2017
2.	Mahesh M Rathore,"Thermal Engineering", McGraw Hill Education (India) Pvt. Ltd.,2015

Reference (s)

1.	Sarkar, B K, "Thermal Engineering" ,Tata McGraw-Hill Publishers, 2016,
2.	Arora.C P,"Refrigeration and Air Conditioning," Tata McGraw-Hill Publishers 2015
3.	Ganesan V " Internal Combustion Engines", Third Edition, Tata McGraw-Hill 2016
4.	Rudramoorthy, R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2010.
5.	Kothandaraman C P, Domkundwar S, Domkundwar A V, "A course in thermal engineering," Dhanpat Rai and sons, 2015

Regulation 2018		Semester IV	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC207T	METROLOGY AND MEASUREMENTS	3	0	0	3

Prerequisite Course (s)

Engineering Materials and Metallurgy

Course Objective (s):

- Learn the linear and angular measuring equipments with their principle of operation and application.
- Gain knowledge about laser principles and advances in metrology.
- Learn about various methods of measurements of mechanical parameters
- Demonstrate modern measuring equipments using Laser
- Measure mechanical parameters

Course Outcome (s) (COs):

CO1	Explain the measurement methods, instruments and errors in measurements.
CO2	Describe the techniques of comparators, linear and the angular measuring instruments.
CO3	Illustrate form measurement of surface roughness and surface finish measurements.
CO4	Describe the coordinate measuring machine and the applications of Laser in Metrology.
CO5	Calculate the force, torque, power, flow and temperature in the system.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2					2	3	2	2		3	2		2
CO2	3	2					1	2	3	2		3	3		2
CO3	3	2					1	2	3	2		2	2		3
CO4	3	2					1	2	3	2		2	2		3
CO5	3	2					1	2	2	2		3	3		2
CO (Avg)	3	2					1.2	2.2	2.6	2		2.6	2.4		2.4

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	CONCEPT OF MEASUREMENT	9
Definition of metrology -General concept– Generalized measurement system-Units and standards-measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response -repeatability-systematic and random errors-correction, calibration, Introduction to Dimensional and Geometric Toleranceing- interchangeability.		
UNIT II	**LINEAR, ANGULAR MEASUREMENT**	**9**
-Linear measuring instruments: Vernier, micrometer, Slip gauges and classification, Tool Makers Microscope interferometery, optical flats, Comparators limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements:- Sine bar, Sine center, bevel protractor and angle Decker.		
UNIT III	**FORM AND SURFACE FINISH MEASUREMENT**	**9**
Measurement of screw threads-Thread gauges, floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish, straightness, flatness and roundness measurements. Surface roughness/surface finish measurement and optical flat in measurement.		
UNIT IV	**LASER AND ADVANCES IN METROLOGY**	**9**
Precision instruments based on laser-Principles- laser interferometer-application in linear, angular measurements and machine tool metrology Coordinate Measuring Machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Demonstration of modern measurement in Industrial applications		
UNIT V	**MEASUREMENTS OF MECHANICAL PARAMETERS**	**9**
Force, torque, power - mechanical, pneumatic, hydraulic and electrical type. Temperature: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor.		

Text Book (s)

1	Jain R K ,"Engineering Metrology", Khanna Publishers, 21st Revised Edition, 2015
2	Beckwith T G, Lewis Buck N, "Mechanical Measurements", Addison Wesley, New Delhi, 2008

Reference (s)

1	Raghavendran N V & Krishnamurthy L, "Engineering Metrology and Measurements", Oxford, 2013
2	Jay L Bucher, "The Metrology Hand Book -Second Edition", ASQ Quality Press, 2012.
3	Ammar Grous, "Applied Metrology for Manufacturing Engineering", Wiley 2011.
4	Hadiya P, Katariya H G, "Mechanical Measurement and Metrology", Books India, 2010.
5	Anand K Bewoor, "Metrology and Measurements" , Tata Mcgraw,2009

Regulation 2018		Semester IV	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC208T	THEORY OF MACHINES	3	1	0	4

Course Objective (s):

- Describe link ,mechanism ,kinematic pair and degree of freedom.
- Explain the working of Governors ad Gyroscopes
- Demonstrate the static and dynamic balancing of Rotary and reciprocating masses
- Demonstrate the gear tooth and gear train
- Describe the free,forced and damped vibration

Course Outcome (s) (COs):

CO1	Define Link,Kinematic pair,and inversion of four bar chain.
CO2	Describe the basics of governors and its effects in ship and automobiles.
CO3	Calculate unbalanced force of rotating and reciprocating masses.
CO4	Explain gear tooth terminology and gear trains .
CO5	Illustrate the frequency of free ,forced and damped vibration.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3			1	2	1	1		3	3	2	3
CO2	3	3	3	3			1	2	1	1		3	3	2	3
CO3	3	3	3	3			1	2	1	1		3	3	2	3
CO4	3	3	3	3			1	2	1	1		3	3	2	3
CO5	3	3	3	3			1	2	1	1		3	3	2	3
CO (Avg)	3.00	3.00	3.00	3.00			1.00	2.00	1.00	1.00		3.00	3.00	2.00	3.00

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	BASICS OF MECHANISMS	9

Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine. -Degree of Freedom – Mobility - Kutzbach criterion (Gruebler's equation) - Grashoff's law- Kinematic Inversions of four-bar chain and slider crank chain - Mechanical Advantage- Transmission angle.

Description of common Mechanisms - Offset slider mechanism as quick return mechanisms, Pantograph, Straight line generators (Peaucellier and Watt mechanisms), Steering gear for automobile, Hooke's joint, Toggle mechanism

UNIT II	MECHANISMS FOR CONTROL	9

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors –Characteristics - Effect of friction.Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Aeroplane and ships

UNIT III	BALANCING	9

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine – Primary and secondary unbalanced forces - Balancing Multi-cylinder Engines – Firing order – Pivoted cradle balancing machines

UNIT IV	GEARS AND GEAR TRAINS	9

Classification of gears – Gear tooth terminology - Fundamental Law of toothed gearing and involute gearing – Length of path of contact and contact ratio -Gear trains – Simple, compound and Epicyclic gear trains.

UNIT V	FREE AND FORCED VIBRATION	9

Basic features of vibratory systems - Free vibration -natural frequency - Types of Damping - Damped free vibration – Whirling of shafts and critical speed– Forced vibration caused by unbalance - Support motion - Vibration isolation

Text Book (s)

1	Khurmi R S "Theory of Machines", S.CHAND Publishers and Distributors, 2017
2	Rattan S S, "Theory of Machines",Tata McGraw-Hill Publishing Company, New Delhi, 2017

Reference (s)

1	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2005.
2	Ramamurti V, "Mechanism and Machine Theory", Second Edition, Narosa Publishing House, 2010.
3	Ghosh A and A K Mallick, "Theory of Mechanisms and Machines", Affiliated East- West Pvt. Ltd., New Delhi, 2010.
4	Ambekar A G, Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2007.
5	Bansal R.K , "A Text Book of Theory of Machines" Laxmi Publications, New Delhi, 2017.

