Indian Institute of Information Technology Bhagalpur Mechatronics Engineering (MEA)

B.Tech. Curricula and Syllabus

Semester-IV

Curricula:

Course Code	Course name	L	т	Ρ	С
<u>EC203</u>	Analog Electronics	3	0	0	3
<u>ME204</u>	Design of Machine Elements	3	0	0	3
<u>ME207</u>	Fluid Mechanics	3	0	0	3
<u>ME205</u>	Kinematics of Machines	3	0	0	3
<u>MA203</u>	Probability and Statistics	3	1	0	4
<u>ME206</u>	Manufacturing Science	3	0	2	4
ME212	Simulation Lab	0	0	3	2
EC215	Analog Electronics LAB	0	0	3	2

Syllabus:

Course Code	Course name	L	Т	Ρ	С	Year	Semester
EC203	Analog Electronics	3	0	0	3	2 nd	3 rd
Course objective: The objective of this course is to provide an introduction to Amplifi					on to Amplifier	s using transistors.	
More particula	More particularly,						
1. To give the	e idea about fundamental properties o	f sen	nicon	duct	ors.		
2. To prepare	e students to perform the analysis of a	ny Ai	nalog	, elec	troni	cs circuit.	
3. To empow	er students to understand the design	and	work	king d	of BJ	Г / FET amplifi	ers, oscillators and
Operation	al Amplifier.						
Торіс	Cont	tents					No. of Lectures
Module-I	BJT Amplifiers: Transistor Confi techniques, Locating the Q-po Stability of the operating point Emitter /feedback bias, Collecto amplifier, CC amplifier, h-param Frequency response, Feedback a feedback. Topologies of the feedback on gain, Input and positive feedback	gurat pints, t, Sta pr fee neter ampl feed outp	ion a Fixe ability edbac s, Hy ifiers back back but i	analy ed bi y fac ck bia vbrid : neg am mpe	sis, E ias c tor, f as, Sr π mo ative plifie dance	Biasing circuit or Base bias, AC load line, mall signal CE odel analysis, e and positive rs, Effect of es, Effect of	10
Module-II	FET Amplifiers: Operation, Tran FET, Self-Bias, Voltage divide Compound configuration: Darlir	s-cor er bi ngtor	nduct ias, i circ	cance Curre uit, C	e curv ent Casca	ve, Biasing of source bias. de Amplifier,	08

	Types of Coupling: RC Coupling, Impedance Coupling,				
	Transformer Coupling, Direct Coupling				
Module-III	Transistorized Audio Power Amplifiers, Difference between Voltage and Power amplifier, Performance quantities, Class A, Class B, Class C power amplifiers. Thermal Runway, Heat Sink, Stages of practical power amplifier. Oscillators: Harmonic Oscillators, RC Phase shift Oscillators, Transistor Phase Shift Oscillator, Colpitts Oscillators and Crystal Oscillator	06			
Module-IV	IC Op-Amps and its ideal characteristics, Basic analog circuit using Op-Amps, Miscellaneous circuits and techniques: Capacitance multiplier, Inductance simulator, Non-inverting and Inverting Integrator and Differentiator, Differential amplifiers, Current mirrors, Parameters of Op-Amp, Open loop and Closed loop Op- amp configuration, Voltage Series and Voltage Shunt feedback	08			
Module-V	08				
	Total	42			
Text	 B. Razavi, Design of Analog CMOS Integrated Circuits, Tata McGraw-Hill, 2nd edition, 2017. A. S. Sedra, K. C. Smith and A. N. Chandorkar, Microelectronics circuits, Oxford university Press India. International Version 7th edition, 2017. 				
Reference	 R. J. Baker, H W Li, D. E. Boyce, <i>CMOS Circuit design, Layout and Simulation</i>, John Wiley & Sons, 2nd edition, 2004. 				

Course Code	Course name	L	Т	Р	С	Year	Semester
ME204	Design of Machine Elements	3	0	0	3	2^{nd}	4 th

Course objective:

- 1. To understand procedure of machine design and develop an ability to apply it for simple component design by using design data hand book.
- 2. To understand the different theories of failure and develop an ability to apply its knowledge for design of mechanical component and determine the resisting areas against failure.
- 3. To determine forces on transmission shaft and design of transmission shaft.
- 4. To determine the endurance strength and design of components subjected to fluctuating loads.
- 5. To determine the forces in welds and riveted joints and formulate design solution for size of weld and size of rivet.
- 6. To determine forces on power screw and bolted joints and formulate design solution for size of power screw and size of bolt.