Regulation 2018		Semester IV	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC209L	METROLOGY AND DYNAMICS LABORATORY	0	0	2	1

Course Objective (s):

- Supplement the principles learnt in kinematics and Dynamics of Machinery.
- Understand measuring devices used for testing various components

Course Outcomes:

CO1 Construct the characteristic curves for various governors
CO2 Calculate the frequency of beam and spring mass systems
CO3 Perform the static and dynamic balancing of rotating and reciprocating masses
CO4 Illustrate the errors in measuring instruments
CO5 Measure the parameters in gear tooth and threads

LIST OF EXPERIMENTS - METROLOGY LAB

1.Calibration of Vernier / Micrometer / Dial Gauge
2.Checking Dimensions of part using slip gauges
3.Measurements of Gear Tooth Dimensions
4.Measurement of Angle using sine bar / sine center / tool makers microscope
5.Measurement of straightness and flatness
6.Measurement of thread parameters using profile projector / floating carriage
7.Measurement of Temperature using Thermocouple / Pyrometer
8.Measurement of Displacement / force / Torque
9.Measurement of Vibration / Shock

LIST OF EXPERIMENTS - DYNAMICS LAB

1. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
   b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
   c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
2. Motorized gyroscope – Study of gyroscopic effect and couple.
3. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
4. Cams – Cam profile drawing, Motion curves
5. a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
   b) Multi degree freedom suspension system – Determination of influence coefficient.
6. Determination of Torsional natural frequency of single and Double Rotor systems - Undamped and Damped Natural frequencies.
7. Vibration of Equivalent Spring mass system – Undamped and damped vibration.
8. Transverse vibration of Free-Free beam – with and without concentrated masses.

Regulation 2018		Semester IV	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18MBM202L	CRITICAL AND CREATIVE THINKING SKILLS	0	0	2	1

Course Objective (s):

The purpose of learning this course is to:

1	To focus on listening, speaking, & writing skills through audio & video sessions
2	To hone soft skill and analytical ability of students
3	To overcome the fear in group communication and to provide the effective communication
4	To expertise intelligible pronunciation, stress and intonation patterns

Course Outcome (s) (Cos):

At the end of this course, learners will be able to:

CO1	Students can be able to solve both analytical and logical problems in an effective manner
CO2	Students can demonstrate an ability to design and deliver messages
CO3	The quality of student's communication with practical experience is improved

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3.00	-	-	-	-	-	-	-	-	2.00	-	-	1.00	1.00	1.00

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**Module - 1**	**6**
Aptitude: Time and Work - Pipes and Cisterns. **Communication:** Sentence Pattern - Debate.		
UNIT II	**Module - 2**	**6**
Aptitude: Boats and Streams. **Communication:** Tenses and voices - Tech Talk.		
UNIT III	**Module - 3**	**6**
Aptitude: Problems on Ages - Probability **Communication:** Analogies - Biography.		
UNIT IV	**Module - 4**	**6**
Aptitude: Data sufficiency - Logical Puzzles. **Communication:** Punctuation - Connection.		
UNIT V	**Module - 5**	**6**
Aptitude: Mensuration. **Communication:** Preposition - News of the Week.		

Text Book (s)

1	Dr.R.S.Aggarwal, "Quantitative Aptitude", S. Chand & Company Limited, 2015
2	Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non - Verbal Reasoning", S. Chand & Company Limited, 2015

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25 MAR 2019
KARUR-639 113.

Regulation 2018		Semester V	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC301J	HEAT AND MASS TRANSFER	3	0	2	4

Prerequisite Course (s)

Fluid Mechanics and Machinery, Engineering Thermodynamics

Course Objective (s):

- To impart the knowledge of conduction heat transfer mechanisms
- To provide the knowledge on the principles of free and forced convection.
- To study the performance of various types of heat exchanger.
- To impart the knowledge on black body radiation and grey body radiation
- To learn about diffusion and convective mass transfer.

Course Outcome (s) (COs):

CO1	Apply the principle mechanism of heat transfer under steady state and transient conditions.
CO2	Apply the fundamental concept and principles in convective heat transfer
CO3	Apply the theory of phase change heat transfer and design of heat exchangers.
CO4	Apply the fundamental concept and principles in radiation heat transfer.
CO5	Analyze the relation between heat and mass transfer and to solve simple mass transfer problems.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	2	2	-	1	3	-	1
CO2	3	3	3	3	-	-	-	-	2	2	-	1	3	-	1
CO3	3	3	3	2	-	-	-	-	1	1	-	1	3	-	1
CO4	3	3	3	2	2	1	-	1	2	2	-	1	3	-	1
CO5	3	3	3	2	-	-	-	-	-	-	-	1	3	-	1
CO (Avg)	3	3	3	2.2	2	1	-	1	1.75	1.75	-	1	3	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**CONDUCTION**	**9**
General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis,Semi Infinite and Infinite Solids –Use of Heisler's charts.		
UNIT II	**CONVECTION**	**9**
Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.		
UNIT III	**PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**	**9**
Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling, correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods		
UNIT IV	**RADIATION**	**9**
Radiation laws, Black Body and Gray body Radiation. Shape Factor. Electrical Analogy. Radiation Shields.		
UNIT V	**MASS TRANSFER**	**9**
Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion. Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations		

Text Book (s)

1	R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2010
2	Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5 thEdition – 2013

Reference (s)

1	Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.
2	Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
3	Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2014
4	Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994
5	S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014

LISTOFEXPERIMENTS

Total:30 Hours

1.	Determination of thermal conductivity of Composite wall
2.	Determination of thermal conductivity of Insulating material
3.	Determination of heat transfer coefficient for forced convection through horizontal pipe
4.	Determination of heat transfer coefficient for natural convection on vertical cylinder
5.	Determination of heat transfer coefficient for forced convection on Pin fin
6.	Determination of heat transfer coefficient for natural convection on Pin fin
7.	Determination of emmissivity of grey surface
8.	Verification of Stefan Boltzman Constant
9.	Compare the performance of parallel flow and counter flow heat exchanger
10.	Determination of performance of cooling tower
11.	Study of Critical Heat Flux in Pool boiling

Regulation 2018		Semester V	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC302T	MACHINE DESIGN	3	1	0	4

Prerequisite Course (s)

Strength of Materials, Engineering Mechanics

Course Objective (s):

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To gain knowledge on the principles and procedure for the design of power Transmission components.
- To understand the standard procedure available for Design of Transmission sip terms
- To learn to use standard data and catalogues

Course Outcome (s) (COs):

CO1	Design machine elements subjected to simple and variable loads.
CO2	Design shaft and welded joints for various engineering applications.
CO3	Identify the appropriate Flexible elements for Industrial Applications and Understand the design procedure involved in Brake and clutc design.
CO4	Design of spur and helical gear drives
CO5	Design and select the suitable spiring and bearing for the industrial applications

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	2	-	1	-	-		1	1	-	-
CO2	3	3	2	1	-	2	-	1	-	-	1	1	1	-	1
CO3	3	3	3	2	-	2	-		-	-	1	2	2	-	1
CO4	3	3	2	1	-	2	-	1	-	-	1	1	1	-	-
CO5	3	3	2	1	-	2	-	1	-	-	1	1	1	-	1
CO (Avg)	3	3	2.4	1.2	-	2	-	1	-	-	1	1.2	1.2	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	STEADY STRESSES AND VARIABLE STRESSES IN MACHINE II MEMBERS	12

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties - Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams - Factor of safety - theories of failure – stress concentration – Design for variable loading – Soderberg, Goodman and Gerber relations.

UNIT II	DESIGN OF SHAFTS AND WELDED JOINTS	12

Introduction to shafts – Materials used for shafts – Types of shafts – standard sizes of shafts - Design of shafts – Shatfs subjected to twisting moment, bending moment, both twisting and bending moment – Design of shafts based on Rigidity – Introduction to welded joints – welding process – Types of welded joints – Elements of a weld symbol – Strength of Transverse Fillet welded joints - Strength of Parallel Fillet Welded Joints - Special Cases of Fillet Welded Joints

UNIT III	DESIGN FOR TRANSMISSION SYSTEMS	12

Belt Drive – Introduction, classification – Types of belts, Factors influencing the selection of belt drive- Flat belt – outline – Design consideration of flat belt – flat belt pulley – materials for pulleys - Design of flat belt drive – Introduction to V-Belt drive – types of V belt drive – Design of V belts – Types of Brakes –Heat Generation and heat dissipation in brakes - Design of Brake – Block Brake – Band Brake – Types of clutch - Design of Single and Multi plate clutches

UNIT IV	DESIGN OF SPUR GEARS AND HELICAL GEARS	12

Gear Terminology-Speed ratios and number of teeth-Force analysis -Tooth stresses – Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces and stresses. Estimating the size of the helical gears

UNIT V	DESIGN OF SPRINGS	12

Intoduction - Types of Springs - Standard Size of Spring Wire - Material for Helical Springs - Terms used in Compression Springs - optimization of helical springs – Stresses in Helical Springs of Circular Wire - Deflection of Helical Springs of Circular Wire - Buckling of Compression Springs- Leaf springs – Construction of leaf springs - Equalised Stress in Spring Leaves - Length of Leaf Spring Leaves - Materials for Leaf Springs – Disc Springs

Text Book (s)

1	J. E. Shigley and C. R. Mischke, Mechanical Engineering Design, 10th Edition, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2014.
2	S.MdJalaludeen, "Machine Design", Anuradha Publications, Chennai, 2014

Reference (s)

1	Bhandari V.B, "Design of Machine Elements", 4th Edition, McGraw-Hill Book Co, 2016.
2	S. G. Kulkarni, Machine Design, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2010.
3	B. J. Hamrock, B. Jacobson and S. R. Schmid, Fundamentals of Machine Elements, Third Edition, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2014
4	U.C.Jindal : Machine Design, "Design of Transmission System", Dorling Kindersley, 2010
5	R. L. Norton, Design of Machinery, Fifth Edition, Tata McGraw Hill Publishing Company [illegible] Delhi, 2011

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Regulation 2018		Semester V	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC303J	AUTOMOBILE ENGINEERING	3	0	2	4

Prerequisite Course (s)

Engineering Thermodynamics , Fluid Mechanics and Machinery

Course Objective (s):

- To impart knowledge on the principles of operation and constructional details of various automobile engine power source.
- To impart knowledge on the working of fuel supply system and combustion technique in various automobiles.
- To provide knowledge on the requirement and function of various components in power transmission and suspension system in vehicle.
- To impart knowledge on the emission in automobile.
- To provide advance automotive driving control.

Course Outcome (s) (COs):

CO1	Explain the operating principles and constructional details of various automobile engine power source.
CO2	Identify the appropriate Fuel supply system for a particular automobile vehicle based on the requirements.
CO3	Analyze the function of various components in transmission and safety driving line of a vehicle.
CO4	Explain the emission control technique and its importance.
CO5	Analyze the advance automotive driving methods.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	-	1	-	3	2	2	-	3	3	-	2
CO2	3	2	2	2	-	2	-	2	2	2	-	3	3	-	2
CO3	3	2	3	2	-	1	-	2	2	2	-	3	3	-	-
CO4	3	2	3	2	-	3	3	2	2	2	-	3	3	-	1
CO5	3	3	2	2	-	1	2	2	2	2	-	3	3	-	1
CO (Avg)	3	2.2	2.2	2.2	-	1.6	2.5	2.2	2	2	-	3	3	-	1.5

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	**VEHICLESTRUCTUREAND ENGINES**	**9**
Types ofautomobiles, Automotive components, sub systems and their positions, vehicleconstruction and differentlayouts, chassis,frame and body,resistancestovehiclemotion and aerodynamics of vehicles. Introduction to automobile engine power source.		
UNIT II	**ENGINEAUXILIARYSYSTEMS**	**9**
Carburetor-basic type and working principles- Electronic fuel injection system for petrol and diesel engine- supercharging and turbo charging. Review of cooling and lubrication system. Electrical sytem (General electrical circuits. Battery, Starting motor, DC generator, Alternator, Ignition circuit, Dash board instrumentation, Lighting system) and electronics system - Ignition system (Magneto coil and Electronic type). Electronic engine management system.		
UNIT III	**TRANSMISSIONSYSYTEMS**	**9**
Clutch-typesandconstruction, gearboxes- manualandautomatic, Wheel drive components, Wheel and tyres - Steeringgeometry ,PowerSteering, Front and Rear Axle-Suspension Systems.BrakingSystems- ABS and electronic brake force distribution (EBD).Stabilizer, Air Bags		
UNIT IV	**EMISSION CONTROL AND ALTERNATIVEENERGYSOURCES**	**9**
Emission Norms and Bharat standard – Non exhaust and exhaust emission (SCR).Useofalternative fuels in Automobiles -Enginemodificationsrequired–Performance and Combustion CharacteristicsofSIandCIengineswiththesealternatefuels.		
UNIT V	**ADVANCES IN AUTOMOTIVE TECHNOLOGY**	**9**
Electric andHybridVehicles,Fuel Cell. Advanced driving controls – Electronic Stability Program (ESP), Traction control system (TCS), Hill hold control, automatic climate control. Fuel smart engines. Autonomous driving – Google car-GPS Technology.		

Text Book (s)

1	Kirpal Singh, "Automobile Engineering Vol. 1& 2" , Standard Publishers, 7th Edition 2012
2	William. H. Crouse, Donald L Anglin, Automotive Mechanics, 10th Edition, McGraw-Hill, 2017.