Contents	No. of Lectures
Module : 1	
Introduction to the design process, factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances - Direct,	8

Bending and to	rsional stress equations - Impact and shock loading - calculation of principle					
stresses for var	ious load combinations eccentric loading - curved beams - crane book and					
'C' frame Fact	or of safety theories of failure. Design based on strength and stiffness					
stross concentre	of of safety - theories of failure - Design based on strength and surfness -					
stress concentra	ation - Design for variable loading					
Module : 2						
Design of solid	d and hollow shafts based on strength, rigidity and critical speed - Keys,	8				
keyways and sp	blines - Rigid and flexible couplings					
Module : 3						
Threaded fastne	ers - Bolted joints including eccentric loading, Knuckle joints, Cotter joints	8				
- Welded joints	, riveted joints for structures - theory of bonded joints, Flat belt drive, V-belt					
drive, chain dri	ve, rope drive, spur gear, helical gear, bevel gear, worn gear					
Module : 4						
Various types o	of springs optimization of helical springs. Flywheels considering stresses in	7				
rims and arms f	for engines and punching machines. Connecting Rods and crank shafts	,				
	tor engines and punctung indennies. Connecting Rods and crank sharts					
Module : 5						
Sliding contact	and rolling contact bearings, Hydrodynamic journal bearings, Sommerfeld	8				
Number, Select	tion of Rolling Contact bearings					
	Total	39				
Text	1. V. B. Bhandari, "Design of Machine Elements", 2nd Ed., Tata Mcgrav	w Hill, 2007.				
2 Design Date Rook of Engineers, Compiled by Ecculty of Mechanical Engineering						
PSG College of Technology Publisher KalaikathirAchchagam Coimbataore						
	2009.	connoutuore,				
Reference	Reference 1. J. E. Shigley, "Mechanical Engineering Design", McGraw Hill, 1989.					
	2. A. H. Burr and J. B. Cheatham, "Mechanical Analysis and Design	n". 2nd Ed				
	Prentice Hall, 1997.	,,				

Course	Course name	L	Т	Р	С	Year	Semester
Code							
ME207	Fluid Mechanics	3	0	0	3	2^{nd}	4^{th}
Course objective							
1) To develop understanding of properties of Newtonian fluid.							

To develop understanding of properties of recentaring in the standing of properties of recentaring in the standing about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.

3) To imbibe basic laws and equations used for analysis of static and dynamic fluids.

- 4) To inculcate the importance of fluid flow measurement and its applications in Industries.
- 5) To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

	Contents	No. of Lectures
Module-I		
	Introduction, properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapourpressure, compressibility and bulk modulus. Concept of continuum, types of fluids etc.,pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, Absolute, gauge, atmospheric and vacuum pressures pressure measurement by simple, differential manometers and mechanical gauges.	8
	Total pressure and center of pressure for horizontal plane, vertical plane surface and inclined plane surface submerged in static fluid. Buoyancy, center of buoyancy, meta center and meta centric height its application in shipping, stability of floating bodies.	
Module-2		
	Types of Flow-steady, unsteady, uniform, non-uniform, laminar, turbulent, one, two and three dimensional, compressible, incompressible, rotational, irrotational, stream lines, path lines, streak lines, velocity components, convective and local acceleration, velocity potential, stream function, continuity equation in Cartesian co-ordinates. Rotation, vorticity and circulation, Laplace equation in velocity potential and Poisson equation in stream function, flow net.	8
	Momentum equation, Impacts of jets- force on fixed and moving vanes.Euler's equation, Integration of Euler's equation to obtain Bernoulli's equation, Bernoulli's theorem, Application of Bernoulli's theorem such as venture meter, orifice meter, rectangular and triangular notch, pitot tube, orifices etc.	
Module-3		
	Reynold's Number, Entrance flow and Developed flow, Navier-Stokes Equation, Laminar flow between parallel plates, Poiseuille equation – velocity profile, Couette flow, fully developed laminar flow in circular pipes, Hagen - Poiseuille equation.	8
	Energy consideration in pipe flow, Loss of Pressure Head due to Fluid Friction, Darcy Weishach formula, major and minor losses in pipes, Commercial pipe, Colebrook equation, Moody equation/ diagram. Pipes in series, parallel, equivalent pipe.	
Module-4		
	Development of boundary layer, Prandtl's boundary layer equations, Blasius solution, laminar layer over a flat plate, boundary layer separation and its control. Basic concept of Lift and Drag, Types of drag, Co-efficient of drag and lift, streamline body and bluff body, flow around circular bodies and airfoils, Lift and drag on airfoil.	8
Module-5		