Reference (s)

1	Ganesan V.." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill ,2007
2	Jain,K.K.,and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers,New Delhi,2002
3	Julian Happian-Smith "Introduction to Modern Vehicle Design", Publisher: Society of Automotive Engineers Inc.2012.
4	Bosch Automotive Hand Book, 8th Edition, Bentley Publishers, 2011.
5	Hand Book - Automotive Research Association of India (ARAI- Pune)

Total:30 Hours

SL.NO	LIST OF EXPERIMENTS
1	STUDY OF TYPES OF CLUTCHES
2	DISMANTLING AND ASSEMBLING OF SINGLE PLATE CLUTCH
3	DISMANTLING AND ASSEMBLING OF SINGLE CYLINDER I.C ENGINE
4	STUDY OF MULTI CYLINDER ENGINES
5	STUDY OF GEAR BOX
6	DISMANTLING AND ASSEMBLING OF FRONT AXLE AND REAR AXLE
7	DISMANTLING AND ASSEMBLING OF DIFFERENTIAL UNIT
8	TESTING OF THE BATTERY
9	TESTING OF THE WHEEL BALANCING
10	TESTING OF THE VALVE CLEARENCE ADJUSTMENT IN ENGINE
11	STUDY OF FUEL SUPPLY SYSTEM IN I.C ENGINE
12	STUDY AND DEMONSTRATION OF AUTOMOBILE CHASSIS
13	MOTORING TEST ON SINGLE CYLINDER FOUR STROKE DIESEL ENGINE
14	RETARDATION TEST ON SINGLE CYLINDER FOUR STROKE DIESEL ENGINE
15	MORSE TEST ON MULTI CYLINDER PETROL ENGINE

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE023T	AUTOMATION AND INDUSTRIAL ROBOTICS	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To explain the fundamentals and working of robots
- To describe the importance of drives and end effectors of robots
- To explain the types of sensors and concept of machine vision system
- To instruct kinematics of robots and its programming
- To identify the applications of robots in industries

Course Outcome (s) (COs):

CO1	Understand the fundamentals and working of robots
CO2	Assimilate the functions of robot drive system and types of end effectors
CO3	Gain knowledge on different sensors and the concept of machine vision system
CO4	Follow the logics of kinematics of robots and syntax of programming
CO5	Summarize the usage and applications of robots in industries

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	1	-	2	-	-	-	-	-	1	-
CO2	3	3	3	2	-	-	-	2	-	-	-	-	2	1	-
CO3	3	3	3	3	2	1	-	2	-	-	-	-	-	2	-
CO4	3	3	3	2	2	-	-	2	-	-	-	-	2	2	-
CO5	3	2	1	2	-	1	-	2	-	-	-	-	2	1	-
CO (Avg)	2.8	2.6	2.4	2	2	1	-	2	-	-	-	-	2	1.4	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**FUNDAMENTAL OF AUTOMATION AND ROBOTICS PROCESS**	9
Introduction to Automation – Definition, types, reasons for automating, Robotics and Automation, Robot -Definition -scope of industrial robot - Law of robotics -Robot Anatomy - Co-ordinate Systems, Work Envelope, classification - Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, PayLoad - Need for Robots.		
UNIT II	**ROBOT DRIVE SYSTEM AND END EFFECTORS**	9
Pneumatic Drives, Hydraulic Drive, Mechanical Drives and Electrical Drives. End Effectors - Grippers- Pneumatic gripper, Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers, and Mechanical Grippers - Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers - Selection and Design Considerations.		
UNIT III	**SENSORS AND MACHINE VISION SYSTEMS**	9
Sensors - types - tactile sensors, proximity and range sensors, contact and non contact sensors, velocity Sensors, touch and slip sensors, force and torque sensors. Robotic vision systems, imaging components, image representation, picture coding, object recognition and categorization, visual inspection, Artificial Intelligence		
UNIT IV	**ROBOT KINEMATICS AND ROBOT PROGRAMMING**	9
Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Teach Pendant Programming, Lead through programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End effecter commands, and Simple programs.		
UNIT V	**IMPLEMENTATION AND ROBOT ECONOMICS**	9
RGV, AGV, Implementation of Robots in Industries - Material transfer and machine loading/Unloading, Welding and painting, Assembly operations, Inspection, Mobile robots, Safety Considerations for Robot Operations - Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method		

Text Book (s)

1	Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 2012
2	Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering – An Integrated Approach", Prentice Hall India, 2012

Reference (s)

1	Subir Kumar Saha, Introduction to Robotics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2008
2	Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008
3	Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE024T	NON DESTRUCTIVE TESTING	3	0	0	3

Prerequisite Course (s)

Manufacturing Technology

Course Objective (s):

To Acquire knowledge about different types of non destructive methods.

To Introduce all types of NDT and their application in engineering fileds

To understand the real time application of NDT methods.

Course Outcome (s) (COs):

CO1	The students will be able to differentiate various defect types and the NDT types and select the appropriate NDT methods for the specimen.
CO2	Explanation of eddy current testing and acoustic emission testing
CO3	Understanding the Magnetic Particle Testing & Thermography
CO4	Testing the different metals and alloys by Ultrasonic testing methods
CO5	To know the Radiography testing and its industrial applications.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	3	1	-	1	-	-	-	-	-	-	-	2	-	1
CO3	3	2	-	-	1	-	-	-	-	-	-	-	2	-	-
CO4	3	3	2	1	-	1	-	-	-	-	-	-	3	-	1
CO5	3	2	-	1	-	1	-	-	-	-	-	-	3	-	2
CO (Avg)	3	2.6	1.6	1	1	1	-	-	-	-	-	-	2.5	-	1.3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	OVERVIEW OF NON DESTRUCTIVE TESTING	9
Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications,Physical principles, procedure for liquid penetrant testing, Penetrant testing materials and methods– Emulsification,water washable and solvent removable methods, applications and limitations.		
UNIT II	**EDDY CURRENT TESTING AND ACOUSTIC EMISSION**	**9**
Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, High frequency ECT, Phased array ECT, Applications. Principle of AET, Instrumentation,Applications - testing of metal pressure vessels, Fatigue crack detection.		
UNIT III	**MAGNETIC PARTICLE TESTING AND THERMOGRAPHY**	**9**
Principle of MPT, Procedure used for testing a component, Equipment used for MPT, Magnetization methods, demagnetization, Applications. Principle of Thermography, techniques, Infrared Radiometry, Active and passive thermography measurements, Applications – Imaging entrapped water under an epoxy coating-thermal imaging for condition Monitoring of Industrial Components.		
UNIT IV	**ULTRASONIC TESTING**	**9**
Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B- Scan, C- Scan, techniques ,applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident through- transmission testing, Angle Beam Pulse-Echo testing, techniques of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks and thickness measurement:corrosion detection.		
UNIT V	**RADIOGRAPHY**	**9**
Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques, Absorption, Scattering-Filters and screens – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Lattitude and special techniques, real Time Radiography - Case studies on defects in cast, rolled, extruded, welded and heat treated components.		

Text Book (s)

1	Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2	Jayamangal Prasad, C. G. Krishnadas Nair, Non-Destructive Test and Evaluation of Materials", Tata McGraw-Hill Education, 2011.

Reference (s)

1	Ravi Prakash, "Non-Destructive Testing Techniques", New Age International Publishers, 1st revised Edition, 2010.
2	ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 2000, Volume-17.
3	Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley,Edition New Jersey, 2005
4	Charles, J. Hellier," Handbook of Nondestructive evaluation", McGraw Hill, New York 2001

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE030T	INDUSTRIAL SAFETY ENGINEERING	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To anticipate, identify, evaluate, and control workplace hazardous conditions and practices.
- To develop effective safe operating procedures and comprehensive safety and health programs.
- To address identified hazards, conditions, and practices in a cost effective manner.
- To measure and evaluate occupational safety and health performance.
- To understand the provisions contained in the industrial laws.

Course Outcome (s) (COs):

CO1	List out the various safety considerations.
CO2	Monitor and review the safety performance followed in various industries.
CO3	Carryout safety study, undertake appraisal and audit of various industries.
CO4	Understand safety management system of an industry.
CO5	Get familiarize with the acts and rules applicable for industries.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	3	2	3	-	-	-	-	-	-	-
CO2	3	2	2	1	-	3	3	3	-	-	-	-	1	-	-
CO3	3	2	2	1	1	3	3	2	-	-	-	-	1	-	-
CO4	3	2	2	1	-	3	3	2	-	-	-	1	-	-	-
CO5	3	2	2	2	-	2	3	3	-	-	-	1	-	-	-
CO (Avg)	2.8	1.8	1.8	1.2	1	2.8	2.8	2.6	-	-	-	1	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	SAFETY IN PROCESS PLANTS	9
Hazards analysis - Energy source – Release of hazardous materials – Fires – Types of fires – Fire extinguishers – types and handling. Personal protective equipments – Types – Helmets – Respirator – Air purification – Chemical protective clothing – gloves for heat – electricity and chemical – Eye stakes – Ear marks – Industrial Hygiene – Principles – Health and safety Ergonomics.		
UNIT II	**SAFETY IN HIGH PREESURE OPERATIONS AND CHEMICAL INDUSTRIES**	**9**
Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves –Plant commissioning and inspection, pressure vessel, non-destructive testing, vibration, corrosion Plant maintenance and emergency planning, management of maintenance HAZOP study, ALOHA SOFTWARE.		
UNIT III	**HAZARDS IN INDUSTRIES**	**9**
Engineering control of hazards and accidents due to fire explosion and natural causes in the Industries – Thermal power plant – Atomic power plant – mining industries – Fertilizers – petroleum refinery.		
UNIT IV	**SAFETY MANAGEMENT**	**9**
Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Investigation and Reporting - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.Types of organization –Safety committee-Safety councils-Safety education-First aid.		
UNIT V	**THE OCCUPATIONAL SAFETY, HEALTH AND WORKING CONDITIONS CODE**	**9**
Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, Building and other construction works act 1996, Motor Vehicle Rules, Explosive Act 1983, Boiler Act, Child labour and women employee Acts		

Text Book (s)

1	Rolland P. Blake, "Industrial safety" , II Edn.., Prentice Hall Inc . New york, Latest Edition.
2	Willaim Handley Mc, "Industrial Safety Hand book" , II Edn.., – Graw Hill Book Co., U. K. (1977).

Reference (s)

1	Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey, 1973.
2	National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988.
3	Explosive Act-1884, Eastern Book Company, Lucknow -266 001,1984.
4	Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules, 1950, Madras.
5	"Occupational Accident Prevention Judson & Brown ", john Wiley , london (1944).

Regulation 2018		Semester V	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18MBM301L	ANALYTICAL AND LOGICAL THINKING SKILLS	0	0	2	1

Course Objective (s):

The purpose of learning this course is to:

1	To sharpen problem solving skills and to improve thinking capability of the students
2	To drive the students to use language with great commitment and cooperation
3	To expertise the creative thinking and presentation skills to meet the company needs

Course Outcome (s) (Cos):

At the end of this course, learners will be able to:

CO1	Students will be able to solve both analytical and logical problems in a fruitful manner
CO2	Students will organize and convey the information in such an incomparable way
CO3	Presentation skills will be imparted to students

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1
CO2	-	-	-	-	-	-	-	-	2	-	-	-	-	1	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3.00	-	-	-	-	-	-	-	2.00	2.00	-	-	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	Module - 1	6
Aptitude: Alligations or Mixtures - Blood Relations. **Communication:** How to set Goals - Interpersonal Relationships - JOHARI Window - Work & Business Etiquette		
UNIT II	**Module - 2**	**6**
Aptitude: Partnership - Statement and Assumptions. **Communication:** Transition to Corporate World - Career opportunities in Various Sectors and know your industry.		
UNIT III	**Module - 3**	**6**
Aptitude: Arithmetic and Geometric Progressions - Syllogisms. **Communication:** Time Management - Anger and Stress Management - Conflict Management.		
UNIT IV	**Module - 4**	**6**
Aptitude: Permutations and Combinations - Statements & Conclusions. **Communication:** Launch a Product - Telephonic Etiquette.		
UNIT V	**Module - 5**	**6**
Aptitude: Geometric Problems. **Communication:** Presentation Skills - Oral presentation and public speaking skills, Business presentations.		

Text Book (s)

1	Dr.R.S.Aggarwal, "Quantitative Aptitude", S. Chand & Company Limited, 2015
2	Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non - Verbal Reasoning", S. Chand & Company Limited, 2015

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Regulation 2018		Semester VI	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18MBH201T	MANAGEMENT PRINCIPLES FOR ENGINEERS	2	0	0	2

Prerequisite Course (s)

Nil

Course Objective (s): The purpose of learning this course is to:

1	Enable the students to study the evolution of management.
2	Study about planning tools and techniques in management for engineers.
3	Learn about career planning for engineers.
4	Enable the effective and barriers communication in the organization.
5	Study the system and process of effective controlling in the organization.

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Acquired the knowledge on fundamental concept of management and its various functions.
CO2	Gained knowledge on planning and decision making process.
CO3	Attained the knowledge of organization structure and career planning.
CO4	Demonstrate the ability to directing, leadership and communicate effectively.
CO5	Analysis isolates issues and formulates best control methods.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	1	-	1	2	-	-
CO2	2	2	-	-	-	1	-	-	1	1	1	1	-	-
CO3	2	-	-	-	-	1	-	-	-	-	1	2	-	-
CO4	1	-	-	-	-	1	-	-	1	1	1	-	-	-
CO5	2	-	-	-	-	1	-	-	-	1	1	3	-	-
CO (Avg)	1.80	2.00	-	-	-	1.00	-	-	1.00	1.00	1.00	2.00	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO MANAGEMENT PRINCIPLES	6

Meaning, Definition of Management – Managerial Role - POSDCORB -Management vs. Administration- Evolution of Management Thoughts- Henry Fayol's 14 Principles- Opportunities and Challenges in Management.