	Dimensional analysis: Need for dimensional analysis, Dimensions and units, Dimensional Homogeneity and dimensionless ratios, methods of dimensional analysis, Rayleigh's method, Buckingham Pi theorem, Similitude and Model studies.	6
	Total	38
Text	1) I. H. Shames, "Mechanics of fluids", McGraw Hill Book Co., 1986.	
	2) F. M. White, "Fluid Mechanics", 6th Ed., Tata McGraw Hill, New Delhi, 2009.	
Reference	1) Y. A. Cengel and J. M. Cimbala, "Fluid Mechanics, Fundamentals and Applications"	", 7th Ed. Tata
	McGraw Hill, New Delhi, 2009.	
	2) S. K. Som and G. Biswas, "Fluid Mechanics and fluid Machines", 2nd Ed., Tata Mc	Graw Hill,
	New Delhi, 2005.	

Course Code	Course name	L	Т	Р	С	Year	Semester
ME205	Kinematics of Machines	3	0	0	3	2 nd	4 th
 Course objective: To understand the basic components and mechanism of linkages in the assembly of a system /machine. To understand the principles of mechanism and use in the assembly with respect to the displacement, velocity, and acceleration at any point in a link. To understand the motion of a specified set of linkages, To design cam mechanisms for specified output motions. To understand the concepts of gears and kinematics of gear trains. 							
	Contents						No. of Lectures
Module 1							
BASICS OF ME constrained motion types of joints, de chain, Elements of and their inversion Mobility of mech Miscellaneous m mechanism, Ha mechanism Tche Motion mechanism toggle mechanism gear mechanism.	CHANISMS: Introduction, mechan n, rigid and resistant bodies, link, ty- gree of freedom, classification of ki f kinematic chain, linkage, mechanis ons: Four bar, Slider crank, Double s anism. nechanisms: Straight line motion rt mechanism, Sccot-Russel r bbicheff mechanism, and Robert\ sms:Genevawheel mechanism, Rate n, pantograph, condition forcorrect s	iisms pes o nema sm an slider mech s mech s mech steeri	and f f link tics j d stru- cran hanis anisn echar and ng, <i>I</i>	mach s, kin pairs, uctur k sms: n, (nism, Pawl Acker	ines: nema , kine e, me Peau Grass Inte meo rman	types of tic pairs, matic of chanism ucellier's -Hopper ermittent chanism, steering	8

KINEMATICS OF LINKAGE: Displacement, velocity and acceleration analysis of planar mechanisms by graphical and analytical: Four bar mechanism, slider crank mechanism, crank and slotted-liver mechanism, Coriolis acceleration components.	8
Module 3	
 Velocity Analysis by Instantaneous Center Method: Definition, Kennedy\'s theorem, Determination of linear and angular velocity using instantaneous center method. Klein's Construction: Analysis of velocity and acceleration of single slider crank mechanism. SYNTHESIS OF MECHANISM: Introduction, Dimensional synthesis for motion; function and path generation 	8
Module 4	
Cam: Definition, types of cam, types of followers, displacement, velocity and acceleration curves for uniform velocity, Simple Harmonic Motion, Uniform Acceleration Retradation, Cycloidalmotion. Under cutting, Cam profiles: disc cam with reciprocating / oscillating follower having knife-edge, rollerand flat-face follower inline and offset.	8
Module 5	
GEARS AND GEAR TRAINS: Gears (spur, helical, bevel and worm) Gear trains: simple, compound and epicyclic gearing	8
Total	40

Text	1. K. J, Waldron and G. L. Kinzel, "Kinematics, Dynamics and Design of
	Machinery", 2nd Ed., Wiley Student Edition, 2004.
	2. S. S. Rattan, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
Reference	1. J. J. Uicker (Jr), G. R. Pennock and J. E. Shigley, "Theory of Machines and
	Mechanisms", 3rd ed., Oxford International Student Edition.
	2. R. L. Norton, "Kinematics and Dynamics of Machinery", Tata Mcgraw Hill,
	2009.