UNIT II	PLANNING	6

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting - Objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III	ORGANIZING	6

Nature and purpose – Formal and informal organization – organization chart – Organization Structure– Types – Line and staff authority – Departmentalization – Delegation of Authority – Centralization and Decentralization – Job Design.

UNIT IV	DIRECTING	6

Foundations of individual and group behavior – Motivation – Motivation Theories – Motivational - Techniques –Leadership – Types and Theories of Leadership – Communication – Process of Communication – Barrier in Communication – Effective Communication.

UNIT V	CONTROLLING	6

System and Process of Controlling – budgetary and Non-Budgetary Control Techniques – Use of Computers and IT in Management control – Control and performance – Direct and Preventive control – Reporting.

Reference (s)

1	P.C.Tripathi., P.N Reddy, Principles of Management, McGraw Hill, 5th Edition 2012.
2	Harold Koontz, Heinz Weihrich, A RamachandraAryasri, Tata McGraw Hill, Principles of Management, 2016
3	Charles W Hill, Stephen L Mcshane, Principles of Management, McGraw Hill, Special Indian Edition 2007.
4	1.Stephen A. Robbins & David A. Decenzo& Mary Coulter, "Fundamentals of Management" 7th Edition, Pearson Education, 2011.
5	Harold Koontz & Heinz Weihrich "Essentials of management" Tata McGraw Hill, 1998.

Regulation 2018		Semester VI	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC304T	AUTOMATION AND INDUSTRY 4.0	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To understand the components that constitute Industry 4.0.
- To understand the various technologies and function aspect of Industry 4.0
- To introduce the importance of automation techniques in manufacturing industries.
- To provide a good understanding of Internet of Things (IoT) and its envisioned deployment domains
- To understand the functioning Numerical Control Production System

Course Outcome (s) (COs):

CO1	Implement Industry 4.0 concepts on any existing systems:
CO2	Make the use of Industry 4.0 technologies
CO3	Familiar with various automation technologies in manufacturing industries
CO4	Understand the design architecture of IoT
CO5	Familiar with the Numerical Control Production System

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	-	1	-	1	-	1	-	1	-	2	-
CO2	2	2	2	1	-	1	-	1	-	1	-	-	1	2	-
CO3	2	2	2	1	1	-	-	2	-	1	-	-	2	2	2
CO4	2	2	2	-	1	-	-	-	-	-	-	1	-	3	2
CO5	2	2	2	1	2	-	-	-	-	-	-	-	3	3	2
CO (Avg)	2	2	2	1	1.33	1	-	1.33	-	1	-	1	2	2.4	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION TO INDUSTRY 4.0	9
Introduction to Industry 4.0- Components of Industry 4.0 - Need for industry 4.0 – Industrial Revolutions - Drivers of Industry 4.0 - Support System for Industry 4.0 - Internet of Services (IoS) - Smart Manufacturing - Smart Devices and Products - Predictive Analytics		
UNIT II	**TECHNOLOGIES AND FUNCTION CONCEPT INDUSTRY 4.0**	**9**
Digital manufacturing, augmented reality, Big data analytics, cyber physical systems, cloud computing, artificial intelligence, cognitive computing, machine learning, cyber security, Mobile Computing, 3D Printing - Function aspect of technologies - Technology classification of I4.0 - Closed Loop Economy - Concept of Knowledge Economy - Sustainability and circular economy		
UNIT III	**AUTOMATION IN MANUFACTURING INDUSTRIES**	**9**
Introduction-Automation in production system, Principles and strategies of automation, Basic elements of an automated system,Levels of automations, Material handling and identification technologies-Overview of material handling systems, Types of material handling equipment, Conveyor system, Automated guided vehicle system, Automated Manufacturing Systems-Components, Classification and overview of manufacturing systems, Cellular manufacturing, Flexible manufacturing system(FMS), FMS and its planning and implementation		
UNIT IV	**INDUSTRIAL INTERNET OF THINGS**	**9**
Introduction to Internet of Things-Overview of Internet of Things-the Edge, Cloud and the Application Development, Anatomy of the Thing, Industrial Internet of Things (IIoT -Industry 4.0), Quality Assurance, Predictive Maintenance, Real Time Diagnostics, Design and Development for IoT, Understanding System Design for IoT, Design Model for IoT, Challenges -future and potential of IoT -application in manufacturing industry		
UNIT V	**NUMERICAL CONTROL PRODUCTION SYSTEMS**	**9**
Numerical Control Production Systems: Basic concepts, coordinate system and machine motion-Types of NC systems- Point to point, straight cut and continuous path. Machine control unit and other components, Tape and tape readers.NC part programming:Punched tape and tape formats, NC words, methods of part programming, manual part programming: APT programming, Direct numerical control. Computer numerical control. Adaptive control. Applications and economics of NC.		

Text Book (s)

1	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress 1st ed. Edition, 2017.
2	M.P.Groover,"Automation, Production Systems and Computer Integrated Manufacturing", 5 th Edition, Pearson Education, 2009

Reference (s)

1	Mohammad Dastbaz , Peter Cochrane "Industry 4.0 and Engineering for a Sustainable Future" Springer ISBN 978-3-030-12953-8- 2019.
2	Elena G. Popkova · Yulia V. RagulinaAleksei V. Bogoviz "Industry 4.0: Industrial Revolution of the 21stCentury" ISBN 978-3-319-94310-7 – 2019.
3	N. Viswanandham, Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", 1st Edition, 2009.
4	Olivier Hersent, "The Internet of Things: Key Applications and Protocols", Wiley 2nd Edition, 2012
	Jonathan Follett, Foundational Elements of an IoT Solution–The Edge, The Cloud and Application Development, Oreilly,1stEdition, 2016

Regulation 2018		Semester VI	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC305T	FINITE ELEMENT ANALYSIS	3	1	0	4

Prerequisite Course (s)

Basic knowledge on Numericals and Calculas

Course Objective (s):

- To enable the students to understand the applications of Finite element analysis in engineering applications by the concepts of virtual work/ equilibrium approach, variational and weighted residual methods for solving engineering problems.
- To appreciate the use of FEM to a range of Engineering Problems.
- To provide knowledge on the fundamental concepts of finite element analysis in two dimensional solid mechanics.
- To impart knowledge on basic concepts of thermal distributions in various engineering components through finite element methods.
- To provide knowledge on higher order elements in complex problems.

Course Outcome (s) (COs):

CO1	Apply mathematical formulation of finite element method to basic (linear) ordinary and partial differential equations in mechanical systems.
CO2	Solve the one dimensional structural problems
CO3	Solve the vector variable problems using 2D element
CO4	Determine thermal distribution in one and two dimensional engineering applications.
CO5	Implement finite element method to solve complex equations.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	3	2	2	2	-	1	-	-	-	-	1	1	2	-	1
CO2	3	2	3	1	1	-	-	-	-	-	-	1	2	-	-
CO3	3	2	3	2	1	-	-	-	-	-	-	1	2	-	1
CO4	3	2	3	3	2	1	-	-	-	-	2	2	2	-	2
CO5	3	2	3	3	-	1	-	-	-	-	2	1	2	-	2
CO (Avg)	3	2	2.8	2.2	1.33	1	-	-	-	-	1.66	1.2	2	-	1.5

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION	9
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – RitzTechnique – Basic concepts of the Finite Element Method.		
UNIT II	**ONE-DIMENSIONAL PROBLEMS**	**9**
Finite element modeling – Natural Coordinates and shape functions - linear bar element, - total potential energy approach - element stiffness matrix and force vector – global stiffness matrix and force vector - boundary condition – problems- quadratic element, Plane Trusses - development of shape function - element equations , element stiffness matrix and force vector – global stiffness matrix and force vector – boundary condition- problems, beam element –finite element formulation – Load vector –boundary condition- problems.		
UNIT III	**TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS**	**9**
Finite element modeling – constant strain triangular element – Iso-parametric representation – Potential Energy approach - Element stiffness matrix and force vector – global stiffness matrix and force vector – Boundary condition – Problems, Axisymmetric solids subjected to Axisymmetric loading - axis symmetric formulation - Element stiffness matrix and force vector – global stiffness matrix and force vector –Boundary condition – Problems.		
UNIT IV	**HEAT TRANSFER / SCALAR VARIABLE PROBLEM 1 D & 2D**	**9**
Scalar variable problems- steady state heat transfer- 1D,2Dconduction& convection – Global stiffness matrix and global thermal load vector - Boundary condition – Problems.		
UNIT V	**TWO DIMENSIONAL VECTOR VARIABLE PROBLEM USING QUADRILATERAL ELEMENTS**	**9**
Selection of order of polynomial-linear, simplex, complex and multiplex elements, errors in FEA, mesh refinement methods and convergence requirements. Iso, Sub and Super parametric element, shape functions for a 2-D four nodded and eight nodded Isoparametric rectangular element using natural coordinate system - problems. Gaussian quadrature method-problems.		

Text Book (s)

1	Tirupathi R. Chandrupatla, Ashok D. Belegundu, "Introduction to Finite Elements in Engineering: International Edition", 4th Edition,Pearson Education Limited, 2014
2	Daryl L. Logan., —A first course in Finite Element Method, Cengage Learning., 2016.

Reference (s)

1	JunuthulaNarasimha Reddy., An Introduction to the Finite Element Method, 3rd Ed., McGraw-Hill, 2006.
2	Fish J., and Belytschko T., A First course in Finite elements, 1st Ed., John Wiley and Sons, 2007.
3	David V.Hutton, —Fundamentals of Finite Element Analysisl, Tata McGraw-Hill Edition, 2005.
4	Robert D. Cook, S. David, Malkucs Michael E. Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New Delhi,2007

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE001T	NEW PRODUCT DEVELOPMENT	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To enable the students to gain knowledge on the process of product development based on customer needs
- To enable the students to understand the standard procedure available for concept development
- To facilitate the students to use design process and system level design issues
- To make the students to familiarize with the Intellectual property rights
- To develop the students creative and Innovative skills

Course Outcome (s) (COs):

CO1	Understand the process to plan and develop products
CO2	List the process of collecting information and develop product specifications
CO3	Discuss the concept generation, selection and testing processes.
CO4	Explain the concepts of industrial design and design for manufacture
CO5	Explain about Intellectual property rights and how to write claims

CO-PO Mapping

COs	POs												PSOs		
	PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	-	-	2	-	-	-	-	-	1	2	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	-	1
CO3	3	3	3	3	3	2	-	-	-	-	-	2	2	-	1
CO4	3	3	2	2	2	1	-	-	-	-	-	2	2	-	1
CO5	2	2	-	-	2	1	-	2	-	2	-	2	-	-	-
CO (Average)				2.6	2.5	1.5	-	2	-	2	-	1.8	2	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	CREATIVITY	9

Concept and history of creativity, need for creativity, creative environment, stages of creativity process, creativity and intelligence, creativity in various contexts, economic view of creativity, measuring creativity, fostering creativity, creative problem solving – brain storming and various techniques, lateral thinking. Role of creativity in entrepreneurship – Research and development (R&D). Case studies on creative solutions to contemporary issues.

UNIT II	INNOVATION	9

Definition, creativity vis-à-vis innovation, conceptualizing innovation, types of innovation, sources of innovation, goals of innovation, process of technological innovation, diffusion of innovation, factors contributing to successful technological innovation, failure of innovations, innovation management, measures of innovation. Case studies - Innovations in health sector, Agriculture, Education, Entrepreneurship and Corporate R & D.

UNIT III	PROJECT PLANNING AND EVALUATION	9

Definition and purpose of project, collection of ideas, screening ideas, selection criteria for new projects, development of project plan, project evaluation – purpose, kinds of evaluation, stages of evaluation process, techniques of project evaluation, project analysis, benefits and risks of new projects.

UNIT IV	PRODUCT DEVELOPMENT AND EVALUATION	9

Research and new product development – process and types of new products, creative design, design of prototype – purpose, process, and types, model preparation, testing and quality evaluation; marketing research – purpose and process, types and methods; introducing new products, cost evaluation, Product deployment and commercialization - Case Studies.

UNIT V	PROTECTION OF INNOVATION	9

Intellectual property (IP), classes of IP – industrial property and copyrights; Intellectual Property Rights(IPR); Patents, patentability, patent acts, governing laws, history of patent laws and acts, patent administration; patenting process – patent application, patent search, prosecution, publication, examination, opposition, grant, renewal, patent rights; international code for patents. Intellectual Property Rights, Write the description of the invention, Refine Claims, Pursue application. Economics and Management Accelerating Projects, Project Execution

Text Book (s)

1	Frederick Betz, Managing Technological innovation, John Wiley & Sons, Inc., Third Edition, 2015
2	Product design and development "Karl T Ulrich; Steven D Eppinger" New York, NYMcGraw-Hill Education,2016

Reference (s)

1	Product Design Kavin N Aotto, Kritine I Wood, Prentice Hall Publications 2015
2	Dieter G.E. —Engineering Design, McGraw Hill Company International Edition 2017
3	Paul Windrum and Per Koch, Innovation in Public Sector Services: Entrepreneurship, Creativity and Management, Edward Elgar Publishing Limited, 2012.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE011T	RENEWABLE SOURCES OF ENERGY	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To understand the solar energy resourse and application
- To identify with Wind energy conversion in to power
- To analyze the Bio energy generation and utilization
- To discover the utilization and environmental merits pattern of renewable energy resources
- To new development of new sustainable energy methodologies / technologies for its utilization