Course Code	Course name	L	Т	Ρ	С	Year	Semester
MA203	Probability and Statistics	3	1	0	4	2 nd	4 th
Торіс	Conter	nts					No. of Lectures

Module-I	Basic Probability: Sample Space and Events. The notion and axiom of Probability, equally likely events, independent events; Conditional Probability, Expectations; Random Variables: Discrete and Continuous Probability Distributions. Moments, Moment Generating Functions.	08
Module-II	Distributions:Binomial-Poisson-Geometric-Uniform-Normal- exponential-Gamma; Two Dimensional Random Variables: Joint Distribution, Marguinal and Conditional Distribution, Covariance, Correlation Coefficient, Linear Regression.	10
Module-III	Transformation of random variables, Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-square, t- and F distributions. Descriptive Statistics: Graphical representation, measures of locations and variability.	09
Module-IV	Estimation: Unbiasedness, Consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions.	07
Module-V	Testing of hypotheses: Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample and two sample problems for normal populations, tests for proportions, Chi-square goodness of fit test and its applications.	09
	Total	43
Text	 P G Hoel, S C Port, C J Stone, Introduction to Probability Theory, UI 2000. J. Medhi, Stochastic Processes, New Age International, 4th edition, 	niversal Book Stall; 2017.
Reference	1. R. D. Yates and D. J. Goodman, <i>Probability and Stochastic Process</i> edition, 2012.	es, Wiley India, 2 nd

Course Code	Course name	L	Т	Р	С	Year	Semester
ME206	Manufacturing Science	3	0	2	4	2 nd	4

Course objective:

- 1. Learning of various methods of manufacturing process helps to fabricate parts, device or components during project or any other research works of the students mainly Electronics and Mechatronics engineering.
- 2. To impart knowledge on selection of suitable manufacturing process for the typical component.

Contents

No. of Lectures

Module:1

Introduction to manufacturing processes; Patterns: Types and various pattern materials. Various moulding process and parameters, Various casting methods, viz., sand casting, investment casting, pressure die casting, centrifugal casting, continuous casting, Casting defects; brazing, soldering, welding; Solid state welding methods; resistance welding; arc welding; submerged arc welding; friction stir welding, inert gas welding; Welding defects					
Module : 2					
Various metal for sheet metal wo deformation; Met	ming techniques, viz., forging, rolling, extrusion, wire drawing, orking, spinning, swaging, thread rolling; Super plastic al forming defects ; Powder metallurgy and its applications	7			
Module : 3					
Mechanics, tool geometry and ch Machine tool: G on machines: lat drilling, boring, rolling and gear c	s (material, temperature, wear, and life considerations), ip formation; surface finish and machinability; optimization; eneration and machining principles; Setting and Operations he, milling (including indexing), shaping, slotting, planing, broaching, grinding (cylindrical, surface, centreless), thread utting machines	7			
Module : 4					
Jigs and fixtures clamping ; Introd 3D printer	: Purposes of jigs and fixtures principles of location and uction and Familiar with M-codes and G-codes ; Introduction,	7			
Module : 5					
Ultrasonic machi Discharge Machi Beam Machinin applications	ning, Water Jet Machining, Abrasive Jet Machining, Electric ning, Electron Beam Machining, Laser Beam Machining, Ion g, Electro chemical Machining, etc. Process, advantages,	8			
	Total	36			
Text	 A. Ghosh and A. K. Mallik, "Manufacturing Science", Wile P. N. Rao, "Manufacturing Technology: Vol. I and Vol. II" 	ey Eastern, 1986. , Tata McGraw Hill.			
Reference	 J. S. Campbell, "Principles of Manufacturing Materials and Processes", Tata McGraw Hill, 1995. 				

2) S. Kalpakjian and S. R. Schmid, "Manufacturing Processes for Engineering
Materials", Pearson education, 2009.