Course Outcome (s) (COs):

CO1	Explain solar radiation, components and applications of PV systems
CO2	Illustrate the wind energy conversion systems, storage systems and applications
CO3	Classify the Bio energy technology and its utilization
CO4	Explain the principle and components of OTEC, Tidal, Geothermal and Hydel Energy sources and environmental issues
CO5	Illustrate the Hydrogen generation, Storage, Transport and applications and Fuel cell technologies

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	2	3	1	-	-	-	1	1	-	-
CO2	3	2	1	-	-	2	3	1	-	-	-	1	1	-	-
CO3	3	2	-	-	-	2	3	1	-	-	-	1	1	-	-
CO4	3	2	-	-	-	2	3	1	-	-	-	1	1	-	-
CO5	3	3	1	-	-	2	3	1	-	-	-	1	1	-	-
CO (Avg)	3	2	1	-	-	2	3	1	-	-	-	1	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**SOLAR ENERGY**	**9**
Solar Radiation – Measurements of solar Radiation and sunshine – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV Applications		
UNIT II	**WIND ENERGY**	**9**
Wind Data and Energy Estimation – wind Energy Conversion Systems – Wind Energy generators and its performance – Wind Energy Storage – Applications – Hybrid systems.		
UNIT III	**BIO ENERGY**	**9**
Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and Economics. Case studies for rural bio gas plant		
UNIT IV	**OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY**	**9**
Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC Cycles – Small hydro, turbines – Geothermal energy sources, power plant and environmental issues.		
UNIT V	**NEW ENERGY SOURCES**	**9**
Hydrogen, generation, storage, transport and utilization, Applications : power generation, transport – Fuel cells – technologies, types – economics and the power generation		

Text Book (s)

1	G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 5th Edition, 2010.
2	D. P. Kothari, K. C. Singal and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, Prentice Hall of India, New Delhi, 2nd Edition ,2009.

Reference (s)

1	Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 3rd Edition, 2012.
2	John Twidell, Tony Weir , Renewable Energy Sources, EFN Spon Ltd., UK, 3rd Edition 2015
3	G.N. Tiwari, solar Energy – Fundamentals Design, Modelingand applications, Narosa Publishing House, New Delhi, Revised Edition 2012.
4	S.P. Sukhatme, Solar Energy-Principles of thermal Collection and storage, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition 2009.
5	Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 3rd Edition, 2012.

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Regulation 2018		Semester VI	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC306L	DESIGN AND ANALYSIS LABORATORY	0	0	4	2

Prerequisite Course (s)

Nil

Course Objective (s):

- To provide knowledge on creating model for a given component using software
- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

Course Outcome (s) (COs):

CO1	Analyze the behavior of a component subjected to structural, dynamic and thermal loading conditions by using Finite Element Method based package.
CO2	Find deformations and stresses in components subjected to combined structural and thermal loads.
CO3	Validate the design of the product by analyzing and comparing the stresses induced with analytical /experimental results.
CO4	CFD analysis to validate simple 2D flow problem
CO5	Develop MAT Lab program to simulate Mechanical system.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	2	2	-	-	2	-	2
CO2	3	3	3	2	2	2	-	-	2	2	-	-	2	-	2
CO3	3	3	3	2	2	1	-	-	2	2	-	-	1	-	1
CO4	3	3	3	2	2	-	-	-	2	2	-	-	2	-	3
CO5	3	3	3	2	2	-	-	-	2	2	-	-	2	-	2
CO (Avg)	3	3	3	2	2	1.6	-	-	2	2	-	-	1.8	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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LIST OF EXPERIMENTS –

A. **CAD PRACTICE AND ASSEMBLY DRAWING**

Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Hatching, Detailing, Assembly, basic principles of GD&T (geometric dimensioning &tolerancing).

Shaft couplings – Plummer block – Screw jack- Lathe Tailstock – Universal Joint – Knuckle joint – Pipe vice - Machine Vice – Stuffing box– Connecting rod - Simple Eccentric Preparation of Bill of materials and tolerance data sheet

B. **ANALYSIS**

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.

Regulation 2018		Semester VI	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18MBM302L	EMPLOYABILITY SKILLS AND PRACTICES	0	0	2	1

Course Objective (s):

The purpose of learning this course is to:

1	Learn the application of mathematical or statistical models to different real-world contexts
2	Focus on writing & speaking skills through vigorous practices.
3	Enhance soft skills and analytical ability of students
4	Defeat the fear while communicating in group and to master the effective communication

Course Outcome (s) (Cos):

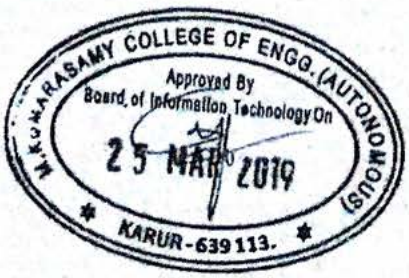
At the end of this course, learners will be able to:

CO1	Solve both analytical and logical problems in a productive manner
CO2	Launch their ability of comprising and delivering the information
CO3	Upgrade their communication quality in near future

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-			
CO2	-	-	-	-	-	-	-	-	3	-	-	-			
CO3	-	-	-	-	-	-	-	-	-	3	-	-			
CO4	-	-	-	-	-	-	-	-	-	-	-	-			
CO5	-	-	-	-	-	-	-	-	-	-	-	-			
CO (Avg)	3.00	-	-	-	-	-	-	-	3.00	3.00	-	-			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)



UNIT I	Module - 1	6

Aptitude: Time and Distance (Speed, Streams) - Problems on Trains - Arrangements and BloodRelations.

Communication: Job Application - Cover letter,Bio-data,Resume& CV building.

UNIT II	Module - 2	6

Aptitude: Time and Work - Pipes & Cisterns - Situation Reaction Test & Data Interpretations.

Communication: Writing practices on circulars, notices, memos, Agenda preparation and Minutes of meeting.

UNIT III	Module - 3	6

Aptitude: Ages - Averages - Probability - Profit and Loss.

Communication: Email Etiquette - Essay writing.

UNIT IV	Module - 4	6

Aptitude: Mensuration - SI & CI - Cause and Effect Analysis - Statement, Assumptions & Conclusions.

Communication: Group Discussion and guidelines.

UNIT V	Module - 5	6

Aptitude: Permutation and Combinations - Partnership - Alligations or Mixtures.

Communication: Interview skills - General instructions, Review of interview questions, Mock Interviews.

Text Book (s)

1	Dr.R.S.Aggarwal, "Quantitative Aptitude", S. Chand & Company Limited, 2015
2	Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non - Verbal Reasoning", S. Chand & Company Limited, 2015

M.KUMARASAMY COLLEGE OF ENGG. (AUTONOMOUS)
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Board of Information Technology On
25 MAR 2019
KARUR-639 113.